Three Aspects of Globalization

Liberalization, Financial Integration, and Multinational Organization

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Preface

"It has been said that arguing against globalization is like arguing against the law of gravity. But that does not mean we should accept a law that allows only heavy-weights to survive. On the contrary: we must make globalization an engine that lifts people out of hardship and misery, not a force that holds them down. We must build partnerships strong enough to make sure that the global market is embedded in broadly shared values and practices that reflect global needs, so that globalization can benefit all the world's people." (Kofi Annan, 2000)

As noted by Kofi Annan, the former Secretary-General of the United Nations, we live in an era of an ongoing process of globalization that appears to be as natural and inevitable as the law of gravity. Undoubtedly, the technological progress is one of the main driving forces of globalization since it shortens distances in a broad sense by reducing transport and communication costs. This is further fostered by the elimination of politically-imposed barriers in recent years. The pace of the globalization process has accelerated especially after the fall of the Iron Curtain in 1989 as most of the countries of the former Eastern bloc got involved into the global economy while undergoing a transition process from centrally planned economies toward free market economies.

Since the process of globalization is so widespread and dynamic, its pros and cons have been some of the most hotly-debated topics in international economics in recent years. On the one hand, already the Ricardian theory of comparative advantage two centuries ago (Ricardo, 1817) predicted that trade liberalization leads to a more efficient reallocation of resources which in turn creates net benefits for both parties involved in the exchange of goods. On the other hand, there are concerns about increasing inequality resulting from the fact that the benefits of globalization are unevenly spread (see Krugman and Venables, 1995; Milanovic, 2005). Therefore, also Kofi Annan called for reasonable and fair-minded rules that would amend the globalization process to benefit all.

This thesis contributes to the ongoing debate on globalization, by studying three different aspects of the process. Chapter 1 shows that liberalization of the air services sector significantly increases air passenger traffic, thereby improving the performance of the sector, facilitating face-to-face communication, and supporting the development of other sectors of an economy such as tourism. The results also suggest that the existing regulatory framework is very uneven as the air services sectors of low-income countries remain heavily regulated. Chapter 2 delivers evidence about tightening interdependence of stock markets that imply limited possibility for international portfolio diversification and increased vulnerability of the financial sector to the transmission of shocks from one country to another. Hence, Chapter 2 points to a potentially negative effect of globalization, especially with respect to the recent global economic crisis. Chapter 3 examines the phenomenon of multinational corporations that are found to be the most productive firms by focusing on their internal business culture and organization. In particular, Chapter 3 provides insights into the conditions under which multinationals transplant their business model to other countries. This is potentially important for getting a better understanding of the ability of multinationals to transplant their productivity advantage abroad.

The three chapters study increasing integration of national economies by analyzing its characteristics, causes, and consequences. Whereas Chapter 1 assesses the process of integration from a global perspective involving a large number of countries, the two following chapters focus on transition economies in Eastern Europe. The three chapters are self-contained and can be read independently of each other.

As mentioned above, the process of globalization is strongly bolstered by new transport, communication, and computer technologies. One of the most dynamic sectors driven by technological change is the air transport sector, which is studied in the first chapter of this thesis.[1] Technological progress apart, the regulatory set-up appears to play an important role in the development of this sector (see Micco and Serebrisky, 2006). In fact, air transport has been heavily regulated by governments since the International Civil Aviation Conference in 1944 and only recently several countries and regions have liberalized the regulatory framework. For instance, the countries of the European Economic Area set up very liberal conditions for air services within their region in the mid 1990s. However, significant restrictions remain and, as a result, the aviation market is regulated by a plethora of different types of regimes, as imposed by various bilateral and plurilateral Air Services Agreements.

[1] Chapter 1 is based on joint work with Roberta Piermartini, World Trade Organization (WTO).

Chapter 1 investigates the extent of discrimination – in terms of access to international air services – generated by this system. In particular, using recently available information on approximately 2300 Air Services Agreements covering 184 countries, we estimate the impact of international air services liberalization on air passenger flows. We use several measures of liberalization as well as alternative estimation techniques to address potential problems of endogeneity, heteroscedasticity, and data inaccuracy. In addition, we argue that the traditional approach of modeling services trade liberalization by means of an index does not fully account for the discontinuous nature of services liberalization and propose the use of cluster analysis instead.

We find strong evidence of a positive and significant impact of the degree of liberalization on passenger traffic. For instance, the higher degree of air services liberalization among countries of the European Economic Area is estimated to account for rates of passenger traffic which are 22 percent higher compared with traffic between countries that signed Open Skies-type of agreements. The latter represents relatively liberal types of Air Services Agreements signed mainly by the United States. Our results suggest that the present system of a complex web of different Air Services Agreements generates a discriminatory environment for access to air services. The discrimination tends to concern especially low income countries whose Air Services Agreements typically include very restrictive provisions.

Chapter 2 studies globalization from a more focused perspective by concentrating on the Central European countries[2] that have been the leaders among the Eastern European countries in the transition process from centrally planned systems toward free market economies. Developed countries have played an important role in the process of transition. Especially the countries in Western Europe have invested large amounts of capital, mainly in the form of foreign direct investment, in the Central European region since the early 1990s (Mora, Garibaldi, Sahay, and Zettelmeyer, 2002; Lankes and Stern, 1999). The tightening economical relations have been accompanied by significant institutional reforms and changes in the fiscal and monetary policies of the Central European countries, driven by the attempt to join the European Union (EU) soon. The EU accession *per se* on May 1, 2004 led for instance to the full removal of restrictions on movements of capital.

Empirical literature on major developed stock markets (see, for instance, Kasa, 1992) suggests that deregulation and liberalization in capital markets, the importance

[2]The term "Central Europe" is used to refer to the group of four Visegrád countries, namely the Czech Republic, Hungary, Poland, and Slovakia.

of foreign capital inflows as well as the deepening institutional integration are likely to lead to stronger stock market integration. Chapter 2 examines whether this can also be observed in the case of the three largest Central European markets, namely those in the Czech Republic, Hungary, and Poland. The financial integration is studied from the perspective of a long-run convergence toward stable equilibrium relations among the stock markets, as modeled by the Johansen cointegration method.

The results in Chapter 2 show that the Central European stock markets have indeed become more integrated with the global economy in general and with the "old" EU in particular after the EU accession. This is evidenced by the emergence of two new long-run equilibrium relations in the post-accession period that link the movements of the Central European markets to the movements of the Western European, United States, and Russian markets, whereas no such relations could be detected before the EU enlargement. In particular, one new relation links the Central European markets to the Western European market, reflecting tighter co-movements of the "new" and the "old" EU markets. The second new relation points at the role of the United States market for both the Central and the Western European markets. These findings suggest that the Central European stock markets have become more vulnerable to shocks hitting the global economy on the one hand but more resistant to domestic shocks on the other hand.

One important channel through which national economies become more interconnected is foreign direct investment. The term foreign direct investment refers to a situation, in which a company from one country is making an investment into building a new enterprise in another country or acquires a majority of shares in a firm operating outside the country so that the investing firm gains control over the firm abroad. The investing company (the parent firm) and its foreign affiliate (the subsidiary firm) together form a multinational corporation. The phenomenon of multinational corporations is studied in Chapter 3.[3]

Recent literature on international trade has established that the most productive firms within a national economy tend to become multinationals. But our data reveal a startling variation in productivity levels of foreign affiliates across countries of the same multinational parent firms suggesting that not all multinationals transplant their home productivity advantage to other countries. One candidate for this startling difference

[3] Chapter 3 is based on joint work with Dalia Marin, University of Munich.

in productivity levels among subsidiaries is the ability of multinationals to transplant their business culture abroad.

Chapter 3 examines the factors which determine what type of organization is implemented abroad and whether or not multinationals transplant their business model to other countries. To investigate this, we collect original and uniquely matched parent and affiliate data on the internal organization of 660 German and Austrian parent firms and 2200 of their subsidiaries in Eastern Europe. In particular, we test the hypothesis that the ability of multinationals to transplant their business model to foreign affiliates is determined by the organization of the multinational corporation on the one hand and the market environment on the other hand.

We find that the organization implemented in foreign affiliates tends to be more decentralized regarding the decision-making structure within the corporation compared with the organization of the parent firm. The decision to decentralize the business model appears to be more strongly determined by the organization of the multinational corporation than the decision to transplant the business model. The other way round, the decision to transplant is more affected by the market conditions in both the home and the host country. In particular, our results point to the importance of product market competition for the transplantation of the business model.

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Chapter 1

Free Sky and Clouds of Restrictions*

1.1 Introduction

Air transport has rapidly expanded in the last few decades. Passenger traffic experienced an average annual increase of five to nine percent between 1960 and 2004 (Hanlon, 2006). Air cargo has grown even faster in recent years. Hummels (2007) reports that ton-miles shipped by air increased by 11.7 percent in the period 1975 to 2004. The reason for this rapid expansion is the substantial decline of air transport costs. Air transport costs decreased by 92 percent between 1955 and 2004. The largest drop, equal to 8.1 percent annually, took place between period 1955 and 1972, the period when the use of jet engines became widespread (Hummels, 2007).

Technological progress apart, changes in the regulatory set-up may have helped in reducing air transport costs as well. The regulatory regime that governs international air transport has been heavily regulated by governments since the International Civil Aviation Conference in 1944. In the absence of a multilateral agreement,[1] over 3500 bilateral and plurilateral Air Services Agreements have been signed worldwide. A first significant step in the liberalization process was taken in 1992, when the United States signed its first Open Sky Agreement with the Netherlands that eased particular regulations on the capacity of services offered. Since then, the United States have signed over 60 Open Skies Agreements and the countries of the European Economic Area have set very liberal conditions for air services in their region. Significant restrictions remain in the aviation market, however, and the result is a very complex web of different

*This chapter is based on joint work with Roberta Piermartini, World Trade Organization (WTO).

[1] Air transport services are excluded from GATS, the WTO multilateral agreement on trade in services.

types of regimes under which air companies operate. Therefore, interesting empirical questions are whether air services liberalization has had a significant impact on the performance of the aviation industry and, more specifically, how effective different types of agreements have been in improving market competition, lowering transport costs, and increasing traffic volumes.

The empirical evidence addressing these questions is scarce and tends to use either indices to measure the degree of liberalization or a dummy to denote the existence of a particular Air Services Agreement. In addition, the evidence is typically limited to a subset of countries. For example, focusing on thirteen OECD countries, Gönenç and Nicoletti (2000) construct a bilateral restrictiveness index by means of factor analysis and estimate positive and significant effects of air services restrictiveness on passenger air fares. Using the same index, Doove, Gabbitas, Nguyen-Hong, and Owen (2001) extend Gonenc and Nicoletti's analysis to a group of 35 economies and obtain similar results. In a study specific to the Open Skies Agreements signed by the United States, Micco and Serebrisky (2006) show that introducing Open Skies Agreements reduced nominal air cargo transport costs by 9 percent between 1990 and 2003, but they notice that the results are driven by Open Skies Agreements with middle- and high-income countries whereas they do not find significant effects of Open Skies Agreements for low-income countries.

One important limit of the existing literature is that it does not take into account that air services liberalization does not follow a continuous process. While tariff barriers in trade in goods can be progressively reduced, barriers to services trade cannot. Air Services Agreements are different in various respects from tariff barriers and, in particular, a wide range of *types* of agreements exists. To take this into account, we suggest a novel approach to estimate the impact of air services liberalization, namely the use of cluster analysis.

Moreover, our analysis relies on a large dataset with 184 countries. This is important because it allows us to cover a wide range of types of agreements and address the discontinuous nature of air services liberalization. More specifically, our dataset includes approximately 2300 Air Services Agreements in force in 2005. Information on the agreements is obtained from the World's Air Services Agreements (WASA) database provided by the International Civil Aviation Organization (ICAO, 2005) and from the "QUASAR" database developed by the World Trade Organization (WTO, 2007). As shown in Table 1.1, these agreements regulate some 80 percent of worldwide

international scheduled passenger traffic in 2005 (545 million passengers out of a total 688 million passengers worldwide)[2] and provide a relatively good representation of the distribution of passenger flows by income group.

Table 1.1: International Air Passengers by Income Group of Countries

	Total traffic in 2005			Traffic covered by our sample		
Income group	Low	Middle	High	Low	Middle	High
Low	1%	2%	5%	1%	1%	3%
Middle		5%	31%		4%	29%
High			51%			61%
Total	**100% (688 millions)**			**100% (545 millions)**		

Notes: The grouping of countries by level of income is in line with the World Bank definition (World Bank, 2008a). Percentages do not add up to 100, because of missing information on the level of income for some countries.
Source: Authors' calculations based on IATA On-Flight Origin-Destination Statistics 2005.

We study the impact of air services liberalization on air passenger flows. Understanding the determinants of air passenger flows is important first of all because passenger transport is essential for face-to-face communication and information exchange in business relations. This has been shown to be important for trade (Rauch and Trindade, 2002; Herander and Saavedra, 2005) and for the choice of firm location. Bel and Fageda (2008) show that the quality of passenger transportation networks is an important determinant of the location of headquarters of multinational firms as it influences the cost for processing and transmitting information efficiently across establishments. A similar result is obtained by Strauss-Kahn and Vives (2009). Second, air passenger transport substantially affects other sectors in the economy. For example, international tourists and migrants are major users of air transport services. In addition, an increasing share of goods, especially high-value and low-bulky goods, is transported by air, not only on dedicated cargo flights but also on passenger flights. Finally, focusing on the link between access to the global airline industry and urban economic growth, Bowen (2002) shows that over the period 1984 and 1996 hubs in rapidly-growing developing countries experienced an improved access to the international airline network, while those in the poorest developing countries experienced a worsening of their access. Bowen highlights the role of deregulation in increasing disparity of access to the global network.

In this chapter we point at the discriminatory nature of Air Services Agreements

[2]Scheduled traffic accounts for 85 percent of total passenger traffic, that is, including also charter flights (Gönenç and Nicoletti, 2000). Furthermore, Air Services Agreements typically refer to rules for scheduled flights.

as one factor explaining the uneven access to the global airline industry. To show this, we estimate the impact of Air Services Agreements on bilateral passenger flows using a gravity-type model augmented for the degree of liberalization of the regulatory regime.[3] The underlying idea is that the extent of liberalization of the aviation market is likely to influence the toughness of competition. An increase in competition in turn may lower prices or improve the quality of the services offered, thus increasing passenger traffic.[4]

Following the traditional approach of measuring the degree of liberalization by means of an index, we estimate a strong positive effect of air services liberalization on passenger traffic. In particular, we show that this effect is robust to the use of an instrumental variable technique that addresses the possible endogeneity of the policy variable as well as to the use of alternative indices. These are a statistical index built using factor analysis and an expert-based index recently developed by the WTO Secretariat (WTO, 2006).

However, our cluster analysis shows that the positive effect of liberalization on passenger traffic is driven by specific types of agreements. In particular, we estimate a significant effect of agreements including multiple designation provisions, Open Skies-type and European Economic Area-type of agreements. This reinforces the importance of studying the effects of air services liberalization (and in general services trade liberalization) on the basis of cluster analysis rather than through an index. Following this approach we are able to address the question of air services liberalization in terms of the impact of a worldwide adoption of a certain type of agreement rather than in terms of an increase in the value of an index. Our results suggest that the multilateralization of certain types of agreements is likely to significantly increase passenger traffic and reduce the uneven distribution of passenger flows worldwide.

The rest of the chapter is organized as follows. Section 1.2 introduces the features of Air Services Agreements that are considered to be relevant indicators of market access liberalization. Section 1.3 presents two different indices of the degree of liberalization of the aviation market and describes the extent of air services liberalization worldwide. Section 1.4 explains our methodological approach, whereas Section 1.5 presents the results. Section 1.6 concludes.

[3] A similar approach focusing on intra-APEC passenger flows has been adopted by Geloso Grosso (2008).

[4] Using data on country-level bilateral air fares, Piermartini and Rousová (2009) find a significant negative impact of air transport liberalization on both business and economy class passenger prices.

1.2 Main Features of Air Services Agreements

Air Services Agreements incorporate many features covering a wide range of issues, including aviation security or incident investigation. Nevertheless, only some features are important determinants of liberalization of the international aviation market. The WTO (2006) study on air services identifies seven features as relevant indicators of increased market access for scheduled air passenger services:

Grant of rights defines the right to provide air services between two countries. In particular, the WTO study focuses on fifth freedom, seventh freedom and cabotage. *Fifth freedom* enables the airlines of any two countries to pick up passengers in each other's territories for destinations in other countries. *Seventh freedom* is the right to carry passengers or cargo between two foreign countries without continuing service to one's own country. *Cabotage* is the right of an airline to operate within the domestic borders of another country on a route with origin or destination in its home country;

Capacity clause identifies the regime to determine the capacity of an agreed service. The capacity regime refers to the volume of traffic, frequency of service and aircraft types. Ranging from the most restrictive to the most liberal regime, three commonly used capacity clauses are: predetermination, Bermuda I and free determination.[5] *Predetermination* requires that capacity is agreed prior to the service commencement, *Bermuda I* gives limited right to the airlines to set their capacities without prior governmental approval and *free determination* removes the capacity determination from regulatory control;

Pricing refers to the regime for pricing air services. The most restrictive regime is that of *dual approval*, whereby both parties have to approve the tariff before this can be applied. The most liberal regime is *free pricing*, when prices are not subject to the approval by any party. The semi-liberal regimes are *country of origin disapproval* (where tariffs may be disapproved only by the country of origin), *dual disapproval* (where both countries have to disapprove the tariffs in order to make them ineffective) and *zone pricing* (where parties agree to approve prices falling within a specific range and meeting certain characteristics, whereas outside the zone one or a combination of the other regimes may apply);

[5] Two types, "other restrictive" and "other liberal", are distinguished in addition in WTO (2006).

Withholding defines the conditions required for the designated airline of the foreign country to operate in the home country. Restrictive conditions require *substantial ownership and effective control*, meaning that the designated airline is the "flag carrier" of the foreign country. More liberal conditions are required under *community of interests* and *principal place of business* regimes, where a foreign airline can also be designated by the foreign country. Whereas community of interests regime still requires a vested substantial ownership and effective control of the airline in one or more countries that are defined in the agreement, principal place of business regime removes the substantial ownership requirement;

Designation governs the right to designate one (*single designation*) or more than one (*multiple designation*) airlines to operate a service between two countries;

Statistics provides rules on exchange of statistics between countries or their airlines. The fact that an exchange of statistics is (can be) requested is an indicator that the parties intend to monitor the performance of each other's airline. Therefore, it is considered a restrictive feature of an agreement;

Cooperative arrangements define the right for the designated airlines to enter into cooperative marketing agreements (such as code sharing and alliances). This is considered to be a liberal feature because it provides a means to rationalize networks.

As shown in Table 1.2, the most restrictive regimes are the most frequent with respect to pricing, capacity and ownership. Cooperative arrangements are in general not allowed and exchange of statistics tends to be required. In contrast, multiple designation dominates single designation. Among the freedoms of air, the fifth freedom is the most frequent, whereas the seventh freedom and cabotage are rare.

1.3 Degree of Air Services Liberalization

The overall degree of liberalization introduced by a certain agreement depends on its specific design. Indices summarize the various features of an agreement in a single figure, by assigning a weight to each provision included in the agreement. Such weight

Table 1.2: Number of Air Services Agreements by Provision

Provision	Frequency	Provision	Frequency
Grant of rights		**Withholding**	
Fifth freedom	1650	Substantial ownership and effective control	1735
Seventh freedom	417	Community of interest	396
Cabotage	353	Principal place of business	138
Missing values	0	Missing values	59
Pricing		**Capacity**	
Dual approval	1625	Predetermination	1324
Country of origin disapproval	37	Other restrictive	125
Dual disapproval	153	Bermuda I	327
Zone pricing	8	Other liberal	10
Free pricing	381	Free determination	464
Missing values	94	Missing values	49
Designation		**Statistics**	
Single	879	Exchange of statistics required	1492
Multiple	1411	Exchange of statistics not required	807
Missing values	9	Missing values	0
Cooperative arrangements			
Not allowed	2173		
Allowed	126		
Missing values	0		

Notes: The total number of agreements available is 2299. The number of agreements with fifth freedom, seventh freedom and cabotage do not total 2299 observations, because these provisions are not mutually exclusive. Similarly, some agreements present combinations of ownership regimes.
Source: Authors' calculations based on ICAO (2005) and WTO (2006, 2007).

denotes the provision's marginal contribution to the liberalization of the aviation market. There are two possible ways to assign reasonable weights. One is to rely on expert knowledge and the other is to use a purely statistical technique such as factor analysis. To get a better understanding of the overall degree of liberalization of the international aviation market we use both types of indices.

The Air Liberalization Index (ALI) constructed by the WTO Secretariat (WTO, 2006) is an expert-based index. The weights assigned to the different provisions of an agreement were defined in consultation with a group of experts on aviation industry with a view to capturing the relative importance of each provision in liberalizing the sector. As a result, each provision got a weight between zero and eight and the ALI ranges between zero and 50, where zero is associated with the most restrictive agreement and 50 denotes the most liberal agreement.[6]

[6]There are four weighting schemes proposed by WTO (2006). The resulting indices are, however,

Following the approach of previous empirical literature (Gönenç and Nicoletti, 2000), we construct a second index of air services liberalization by means of factor analysis (see Appendix 1.A.1 for more details). This statistical index (Factor Analysis Index or FAI) ranges between zero and one and increases with the degree of liberalization of the aviation market.[7]

The comparison between the relative importance that each indicator of liberalization takes in these two indices shows that grant of rights and withholding have a relatively higher weight in the ALI than in the FAI, whereas the opposite is true for statistics and cooperative arrangements (see Table 1.3). Nevertheless, overall the ALI and the FAI are highly correlated with a correlation coefficient of 0.97 and a Spearman correlation coefficient based on the countries-pair ranking equal to 0.92. This is the result of a typically high correlation among individual indicators of liberalization within an agreement. For instance, 96 percent of agreements with the restrictive dual approval pricing regime also require a withholding regime of substantial ownership and effective control. Average values of ALI and FAI by country are reported in Appendix 1.A.2.

Table 1.3: The Informed Index (ALI) and the Statistical Index (FAI) Comparison of Weighting Schemes

Indicators of liberalization	ALI weights	FAI weights
Grant of rights	0.36	0.17
Capacity	0.16	0.17
Pricing	0.16	0.18
Withholding	0.16	0.1
Designation	0.08	0.08
Statistics	0.02	0.11
Cooperative arrangements	0.06	0.19
Sum of weights	**1**	**1**

Notes: ALI and FAI refer to the Air Liberalization Index and Factor Analysis Index, respectively. The weights reported for the ALI are not the original ones, but they are adjusted to sum up to one for a better comparison with the weights of the FAI. For the definition of the indicators of liberalization see Table 1.10 in Appendix 1.A.1.
Source: Authors' calculations based on ICAO (2005) and WTO (2006, 2007).

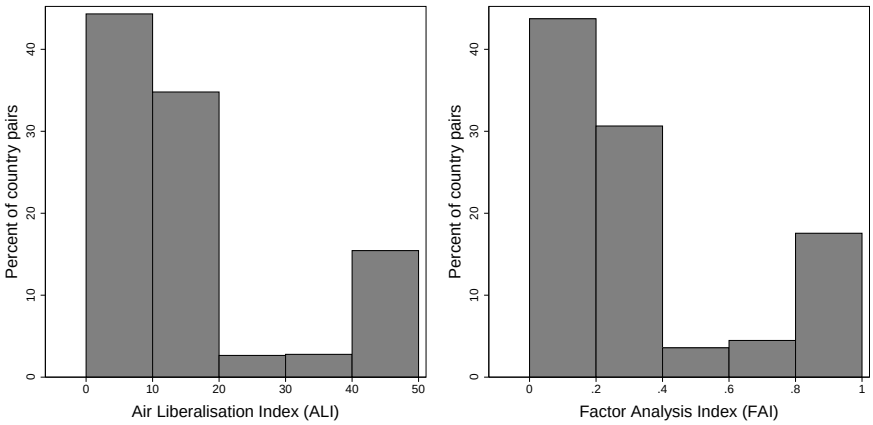
As shown in Figure 1.1 both indices present a distribution highly skewed toward the left. Overall, existing agreements provide a limited degree of liberalization of the aviation market. Approximately 70 percent of agreements are very restrictive with an ALI (FAI) below 15 (0.4). Very few agreements introduce an intermediate degree of liberalization. A high degree of liberalization with an ALI over 40 is reached only in

highly correlated (the correlation is over 90 percent). Therefore, in this chapter we report the results for only one of them, the standard ALI.

[7]The constructed FAI is broadly consistent with the index of bilateral restrictiveness (BRI) calculated by Gönenç and Nicoletti (2000) with a high negative correlation coefficient of -0.84.

15 percent of country-pairs. This is mainly because of the liberalization of air services among countries in the European Economic Area for which the ALI takes a value of 43.

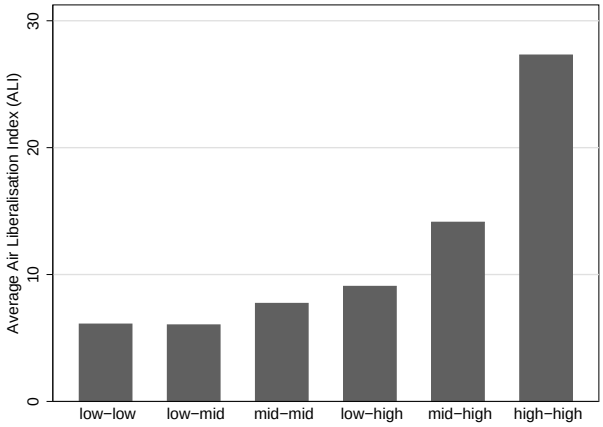
Figure 1.1: Histograms of the Degree of International Air Services Liberalization



Source: Authors' calculations based on ICAO (2005) and WTO (2006, 2007).

An interesting aspect of the complicated web of regulations set up by the Air Services Agreements is to what extent they liberalize aviation markets in developing relative to developed countries. Figure 1.2 reveals that the higher the income of the countries, the more liberal agreements signed between the countries tend to be.

Figure 1.2: International Air Services Liberalization by Income Level



Note: The grouping of countries by level of income is in line with the World Bank definition (World Bank, 2008a). "Low", "mid", and "high" refer to low-income, middle-income, and high-income countries, respectively.

Source: Authors' calculations based on ICAO (2005) and WTO (2006, 2007).

1.4 Empirical Model

The gravity model is the workhorse model for analyzing international trade flows, but it is also used to describe migration flows and trip distributions in general. To assess the impact of air services liberalization on the international aviation market, we adjust the gravity model for modeling bilateral air passenger traffic and estimate it in the following log-linear form:

$$\begin{aligned}\log(\textit{traffic}_{ij}) = {} & \beta_1 \textit{air liberalization}_{ij} + \beta_2 \textit{ASA age}_{ij} + \beta_3 \log(\textit{trade}_{ij}) + \\ & + \beta_4 \log(\textit{distance}_{ij}) + \beta_5 \textit{border}_{ij} + \beta_6 \textit{colony}_{ij} + \beta_7 \textit{language}_{ij} + \\ & + \beta_8 \log(GDP_i) * \log(GDP_j) + \gamma_i + \gamma_j + \epsilon_{ij}, \end{aligned} \tag{1.1}$$

where log denotes the natural logarithm and ϵ_{ij} is an error term.

The dependent variable (the log of) $\textit{traffic}_{ij}$ is the total number of air passengers traveling between country i and country j in 2005. Our explanatory variable of interest, $\textit{air liberalization}_{ij}$, denotes the degree of air services liberalization between the two countries in the corresponding year as measured by the Air Liberalization Index (ALI) or the Factor Analysis Index (FAI). We expect that the degree of liberalization of air passenger services has a positive impact on the number of air passengers. To the extent that Air Services Agreements by improving market access to foreign markets introduce more competition in the sector and allow for a better rationalization of the air services, they will yield lower air fares and/or better quality of the air services (see Piermartini and Rousová, 2009). Consumers can be expected to respond to these changes by flying more.

We further augment the standard gravity model with a variable capturing the number of years ($\textit{ASA age}_{ij}$) since the first Air Services Agreement (ASA) entered into force. This variable attempts to account for the effective implementation of an agreement and the more likely realization of its pro-competitive effects. We expect this variable to affect passenger flows positively. We also include total bilateral trade flows ($\textit{trade}_{ij}$), defined as the sum of bilateral exports and imports. We expect bilateral passenger traffic to be higher between countries that trade more, because trade relations increase the need for face-to-face communication. To avoid any contemporaneous feedback we use one-year lagged trade data.

The following four variables in Equation (1.1) – $distance_{ij}$, $border_{ij}$, $colony_{ij}$ and $language_{ij}$ – are the standard gravity regressors. They denote, respectively, the distance in kilometers between the most populated cities in countries i and j, whether the two countries share a common border, a colonial link or a common official language. We expect these standard gravity regressors to have the usual effect on passenger traffic, except for the *border* dummy. In the gravity models applied to trade flows, this effect is in general estimated to be positive and significant. Conversely, in the case of air transport services, we expect a negative impact of adjacency of countries on the number of passengers. The reason is that the existence of a common border makes it easier for people to use alternative means of transport to air transport (e.g. rail and road) to travel between two countries.

We adopt the approach suggested in Anderson and van Wincoop (2003) and include country fixed effects (denoted as γ_i and γ_j) to account for any country-specific factor that may determine differences in the number of passengers across countries such as GDP, GDP per capita, population or remoteness of the country.[8] We also include the interaction term $\log(GDP_i) * \log(GDP_j)$ to control for the possibility of a non-linear impact of income on passenger flows. We expect a positive coefficient for this variable, as the propensity to fly is likely to disproportionately increase with the level of income.[9]

Data sources for all variables used are provided in Appendix 1.A.3.

1.5 Results

We start estimating Equation (1.1) using the standard OLS estimation method with robust standard errors. The results reported in Table 1.4, column (1), show a positive and significant effect of air services liberalization on passenger flows. In particular, an increase in the degree of liberalization from the 25th percentile (when ALI = 6) to the 75th percentile (when ALI = 34) is estimated to increase traffic volumes by 21 percent.[10] We also find a positive and significant coefficient for the number of

[8] Since our dependent variable is symmetric we do not distinguish whether the country i (resp. country j) is the country of origin or the destination country. More specifically, we can write $\gamma_i + \gamma_j = \sum_k \gamma_k D_{ijk}$, where D_{ijk} is defined as a 0-1 dummy equal to one when a country k is either country i or country j.

[9] Analogous non-linear impacts of other country specific factors such as a non-linear impact of GDP per capita are found to be statistically insignificant and, therefore, they are not included in Equation (1.1).

[10] The formula to compute this effect is $[\exp(0.0067 * (34 - 6)) - 1)] * 100\%$.

years since the first Air Services Agreement was signed between two countries. This is in line with the expectation that older agreements are more likely to be effectively implemented. An additional year of an existing Air Services Agreement between two countries is related to an increase in passenger traffic by 0.5 percent. All coefficients of the other explanatory variables have the expected sign and are significant. Overall, the gravity model explains an important proportion of the variance of the data, with an adjusted R^2 of 0.79.

Table 1.4: Determinants of International Passenger Flows
The role of Air Liberalization Index (ALI)

	Dependent variable: log(traffic)				
	(1)	(2)	(3)	(4)	(5)
	Full sample	**Distance < 8000 km**	**Distance < 5000 km**	**Distance < 5000 km & no low-low income**	**Distance < 5000 km & no high-high income**
ALI	0.0067**	0.013***	0.018***	0.019***	0.013*
	(0.04)	(0.00)	(0.00)	(0.00)	(0.05)
ASA age	0.0053***	0.0041**	0.0039*	0.0035	-0.00028
	(0.01)	(0.04)	(0.09)	(0.13)	(0.91)
Log (trade)	0.35***	0.34***	0.33***	0.37***	0.27***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Log (distance)	-0.59***	-0.48***	-0.40***	-0.32***	-0.59***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Border	-0.40***	-0.36***	-0.42***	-0.51***	-0.15
	(0.00)	(0.01)	(0.00)	(0.00)	(0.31)
Colony	0.35***	0.25*	0.21	0.22	0.20
	(0.00)	(0.05)	(0.22)	(0.19)	(0.29)
Language	0.45***	0.46***	0.48***	0.43***	0.83***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Log(GDP_i)*log(GDP_j)	0.022***	0.028***	0.039***	0.040***	0.037***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
Country dummies	YES	YES	YES	YES	YES
Observations	1223	1039	845	792	600
Adjusted R^2	0.79	0.79	0.79	0.80	0.76

Notes: ***, **, * denote significance at 1, 5 and 10 percent significance levels, respectively. P-values are reported in parentheses. Estimates are based on OLS with robust standard errors. ALI refers to the Air Liberalization Index.

A typical problem commonly neglected in the literature on air services liberalization is the bias that may be introduced by a possible mismatch between the air transport regulation in force between two countries and the regulation applying to each of the passengers flying between the two countries. Data on the number of passengers traveling between two countries (A and B) typically refer to the true origin and true destina-

tion of each passenger. This type of data does not allow us to distinguish between passengers flying directly and passengers flying via a third country. For example, if a passenger travels from country A to country B via (unknown) country C, the rules governing his/her trip are not those established by the Air Services Agreement between countries A and B, but those established by the agreements between countries A and C and between countries B and C.

In order to minimize this potential bias, we estimate Equation (1.1) only for the sample of country-pairs that are connected by a direct air service. When a direct service between two countries exists, we can reasonably assume that most of the bilateral passenger traffic is regulated on the basis of the bilateral agreement signed by the two countries. In fact, case studies suggest that the number of passengers traveling via a third country when a direct service exists is a small percentage of total passenger flow.[11] In contrast, when there is no direct flight, the degree of air services liberalization defined in the agreement between two countries does not represent the conditions under which airlines operating the indirect connection work.[12]

To address the mismatch in the passenger data and the regulatory data, we run regressions on sub-samples of country pairs with distances below 8000 and 5000 km in columns (3) and (4) of Table 1.4, respectively. The underlying idea is that passengers are more likely to fly directly on shorter distances, because stopovers prolong the total duration of travel relatively more on short-distance than on long-distance flights and because short-distance flights are more frequent. Therefore, we expect a better correspondence between passengers and regulation on short-distance flights than on long-distance flights. We indeed find a stronger impact of air services liberalization on traffic flows in these sub-samples than in the full sample (the ALI coefficient increases from 0.0067 to 0.018). This suggests that the possible problem created by data mismatch does not undermine our results. On the contrary, if any, the bias acts toward underestimating the impact of air services liberalization on the number of air passengers.

In columns (4) and (5) of Table 1.4 we remove from the sample of short-distance routes country-pairs of two low- and two high-income countries, respectively, to test

[11] For example, estimates for a flight from London Gatwick to Dallas based on 1996 information show that non-EU passengers constitute less than 20 percent of total passengers (Hanlon, 2006). Since London is an important hub for long-haul flights we should expect this percentage to be even lower for other countries and on other routes.

[12] This is confirmed by the data. When we run regressions only for the sample of country-pairs without a direct service link, we find that the coefficient for the ALI is insignificant.

the sensitivity of our results to different income groups. The estimated coefficient for ALI remains positive and significant, though it is somewhat smaller for the sample of agreements signed by low- and middle-income countries (column (4)) than for those signed by middle- and high-income countries (column (5)).

1.5.1 Alternative Estimation Methods

A standard problem of studies that look at the impact of liberalization policies is the potential endogeneity of the policy variables. One way in which the endogeneity problem can arise in the model is if countries respond to the actual traffic volumes by signing more liberal agreements. For instance, a country could tend to sign liberal agreements with partners with which it has low traffic volumes in order to promote bilateral traffic. In this case the coefficients resulting from OLS estimations would be biased downwards. On the other hand, OLS will overestimate the impact of liberalization on passenger traffic, if a country tends to sign liberal agreements with partners with whom it already shares high traffic volumes.

To address the endogeneity problem, we run instrumental variable (IV) regressions and report the results in Table 1.5, columns (2) to (4). We use two instruments. The first instrument is the interaction between the average levels of the ALI (denoted as $AvALI$) of the two countries in a pair. This instrument is motivated by the expectation that the *bilateral* degree of air services liberalization is positively influenced by the *overall* level of air services liberalization of each country in the pair and that this effect is likely to be magnified if both countries have already high overall degree of liberalization. The results of the first stage regression in column (2) confirm this expectation as the coefficient of the interaction term $AvALI_i * AvALI_j$ is estimated to be positive and significant.[13] Furthermore, this instrument is likely to be exogenous to *bilateral* traffic flows, because the average level of air services liberalization of a country is determined by negotiations with a variety of partners (the average number of partners for a country in our sample is 25). In particular, the reversed causality problem tends to be minimized: If bilateral traffic flows influenced governmental decisions to sign a new Air Services Agreement between the relevant country pair, the overall liberalization level would change only marginally due to a change in one bilateral agreement.

[13]Note that the linear effect of $AvALI_i + AvALI_j$ on ALI_{ij} is already captured by the country fixed effects.

As an alternative instrument, we use the share of trade in time-sensitive goods in total trade, denoted as *time-sensitive trade share*. We define time-sensitive those sectors, for which the share of imports via air exceeds 40 percent.[14] The rationale for using this instrument relies on the political economy argument that producers of time-sensitive goods will lobby the government to liberalize air cargo transport in order to benefit from lower prices. Since negotiations are costly, liberalization of passenger and cargo air services are likely to go hand in hand. As a result, a high share of trade in time-sensitive goods is likely to act toward liberalization of Air Services Agreements regulating passenger traffic. The results reported in the first stage regressions in column (3) confirm this intuition. In addition, we expect this instrument to be exogenous because there is no particular reason why people trading in time-sensitive goods would tend to fly more (or less) than people active in other sectors.

The results obtained using the IV estimations confirm a positive and significant effect of the degree of air services liberalization on the number of passengers. The coefficient of the ALI estimated with the IV method is always higher than that estimated with OLS. This supports the hypothesis that endogeneity arises because countries tend to sign more liberal agreements with the intention to promote initially low traffic flows. When using both instruments jointly in column (4), the Sargan-Hansen test of over-identifying restrictions suggests that the instruments are valid instruments, i.e., uncorrelated with the error term.

To check the robustness of our results to different estimation techniques, we also use the Poisson and the Negative Binomial (NB) estimation methods. These techniques take into account that bilateral passenger traffic is a count variable, i.e. non-negative and discrete, and address the heteroscedasticity pattern in the data (Silva and Tenreyro, 2006). The results of these regressions are reported in Table 1.5, columns (5) and (6). The coefficient for the ALI remains positive and significant. The more flexible NB regression turns out to be more suitable than the Poisson regression according to the test for over-dispersion and the coefficients obtained by the NB appear to be very similar to those of OLS in column (1). Although the NB is a methodology explicitly designed for count data, OLS estimation is in our case a satisfactory method as well. The reason is that the values of the count variable are large and dispersed and thus the characteristics of the variable are similar to those of a continuous variable. The average number of passengers in our sample is over 410,000.

[14] Data on imports via air are obtained from the Global Trade Atlas and refer to the US (the list of the time-sensitive sectors is reported in Table 1.12 in Appendix 1.A.3).

Table 1.5: Determinants of International Passenger Flows
Alternative Estimation Techniques

	(1)	(2)		(3)		(4)		(5)	(6)
	OLS	**IV (2SLS)**		**IV (2SLS)**		**IV (2SLS)**		**Poisson**	**NB**
		1st stage	**2nd stage**	**1st stage**	**2nd stage**	**1st stage**	**2nd stage**		
Dependent variable:	**log(traffic)**	**ALI**	**log(traffic)**	**ALI**	**log(traffic)**	**ALI**	**log(traffic)**	**traffic**	**traffic**
ALI	0.0067**		0.016**		0.0078#		0.011**	0.013***	0.0068**
	(0.04)		(0.01)		(0.14)		(0.03)	(0.00)	(0.03)
ASA age	0.0053***	-0.0005	0.0054***	-0.011	0.0053***	-0.0068	0.0054***	0.0012	0.0029**
	(0.00)	(0.97)	(0.00)	(0.46)	(0.00)	(0.61)	(0.00)	(0.71)	(0.05)
Log (trade)	0.35***	0.34	0.34***	0.081	0.36***	0.066	0.35***	0.69***	0.31***
	(0.00)	(0.18)	(0.00)	(0.74)	(0.00)	(0.78)	(0.00)	(0.00)	(0.00)
Log (distance)	-0.59***	-4.29***	-0.55***	-3.03***	-0.58***	-3.02***	-0.57***	-0.31***	-0.66***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Border	-0.40***	-1.54	-0.39***	-0.49	-0.40***	-0.84	-0.40***	-0.57***	-0.28***
	(0.00)	(0.08)	(0.00)	(0.55)	(0.00)	(0.28)	(0.00)	(0.00)	(0.01)
Colony	0.35***	-4.13***	0.39***	-2.26***	0.36***	-2.43***	0.38***	0.32***	0.39***
	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)
Language	0.45***	1.11#	0.44***	-0.077	0.44***	0.012	0.44***	0.23**	0.45***
	(0.00)	(0.12)	(0.00)	(0.91)	(0.00)	(0.99)	(0.00)	(0.02)	(0.00)
Log(GDP_i)*log(GDP_j)	0.022***	-0.23***	0.024***	-0.15***	0.022***	-0.18***	0.022***	0.023**	0.023***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)
$AvALI_i$*$AvALI_j$		0.059***				0.037***			
		(0.00)				(0.00)			
Time-sensitive trade share				0.27***		0.22***			
				(0.00)		(0.00)			
Country dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	1223	1223	1223	1215	1215	1215	1215	1223	1223
R^2	0.79	0.82	0.78	0.84	0.79	0.86	0.79	0.91	0.08
Additional IV estimation results, column (4): Test of excluded instruments: F(2,1046) = 302, p-value = 0.00; Sargan-Hansen test: $\chi^2(1) = 1.22$, p-value = 0.24									
Additional NB estimation results, column (6): Overdispersion LR test of $\alpha = 0$: $\hat{\alpha} = 0.41$, p-value = 0.00 (in estimation without robust standard errors)									

Notes: ***, **, *, # denote significance at 1, 5, 10 and 15 percent significance levels, respectively. P-values reported in parentheses. Robust standard errors used. Adjusted R^2 reported in column (1), adjusted (centred) R^2 in columns (2) to (4) and McFadden's Pseudo R^2 in columns (5) and (6). Equation (1.1) is estimated in its multiplicative form in columns (5) and (6), i.e. not in the log-linear specification. The NB2 specification as defined in Cameron and Trivedi (1998) is used for the NB regression in column (6). ALI refers to the Air Liberalization Index and $AvALI_i$ denotes the average level of ALI for country i.

In conclusion, the most conservative estimate regarding the variable of interest is obtained by the standard OLS estimation method. For this reason the results presented hereafter are those obtained using this method.

1.5.2 Alternative Measures of Liberalization

We also examine the sensitivity of our results to the use of alternative measures of air services liberalization. Table 1.6 shows the estimated effects of increasing the degree of liberalization from the 25th to the 75th percentile using the two alternative indices: the ALI and the FAI. The results are broadly consistent, with a slightly higher estimate for the FAI (22 percent increase in the number of passengers) than for the ALI (21 percent increase).

Table 1.6: The Informed Index (ALI) and the Statistical Index (FAI) Comparison of Estimated Effects

Index	Estimated coefficient	Range of the index (min-max)	25th percentile	75th percentile	Estimated effect
ALI	0.0067***	0-50	6	34	21%
	(0.01)				
FAI	0.30***	0-1	0.08	0.73	22%
	(0.01)				

Notes: *** denote 1 percent significance level. Estimated coefficients are obtained by OLS with robust standard errors using the same specification as in Table 1.4, column (1). P-values are reported in parentheses. The column titled "Estimated effect" reports the estimated impact on passenger volumes of an increase in the index from the 25th to the 75th percentile. ALI and FAI refer to the Air Liberalization Index and the Factor Analysis Index, respectively.

1.5.3 Cluster Analysis

Despite the fact that economic literature tends to use indices to measure the degree of liberalization of international air services markets,[15] it is impossible to formulate a policy in terms of a certain increase in the index of liberalization. The use of indices does not allow us to single out which specific provision affects passenger flows. On the other hand, it is very difficult to disentangle the effect of each provision on passenger flows, because restrictive (liberal) provisions tend to go hand in hand with other restrictive

[15] The same approach tends to be used for measuring the degree of liberalization of other types of services (see Dihel and Shepherd, 2007).

(liberal) provisions within one agreement, thus creating a problem of multicollinerity in estimations.

To address the issue of multicollinearity and to identify the relative importance of different types of agreements for passenger flows, we use cluster analysis. Cluster analysis is a suitable tool to distinguish various types of agreements, because it classifies objects (agreements) into different groups (clusters) according to their "similarity". In the analysis that follows, we use agglomerative hierarchical cluster analysis (Härdle and Simar, 2007) that takes each observation as a separate cluster at the beginning and merges them successively into larger and larger clusters.

We conduct cluster analysis in two steps. In the first step, we identify provisions that have a significant effect on passenger flows by running three different types of gravity regressions. First, we run a set of 19 regressions, one for each provision (modeled by a dummy variable). Then, we run a set of seven regressions, each one including the group of provisions specific to a certain indicator of liberalization (grants of right, withholding, etc.). Finally, we run one regression with all provisions. Using a non-conservative significance level of 15 percent to detect all potentially influential provisions, we identify nine provisions, significant in at least one regression.[16] These are seventh freedom, cabotage, free determination of capacity, free pricing, community of interest, multiple designation and no requirement for statistical exchange – all showing a positive effect on passenger flows – and dual approval and substantial ownership and effective control – showing a negative sign.[17] In the second step, we use these nine provisions as distinguishing features for the cluster analysis.

The first level of aggregation reveals 24 different types of existing agreements. In order to obtain more balanced clusters in terms of the number of agreements, we opted for higher levels of aggregation. Table 1.7 displays seven clusters obtained at the seventeenth level of aggregation. This level turned out to be reasonable in terms of the number of observations in each cluster and in terms of explanatory power in the gravity regressions. Clusters are ordered from the most restrictive to the most liberal type (from C1 to C7) and for each cluster the percentage of agreements characterized by a certain provision is reported. For instance, cluster C1 includes the most restrictive

[16] The results of these regressions are available on request.

[17] Recall that passenger traffic data do not contain information on stop-overs. For this reason we use only the sample of country pairs with a direct service link. It is therefore not surprising that fifth freedom that relates exclusively to stop-over flights is not found to be significant in this sample. The fact that we find a significant effect of fifth freedom for the sample of country pairs without a direct connection confirms this intuition.

types of agreements, none of which contains a liberal feature. Three types of agreements denoted by clusters C1, C3, and C7, respectively, are very frequent and account together for more than 90 percent of Air Services Agreements.

Table 1.7: Different Types of Agreements Identified by Cluster Analysis

Clusters	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**
Observations	291	45	319	64	62	63	305
Liberal provisions							
Seventh freedom	0	0	0	0	0	32	100
Cabotage	0	0	0	0	0	0	92
Free determination of capacity	0	0	0	0	0	90	100
Free pricing	0	0	0	0	0	2	100
Community of interest	0	0	0	0	0	0	99
Multiple designation	0	0	100	100	89	93	100
Exchange of statistics not required	0	100	0	100	2	86	100
Restrictive provisions							
Dual approval of tariffs	100	100	100	100	14	8	0
Substantial ownership and effective control	100	100	100	100	77	97	0

Notes: Percentage of agreements containing corresponding provision within each cluster is reported. Incomplete agreements are excluded. Clusters are obtained by Ward's clustering algorithm using Jaccard binary measure of similarity.

Using the standard gravity model to explain bilateral passenger flows, we estimate the impact of different types of agreements by adding to the standard explanatory variables six dummies, one for each cluster C2 to C7. We report the results in Table 1.8, column (1). The agreements falling in clusters C3, C4, C6, and C7 have an increasingly positive and significant effect on passenger flows relative to the most restrictive agreements of cluster C1 that form a reference group.

The most liberal cluster C7 is found to have the largest impact on the number of passengers. Passenger traffic is estimated to be 58 percent higher among countries applying these types of regulations than among countries falling in the most restrictive cluster C1.[18] Cluster C7 includes all country pairs covered by the Air Transport Agreement between EU and Switzerland and the European Economic Area (EEA) involving the EU countries, Norway, Iceland and Liechtenstein as well as two bilateral agreements of New Zealand (with Brunei Darussalam and Singapore). In particular, this result shows the importance of free pricing, seventh freedom, cabotage rights and the removal of the requirement for substantial ownership and effective control for an effective liberalization of international air services.

[18] We calculate this effect as $(\exp(0.46) - 1) * 100\%$.

Table 1.8: Determinants of International Passenger Flows
The Role of Different Types of Air Services Agreements

	Dependent variable: log(traffic)				
	(1)	(2)	(3)	(4)	(5)
	Full sample	**Distance < 8000 km**	**Distance < 5000 km**	**Distance < 5000 km & no low-low income**	**Distance < 5000 km & no high-high income**
C2	-0.072	-0.040	-0.019	0.040	0.024
	(0.62)	(0.82)	(0.92)	(0.85)	(0.91)
C3	0.14*	0.22**	0.22*	0.26*	0.20#
	(0.09)	(0.03)	(0.08)	(0.06)	(0.15)
C4	0.21*	0.29*	0.25#	0.28*	0.22
	(0.10)	(0.05)	(0.16)	(0.10)	(0.27)
C5	0.087	0.21	0.17	0.13	0.016
	(0.56)	(0.23)	(0.40)	(0.53)	(0.94)
C6	0.31*	0.50**	0.50#	0.61*	0.55#
	(0.10)	(0.03)	(0.12)	(0.05)	(0.16)
C7	0.46***	0.83***	1.05***	1.17***	0.70**
	(0.01)	(0.00)	(0.00)	(0.00)	(0.03)
ASA age	0.0060***	0.0047**	0.0043*	0.0033	0.00027
	(0.01)	(0.04)	(0.10)	(0.19)	(0.94)
Log(trade)	0.37***	0.37***	0.35***	0.36***	0.30***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Log(distance)	-0.56***	-0.43***	-0.34***	-0.27***	-0.54***
	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)
Border	-0.41***	-0.35**	-0.37***	-0.46***	-0.097
	(0.00)	(0.01)	(0.01)	(0.00)	(0.57)
Colony	0.42***	0.30**	0.22	0.27	0.22
	(0.00)	(0.04)	(0.25)	(0.19)	(0.31)
Language	0.40***	0.39***	0.35**	0.30**	0.71***
	(0.00)	(0.00)	(0.02)	(0.05)	(0.00)
$\text{Log}(\text{GDP}_i)$*$\log(\text{GDP}_j)$	0.021***	0.028***	0.035***	0.037***	0.030*
	(0.01)	(0.00)	(0.00)	(0.00)	(0.06)
Country dummies	YES	YES	YES	YES	YES
Observations	1082	919	755	712	514
Adjusted R^2	0.78	0.79	0.80	0.81	0.75

Notes: ***, **, *, # denote significance at 1, 5, 10, and 20 percent significance levels, respectively. P-values are reported in parentheses. Estimates are based on OLS with robust standard errors. The omitted group is cluster C1.

Cluster C6 is the second most liberal cluster identified. It includes 45 Open Skies Agreements signed by the United States and gathers agreements with multiple designation, free determination of capacity and a semi-liberal price regimes (i.e. in between dual approval and free pricing). Passenger traffic related to this cluster is estimated to be approximately 36 percent higher than in cluster C1.

The positive coefficient for cluster C4 and C3 shows the importance of multiple designation, that accounts for some 15 to 21 percent increase in passenger traffic compared to cluster C1. The countries that most frequently appear in these groups are: for cluster C4 the United States and France (in eight agreements), Tunisia and Brazil (in six agreements) and Paraguay (in five agreements); for cluster C3 United Kingdom (37 agreements), Hong-Kong China (22 agreements), India (21 agreements), Singapore (16 agreements) or Malaysia (15 agreements).

To check the robustness of the results, we estimate the effects of different types of agreements using various subsamples in columns (2) to (5) of Table 1.8. In line with the results in Table 1.4, we find a stronger impact of air services liberalization on passenger flows, when using subsamples of short-distance flights (columns (2) and (3)). Similarly, the impact is estimated to be higher when using the sample of agreements signed by high- and middle-income countries (column (4)) compared to the sample of agreements signed by middle- and low-income countries (column (5)). The difference is, however, rather small for the type of agreements with multiple designation and Open Skies-type of agreements, which suggests a similar response of passenger traffic flows to the implementation of those two types of agreements across countries with different level of income.

Overall, we consistently find positive and significant effects of agreements that introduce multiple designation (cluster C3 and C4), Open Skies-type of agreements (cluster C6), and the EEA-type of agreements (cluster C7). The result that more liberal agreements increase passenger flows the most also appears to be robust.

Finally, using the most conservative estimates from Table 1.8 (those for the full sample in column (1)), we conduct in Table 1.9 a small simulation exercise to get a better understanding of the likely impact of a worldwide application of three different types of agreements: those including multiple designation provisions (cluster C3), Open Skies-type (cluster C6), and EEA-type (cluster C7). The figures show a strong positive effect of the adoption of these types of agreements worldwide. For example, the world wide adoption of Open Skies- and EEA-type of agreements is estimated to increase worldwide passenger traffic by 10 and 20 percent, respectively.

In addition, in all liberalization scenarios depicted in Table 1.9 the highest percentage increases in traffic tend to occur on routes to and from low-income countries, followed by middle-income countries. This suggests that multilateralization of these

types of agreements would significantly reduce the uneven distribution of passenger traffic (see Table 1.1 in Section 1.1). However, the exact figures obtained for the different income groups of countries should be interpreted with caution, as we do not account in the simulation for the tendency in our data that the size of the effect of liberalization on traffic flows can somewhat differ with the level of income as suggested by results in columns (4) and (5) of Tables 1.8 and 1.4.

Table 1.9: Worldwide Adoption of Different Types of Agreements Estimated Increase in Passenger Traffic by Income Level

Type of agreement	Income group	Low	Middle	High	World wide
Multiple designation (C3)					2%
	Low	9%	8%	5%	
	Middle		6%	3%	
	High			1%	
Open Skies-type (C6)					10%
	Low	30%	27%	24%	
	Middle		24%	17%	
	High			4%	
EEA-type (C7)					20%
	Low	50%	47%	45%	
	Middle		43%	34%	
	High			10%	

Notes: Percentage increases in passenger traffic are simulated assuming that a more liberal regime is adopted by country pairs whose air traffic is regulated by a more restrictive type of agreement. The coefficients of 0.14, 0.39, and 0.57 estimated in column (1) of Table 1.8 are used, respectively, for the type of agreements with multiple designation, for the Open Skies-type, and the EEA-type of agreements.

1.6 Conclusions

The aviation industry has been highly regulated both domestically and internationally, with governments setting conditions on ownership, capacity and fares. The conditions under which air companies operate between two countries are typically set by bilateral Air Services Agreements and, in a few cases, plurilateral agreements apply. Although in the last 30 years countries have undertaken a process of liberalization of the industry, the outcome of this process has been a very unevenly liberalized global aviation market, where high-income countries tend to sign less liberal agreements with low-income countries than with middle- and high-income countries.

To assess the economic impact of the present system of Air Services Agreements, this chapter focuses on international air passenger transport, an important factor in facilitating trade and in the development of other sectors of an economy such as tourism. Relying on detailed information on the regulatory set-up of the aviation market for a sample of some 2300 Air Services Agreements, we estimate the impact of the degree of air services liberalization on the volume of international passenger flows.

Following the traditional approach of measuring the degree of liberalization by means of an index, we find strong evidence of a positive and significant impact of the degree of liberalization of the international aviation market on passenger traffic. In particular, we estimate that increasing the degree of liberalization from the 25th to the 75th percentile increases passenger traffic by approximately 21 percent. This effect is shown to be robust to potential problems of endogeneity, heteroscedasticity and data inaccuracy.

However, unlike the removal of tariff barriers in goods, the liberalization of air transport services cannot take place in the form of a continuous process of liberalization. For this reason we conduct a cluster analysis to disentangle the effects of different types of possible agreements. Using this approach, we show that the positive effect of liberalization on passenger traffic is driven by particular types of agreements: those including multiple designation, Open Skies-type, and European Economic Area-type (EEA-type) of agreements. For instance, we estimate that traffic flows regulated by the very liberal EEA-type of agreements tend to be by some 22 percent higher that traffic flows regulated by the Open Skies-type of agreements. In addition, our results suggest that multilateralization of multiple designation provisions and Open Skies-type of agreements is likely to increase passenger traffic worldwide by two and ten percent, respectively.

More research is needed to quantify the impact of Air Services Agreements on cargo traffic. The results of this chapter, however, suggest a very important policy implication. The present system of a plethora of Air Services Agreements characterized by a variety of degrees of liberalization generates a discriminatory environment for access to air services. This discrimination appears particularly to penalize low-income countries that tend to sign less liberal Air Services Agreements. They may be the primary beneficiary of improved access to the international aviation market.

1.A Appendices to Chapter 1

1.A.1 Construction of the Factor Analysis Index (FAI)

We construct the Factor Analysis Index (FAI) following the approach introduced by Nicoletti, Scarpetta, and Boylaud (2000). The seven indicators of liberalization identified in WTO (2006) are taken as the initial set of variables to which factor analysis is applied. Table 1.10 provides the definition of each indicator. The most restrictive and the most liberal provision within an indicator are associated with zero and one, respectively.

Table 1.10: Definition of Indicators of Liberalization

Name of indicator	Definition
Grant of rights	categorical variable that takes the values 0, 1/3, 2/3 or 1 depending on the number of traffic rights (fifth freedom, seventh freedom, and cabotage) provided by the agreement (0 means that none of the traffic rights is provided, 1/3 refers to one traffic right provided, 2/3 to two rights and 1 means that all three traffic rights are provided)
Capacity	categorical variable that takes the values 0, 1/4, 2/4, 3/4 or 1 depending on the capacity clause (0 refers to predetermination, 1/4 to "other restrictive" regime, 2/4 to Bermuda I, 3/4 to "other liberal" regime and 1 to free determination)
Pricing	categorical variable that takes the values 0, 3/8, 4/8, 6/8, 7/8 or 1 depending on the pricing regime (0 refers to dual approval, 3/8 to country of origin disapproval, 4/8 to zone pricing combined with dual approval, 6/8 is associated with dual disapproval, 7/8 refers to zone pricing combined with dual disapproval and 1 refers to free pricing)
Withholding	categorical variable that takes the values 0, 1/2 and 1 depending on the ownership/withholding regime provided; when more than one regime is included, the less restrictive one is considered (0 refers to substantial ownership and effective control, 1/2 to community of interests and 1 to principal place of business regime)
Designation	dummy variable that takes the value 1 if multiple designation of airlines is allowed and 0 otherwise
Statistics	dummy variable that takes the value 0 if a provision on the exchange of statistics is included and 1 if the provision is absent
Cooperative arrangements	dummy variable that takes the value 1 if cooperative arrangements are allowed and 0 otherwise

The factor analysis extracts two most relevant factors that together explain 68 percent of the overall data variation as depicted in Table 1.11. Factor 1 accounts individually for more than 50 percent of data variability. The magnitude of its loadings (in general larger than 0.5) shows that it is highly correlated with all indicators of liberalization, but cooperative arrangements. Factor 1 therefore captures an overall degree of liberalization of the agreement. The detection of one common factor for most of the indicators results from strong correlations between them (in the range of

0.30 and 0.82). Factor 2 explains only 16 percent of the data variability and its main contribution to the overall variance is as an indicator for cooperative arrangements.

Table 1.11: The Statistical Index (FAI)
Factors Loadings and Weights

	Factor 1		**Factor 2**		**Total**
Explained variance	52%		16%		68%
Eigenvalues	3.64		1.10		
Indicators of liberalization	**Loadings**	**Weights**	**Loadings**	**Weights**	**Weights**
Grant of Rights	0.89	0.22	-0.07	0.00	0.17
Capacity	0.89	0.22	0.14	0.02	0.17
Pricing	0.91	0.23	0.13	0.02	0.18
Withholding	0.68	0.13	-0.05	0.00	0.10
Designation	0.50	0.07	0.35	0.11	0.08
Statistics	0.72	0.14	0.14	0.02	0.11
Cooperative arrangements	0.04	0.00	0.96	0.83	0.19
Weights of factors		**0.77**		**0.23**	**1**

Notes: Factor loadings were obtained by the principal component method and after varimax rotation.
Source: ICAO (2005) and WTO (2006, 2007).

We assign a weight to each indicator of liberalization and factor according to the proportion of the variance that is explained by the indicator/factor. More formally, if i denotes an indicator of liberalization and w_i its weight, j a factor and W_j its weight, V_{ij} a weight of indicator i within a factor j and $T_j = \sum_{k=1}^{7} \text{loading}_{kj}^2$, then

$$V_{ij} = \frac{\text{loading}_{ij}^2}{T_j}, \qquad W_j = \frac{T_j}{T_1 + T_2}, \quad \text{and} \quad w_i = V_{i1}W_1 + V_{i2}W_2.$$

1.A.2 Air Services Liberalization by Country

	ALI		FAI	
Country	**rank**	**average**	**rank**	**average**
Angola	1	0.67	15	0.08
Papua New Guinea	2	3.60	6	0.06
Mozambique	3	3.67	5	0.06
Burkina Faso	4	3.71	14	0.07
China	5	3.73	13	0.07
Georgia	6	3.83	20	0.08
Sao Tome and Principe	7	4.00	17	0.08
Lesotho	7	4.00	1	0.05
Central African Republic	9	4.25	16	0.08
Yemen	10	4.33	9	0.07
Ukraine	11	4.53	39	0.10
Togo	12	4.62	2	0.05
Niger	13	4.63	19	0.08
Moldova	14	4.71	32	0.10
Iran, Islamic Rep. Of	15	4.74	18	0.08
Kazakhstan	16	4.83	38	0.10
Cameroon	17	4.89	22	0.08
Zimbabwe	17	4.89	37	0.10
Bahamas	19	5.00	118	0.19
Solomon Islands	19	5.00	8	0.07
Fyr Macedonia	21	5.27	48	0.11
Kuwait	22	5.35	7	0.07
Bangladesh	23	5.50	21	0.08
Zambia	24	5.60	28	0.09
Seychelles	25	5.70	11	0.07
Israel	26	5.72	36	0.10
Russian Federation	27	5.78	56	0.12
Benin	28	5.81	44	0.11
Oman	29	5.82	29	0.09
Kyrgyz Republic	30	5.93	46	0.11
Mauritius	31	5.94	12	0.07
Comoros	33	6.00	4	0.06
Guyana	33	6.00	3	0.06
Congo	33	6.00	34	0.10
Korea, Dem. People's Rep. Of	35	6.17	26	0.09
India	36	6.25	27	0.09
Kenya	37	6.32	10	0.07
Somalia	38	6.33	30	0.09
Libyan Arab Jamahiriya	39	6.45	24	0.08
Algeria	40	6.47	51	0.12
Samoa	41	6.50	23	0.08
Uzbekistan	41	6.50	81	0.15
Bulgaria	43	6.57	49	0.12
Côte D'ivoire	44	6.64	25	0.09

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	ALI		FAI	
Country	**rank**	**average**	**rank**	**average**
Lao People's Dem. Rep.	45	6.67	66	0.14
Burundi	45	6.67	41	0.11
Cuba	47	6.68	35	0.10
Bosnia and Herzegovina	48	6.75	60	0.13
Vietnam	48	6.75	59	0.13
Senegal	50	6.76	47	0.11
Romania	51	6.78	42	0.11
Saudi Arabia	52	6.95	50	0.12
Mauritania	53	7.00	58	0.12
Albania	54	7.14	116	0.19
Nigeria	55	7.20	31	0.09
Fiji	56	7.22	43	0.11
Equatorial Guinea	57	7.25	67	0.14
Croatia	57	7.25	71	0.14
Afghanistan	59	7.29	65	0.14
Pakistan	60	7.34	33	0.10
Ethiopia	61	7.43	40	0.10
Mexico	62	7.44	123	0.20
Serbia and Montenegro	63	7.58	100	0.17
Tanzania	64	7.62	75	0.15
Azerbaijan	65	7.67	117	0.19
Morocco	66	7.84	64	0.14
Mali	67	7.86	74	0.15
Iraq	68	7.98	55	0.12
Saint Kitts and Nevis	69	8.00	94	0.16
Chad	69	8.00	52	0.12
Maldives	71	8.08	61	0.13
Turkmenistan	72	8.13	104	0.17
Belarus	73	8.15	76	0.15
Malawi	74	8.19	54	0.12
Thailand	75	8.40	53	0.12
Guinea-Bissau	77	8.50	78	0.15
Bahrain	77	8.50	82	0.15
Philippines	77	8.50	95	0.16
Colombia	79	8.55	125	0.20
Korea, Republic of	80	8.58	72	0.14
Argentina	81	8.58	83	0.15
Tonga	82	8.67	45	0.11
Bolivia	83	8.69	86	0.16
Myanmar	84	8.73	68	0.14
South Africa	85	8.73	91	0.16
Gabon	86	8.75	77	0.15
Tunisia	87	8.78	114	0.18
Turkey	88	8.89	99	0.17
Bolivarian Rep. of Venezuela	89	8.93	89	0.16
Armenia	90	9.00	80	0.15
Syrian Arab Republic	91	9.03	121	0.20
Guinea	92	9.06	90	0.16
Cambodia	93	9.07	85	0.16

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	ALI		FAI	
Country	**rank**	**average**	**rank**	**average**
Egypt	94	9.08	69	0.14
Congo, Dem. Republic of	95	9.08	79	0.15
Jordan	96	9.29	115	0.19
Barbados	97	9.38	92	0.16
Qatar	98	9.42	108	0.17
Botswana	99	9.44	124	0.20
Sri Lanka	100	9.48	88	0.16
Canada	101	9.51	97	0.17
Lebanon	102	9.68	102	0.17
Nepal	103	9.75	73	0.15
Malaysia	104	9.79	87	0.16
Bhutan	105	10.00	62	0.13
Djibouti	105	10.00	62	0.13
Tuvalu	105	10.00	70	0.14
Suriname	105	10.00	57	0.12
Paraguay	105	10.00	122	0.20
Ecuador	110	10.08	120	0.19
Sudan	111	10.09	106	0.17
Brazil	112	10.17	103	0.17
Uganda	113	10.20	112	0.18
Mongolia	114	10.22	111	0.18
Costa Rica	115	10.25	142	0.27
Sierra Leone	116	10.38	93	0.16
Australia	117	10.38	84	0.16
Liberia	118	10.42	119	0.19
Ghana	119	10.46	98	0.17
Uruguay	120	10.47	96	0.16
Indonesia	121	10.52	105	0.17
Brunei Darussalam	122	10.74	113	0.18
Japan	123	10.80	107	0.17
Peru	124	10.93	133	0.23
Cape Verde	125	11.00	140	0.27
Trinidad and Tobago	125	11.00	110	0.18
United Arab Emirates	127	11.10	128	0.21
Dominican Republic	128	11.25	138	0.25
Jamaica	129	11.32	132	0.23
Cook Islands	130	11.33	101	0.17
Rwanda	131	11.40	134	0.23
Guatemala	132	11.43	135	0.24
Panama	133	11.75	143	0.27
Madagascar	134	11.80	139	0.25
Hong Kong, China	135	11.98	109	0.18
Saint Lucia	136	12.00	126	0.20
Namibia	136	12.00	149	0.30
Nicaragua	138	12.20	137	0.25
Singapore	139	12.29	127	0.21
Vanuatu	140	13.00	136	0.24
Gambia	140	13.00	144	0.27
Swaziland	143	14.00	129	0.22

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	ALI		FAI	
Country	**rank**	**average**	**rank**	**average**
Antigua and Barbuda	143	14.00	129	0.22
Haiti	143	14.00	129	0.22
New Zealand	145	15.68	147	0.28
Nauru	146	15.75	146	0.28
American Samoa	147	16.00	141	0.27
Honduras	147	16.00	163	0.42
Chile	149	16.08	158	0.35
Macao, China	150	16.61	145	0.28
Switzerland	151	16.93	148	0.29
Austria	152	17.42	152	0.31
Marshall Islands	153	17.67	155	0.32
Germany	154	17.77	151	0.31
Netherlands	155	17.83	154	0.32
Spain	156	17.98	153	0.32
Grenada	157	18.00	150	0.31
United Kingdom	158	18.93	157	0.34
Belgium	159	19.17	156	0.33
France	160	20.13	159	0.35
Sweden	161	21.53	160	0.38
Italy	162	22.78	161	0.41
Czech Republic	163	22.93	164	0.42
Denmark	164	23.09	162	0.41
El Salvador	165	23.50	177	0.60
Norway	166	24.20	166	0.44
Cyprus	167	24.90	165	0.43
United States	168	24.96	176	0.60
Poland	169	26.65	167	0.47
Finland	170	26.75	168	0.48
Greece	171	28.67	169	0.50
Portugal	172	28.87	171	0.52
Hungary	173	28.89	170	0.51
Luxembourg	174	30.57	172	0.55
Malta	175	32.92	173	0.59
Slovenia	176	33.74	174	0.60
Latvia	177	33.75	175	0.60
Aruba	178	34.00	183	0.80
Netherlands Antilles	178	34.00	183	0.80
Ireland	180	35.00	178	0.63
Lithuania	181	35.55	179	0.63
Slovak Republic	182	35.88	180	0.64
Iceland	183	39.06	181	0.71
Estonia	184	41.43	182	0.74

1.A.3 Data Sources

Data on distance, common border, common colonial link and common language were obtained from CEPII (2008). Data on GDP are based on the World Development Indicators (WDI) database (World Bank, 2008b) and trade data are extracted from the WITS - UN COMTRADE database (World Bank, 2008c). The definition of time-sensitive sectors is based on the US imports obtained from the Global Trade Atlas (Global Trade Information Services, 2009) (see Table 1.12 for the full listing of the time-sensitive sectors). The grouping of countries by level of income is in line with the World Bank definition (World Bank, 2008a). Data on passenger traffic and the existence of direct services between two countries are provided by the International Aviation Transport Association (IATA). Information on the agreements and the number of years since they were first signed come from the World's Air Services Agreements (WASA) database provided by the International Civil Aviation Organization (ICAO, 2005). This database covers 2204 bilateral Air Services agreements, but only 1921 of these are used, since the rest are covered by plurilateral agreements. Information on plurilateral agreements was obtained from WTO (2007). In particular, we include the Air Transport Agreement between EU and Switzerland and the Agreement on the European Economic Area (EEA) involving the EU (25) countries, Norway, Iceland and Liechtenstein. We ignore other plurilateral agreements because their effective implementation is improbable (see WTO, 2007, Chap. I for more details). The informed index of air transport liberalization, the ALI, is from WTO (2006, 2007). All data collected are for the year 2005.

Table 1.12: Time-sensitive Sectors

Code	Name	Share of US imports via air
71	Natural or cultured pearls, precious or semiprecious stones, precious metals; precious metal clad metals, articles thereof; imitation jewelry; coin	87%
97	Works of art, collectors' pieces and antiques	84%
50	Silk, including yarns and woven fabrics thereof	82%
30	Pharmaceutical products	76%
91	Clocks and watches and parts thereof	73%
90	Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical instruments and apparatus; parts and accessories thereof	62%
43	Furskins and artificial fur; manufactures thereof	59%
6	Live trees and other plants; bulbs, roots and the like; cut flowers and ornamental foliage	59%
29	Organic chemicals	58%
93	Arms and ammunition; parts and accessories thereof	53%
85	Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television recorders and reproducers, parts and accessories	46%
38	Miscellaneous chemical products	40%

Notes: The data refer to the US imports from the rest of the world. HS 2005 classification at the two-digit level is used.
Source: Global Trade Atlas (Global Trade Information Services, 2009).

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Chapter 2

Are the Central European Stock Markets Still Different? A Cointegration Analysis

2.1 Introduction

The recent financial crises has rapidly developed and spread from the United States to other parts of the world. This points to the risks of the global financial sector, where shocks are easily transmitted from one country to another. Therefore, it is of particular interest to understand the process of financial integration, investigate its underlying linkages, and identify its drivers.

The transition economies in Central Europe[1] offer a unique opportunity to study the effects of institutional changes on financial integration. First of all, many substantial legal and institutional reforms have been occurring in the Central European countries since the fall of communist regimes in 1989. The countries quickly embarked on programs of liberalization and privatization and their economies have undergone a relatively fast and successful transition process from centrally planned economies towards free markets. Second, an important role in the transition process has been played by large capital inflows to the region from developed countries. The Central European countries have attracted particularly significant amounts of foreign direct investment (FDI), originating mainly from Western Europe (see

[1] The term "Central Europe" refers to the Visegrád Group of countries, namely the Czech Republic, Hungary, Poland and Slovakia.

Mora, Garibaldi, Sahay, and Zettelmeyer, 2002).

Furthermore, the institutional arrangements as well as fiscal and monetary policies have been strongly motivated by several criteria that set conditions for the European Union (EU) accession and have directed the adjustment of the Central European countries towards the EU standards since the mid 1990s.[2] The EU accession *per se* on May 1, 2004 was associated with the full removal of restrictions on movements of capital. Nevertheless, the restructuring process continues as policy makers in the new member countries attempt to join the Eurozone (McKinnon, 1999; Buiter and Grafe, 2002; Buiter, 2004),[3] and the institutional changes are accompanied by a convergence in macro-economic fundamentals of the recent EU members to the EU standards (Kocenda, Kutan, and Yigit, 2006).

The ongoing institutional integration of the Central European countries with the global economy, the importance of foreign investment in these countries and their macro-economic developments suggest tightening of the stock market relations, as evidenced by extensive empirical literature on major developed stock markets (see Eun and Shim, 1989; Koch and Koch, 1991; Taylor and Tonks, 1989; Kasa, 1992; Masih and Masih, 1992; Longin and Solnik, 1995; Bessler and Yang, 2003). In particular, financial integration of the Central European markets with the "old" EU[4] markets can be expected due to the EU enlargement as well as significant capital inflows to Central Europe from these countries. Surprisingly, the existing empirical literature on the Central European stock markets has delivered no (Gilmore and McManus, 2002, 2003) or only limited evidence (Egert and Kocenda, 2007; Syrioupoulus, 2006; Syllignakis and Kouretas, 2009) for such developments so far, when focusing on the long-run stock market linkages. In fact, this literature does not typically investigate the *developments* of the long-run relations; rather, it tends to fit only one model for the whole period of interest, tacitly assuming that the parameters of the model are constant over the whole time span. One exception is Voronkova (2004), who controls for structural breaks in the relations and indeed finds stronger evidence of long-run links than reported in the previous literature.

My approach follows Voronkova's work by assuming *a priori* that the characteris-

[2]Hungary and Poland applied for the EU membership in 1994, followed by Slovakia in 1995 and the Czech Republic in 1996.

[3]Slovakia already adopted the Euro on January 1, 2009.

[4]The "old" EU refers to the EU-15 and comprises the following 15 countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom.

tics of the linkages are likely to change. Therefore, I pay particular attention to the stability of the detected relations. I further extend the assumption of potential changes in the model and consider varying number of existing relations. In particular, I expect emergence of new long-run linkages related to the EU accession of the Central European countries in 2004. For this purpose, I compare the period before and after the EU enlargement[5] and find first strong evidence for increased stock market integration between the Central European markets and the developed markets associated with the EU accession. Moreover, the expected major role of the "old" EU in the integration process is confirmed by the results.

More specifically, my analysis concentrates on the three largest Central European markets: the Czech, Hungarian and Polish markets.[6] The "old" EU is used as their mature counterpart. To capture other potentially influential stock market movements, the United States (US) and the Russian market are added to the analysis as well. The US market obviously represents the largest developed stock market in the world. The inclusion of the Russian market, on the contrary, characterizes the development in the largest emerging market in Europe with strong historical links to the Central European countries.

To model the long-term trends in the stock market co-movements, I use the Johansen cointegration method in its multivariate setting. Although this method enables the analysis of both the long-run and the short-run market structure, I focus on the long-run. The reasons are threefold. First, the potential long-run relations can be interpreted as equilibrium relations between asset prices and hence are a good measure of the degree of market integration. The asset prices may deviate from each other in the short run, but they will return to the equilibrium as a result of financial integration. Second, portfolios designed using only short-run correlations may not properly estimate the long-term gains. In fact, the standard risk-return analysis using the mean-variance approach ignores the long-term trends, since these are lost as the data are differenced. However, in case of tightening long-run linkages among the markets, potential benefits from international portfolio diversification can substantially decrease. Therefore, the long-run relations are of particular interest for stock market investors acting internationally. Finally, the estimates of the long-run relations within the Johansen cointegra-

[5] Similar approach was used by Jochum, Kirchgassner, and Platek (1999) andYang, Hsiao, Li, and Wang (2006) to study the effects of the Russian financial crises.

[6] The Slovakian stock market is not considered because of its minor size. For instance, its market capitalization was approximately ten times smaller than that of the Czech stock market in 2007 (Standard & Poor's, 2008).

tion framework are more reliable than the estimates of the short-run structure because the convergence to their true values is faster (Juselius, 2007, p. 230).

The proper use of the cointegration technique relies on several assumptions, such as constancy of parameters or independence of residuals. Surprisingly, the literature applying this technique to the stock markets do not typically report *any* tests of these assumptions. I attempt to overcome this crucial shortcoming. As already addressed, I check the assumption of constant parameters by several recursive tests to detect possible structural changes and to avoid the distortion of the results by assumption violation. The stability of the relations is surely also a key issue for a plausible portfolio design. Furthermore, I carefully handle the assumption of independently and normally distributed residuals and, if necessary, I model too-large residuals caused by extraordinary shocks such as the terrorist attacks in September 11, 2001 by inclusion of proper dummy variables. In addition, I explicitly address the question of which markets are significantly involved in the long-run relations, which is also a commonly neglected, though very important, issue.[7]

In this way, I provide evidence for a similar degree of cointegration among the three Central European markets in both periods, before and after the EU enlargement. Nevertheless, no long-run linkages between the Central European markets and the two developed markets or the Russian market can be detected in the period before the enlargement. On the contrary, two new relations which link the Central European markets to the other markets emerge after the EU enlargement. In particular, one of these relations is identified as a "new EU relation", linking the movements of the Central European markets to the "old" EU.

The remaining part of the chapter is organized as follows. Section 2.2 describes the developments of the three largest Central European markets. Section 2.3 introduces the data and provides basic descriptive statistics. Section 2.4 explains the methodological approach. Two models for the pre- and post-accession period are estimated and compared in Section 2.5, and Section 2.6 concludes.

[7] A detection of a cointegration relation in a multivariate setting does not necessarily mean that a long-run equilibrium relation between the Central European and other markets exists. It might be the case that the relation involves only two markets - in an extreme case the two developed markets of Western Europe and the US. Hence, the study of Syllignakis and Kouretas (2009) involving seven Central and Eastern European markets and two developed markets does not deliver a clear picture of which of these markets are inter-linked.

2.2 Development of the Central European Stock Markets

After the collapse of communist regimes, the transition process of the Central European countries was accompanied by the establishment of stock markets. The first stock exchange in the region was reopened in Hungary in July 1990. In the next two years, the stock exchanges in Poland (1991) and in the Czech Republic (1992) started to operate as well. Consequently, all three markets underwent considerable growth in their size.

Market capitalization grew relatively steadily in Hungary and Poland from around five percent of GDP in 1995 to 34 percent of GDP in Hungary and nearly 50 percent of GDP in Poland in 2007 (see Table 2.1). The EU accession in 2004 seems to have accelerated the growth of the markets since the market capitalization nearly doubled in this year in both markets. The development in the Czech market reveals a somewhat different scenario. The high rates of market capitalization and the large number of listed companies in the early stage of the transformation process reflect to a large extent the effects of a privatization program that was carried out in the first half of the 1990s (see Hanousek, Kocenda, and Svejnar, 2009). After the large waves of privatization, the size of the stock market even decreased, but it started to considerably grow again in 2001. Following the scenario of the other two markets in the region, the Czech market experienced a steep jump in size in 2004. In 2007, the market capitalization of the Prague stock exchange accounted for more than 40 percent of GDP.

Compared to the developed markets, the rates of market capitalization in percent of GDP are still rather low, but they are significantly catching up.[8] The liquidity of the Central European stock markets appears to already be quite comparable to that of the developed markets. This is reflected by relatively high turnover ratios that even exceeded 100 percent in Hungary (2007) and in the Czech Republic (2005). The lower turnover ratios in Poland are similar, for instance, to turnover ratios in Austria, which have typically stayed below 50 percent in recent years (Standard & Poor's, 2008).

But who invests in the Central European markets, the domestic or the foreign investors? Are the stock markets of the Central European countries developed enough

[8] The market capitalization in 2006 represented 57, 59, 148, and 160 percent of GDP for Germany, Austria, the US, and the United Kingdom, respectively (Standard & Poor's, 2008).

Table 2.1: Development of the Central European Stock Markets

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Prague stock exchange (Czech Republic)													
Number of listed companies	1635	1588	276	261	164	131	94	78	63	54	36	29	32
Market capitalization (billions of US $)	15.7	18.1	12.8	12.0	11.8	11.0	9.3	15.9	17.7	30.9	38.3	48.6	73.4
Market capitalization (% of GDP)	30.1	31.2	24.1	21.4	21.6	21.7	15.3	21.5	19.5	28.8	30.8	34.0	42.2
Turnover ratio	32.9	50.3	47.9	38	36.7	60.3	34.1	48.7	52.5	78.5	120.7	75.1	71.7
Foreign investment (billions of US $)	2.6	3.4	3.0	3.8	2.7	3.1	3.6	4.3	5.5	9.3	9.0	11.6	14.5
Foreign investment (in % of market cap.)	16.9	18.8	23.7	31.5	23.1	27.8	38.1	26.7	31.1	30.3	23.4	23.8	19.8
Foreign investment (in % of GDP)	5.1	5.9	5.7	6.7	5.0	6.0	5.8	5.8	6.1	8.7	7.2	8.1	8.3
Budapest stock exchange (Hungary)													
Number of listed companies	42	45	49	55	66	60	57	48	49	47	44	41	41
Market capitalization (billions of US $)	2.4	5.3	15.0	14.0	16.3	12.0	10.4	13.1	16.8	28.7	32.6	42.0	47.7
Market capitalization (% of GDP)	5.4	11.7	32.8	29.3	34.0	26.3	20.0	20.0	20.1	28.5	29.8	37.1	34.4
Turnover ratio	17.3	41.6	73.4	113.9	95.8	90.7	44.4	52.2	57.6	59.9	79.2	86.8	107
Foreign investment (billions of US $)	.	.	2.5	2.3	4.4	3.0	2.9	3.8	5.6	11.4	13.2	18.4	15.3
Foreign investment (in % of market cap.)	.	.	16.7	16.7	26.7	24.8	28.0	28.9	33.5	39.6	40.4	43.8	32.0
Foreign investment (in % of GDP)	.	.	5.5	4.9	9.1	6.5	5.6	5.8	6.7	11.3	12.0	16.3	11.0
Warsaw stock exchange (Poland)													
Number of listed companies	65	83	143	198	221	225	230	216	203	225	248	267	328
Market capitalization (billions of US $)	4.6	8.4	12.1	20.5	29.6	31.3	26.0	28.8	37.2	71.1	93.9	149.1	207.3
Market capitalization (% of GDP)	3.6	5.9	8.5	12.9	19.1	19.8	14.0	15.0	17.7	29.3	31.0	44.0	48.9
Turnover ratio	71.5	84.8	78.4	54.4	45.8	49.9	26.1	22.4	26.6	33.1	37.3	45.7	49.2
Foreign investment (billions of US $)	.	2.3	2.7	5.0	5.0	5.4	4.3	4.4	6.7	13.7	18.8	22.6	33.2
Foreign investment (in % of market cap.)	.	27.2	22.0	24.3	16.8	17.1	16.5	15.3	18.0	19.3	20.0	15.1	16.0
Foreign investment (in % of GDP)	.	1.6	1.9	3.1	3.2	3.4	2.3	2.3	3.2	5.7	6.2	6.7	7.8

Sources: Author's calculation based on the Emerging and Global Stock Market Factbooks (Standard & Poor's, 2002, 2008) and International Financial Statistics (IMF, 2008b, 2009).
Notes: Foreign investment refers to the international investment position, liabilities, and equity securities in the International Financial Statistics (IMF, 2008b, 2009, line 79 ldd).

to attract significant foreign capital?

In general, the Central European countries have been receivers of large capital inflows from developed countries. The capital flows to these countries constituted around five to six percent of their GDPs in the period between 1993–1999. The main source of foreign financing was direct investment, followed by portfolio investment (see Mora, Garibaldi, Sahay, and Zettelmeyer, 2002; Koeke and Schroeder, 2003). In 1995, for instance, Hungary attracted the largest amount of FDI per capita of any country outside the developed market economies, and as a result, the share of FDI in its GDP exceeded ten percent (Lankes and Stern, 1999). Most of the capital flows to Central Europe originated in Western European countries such as Germany or Austria (Marin, 2004). Direct investment from Germany accounted for about one third of cumulative FDI to the broader Eastern European region by 1996, and its majority indeed flew to Central Europe.

Nevertheless, foreign investment figures in Table 2.1 indicate that foreigners indeed also held significant amounts of stock market assets (other than FDI-related holdings).[9] In 2007, the value of foreign investment in stock market assets represented around eight percent of GDP in the Czech Republic and Poland and even eleven percent of GDP in Hungary. Especially in Hungary, foreign investment has constituted around 40 percent of market capitalization in recent years, which even exceeds foreign ownership holdings in some of the developed markets.[10]

Foreign investment followed the scenario of market capitalization and experienced a sharp one-time increase in 2004. This is very likely a result of increased confidence and willingness of foreign investors to participate in the Central European markets associated with the accession of the countries to the EU in 2004. From a legal point of view, the stock markets had already been open to foreign investors prior to the EU accession. The restrictions on foreign investment were gradually lifted between 1994 to 1999 (see Dvorak and Podpiera, 2006; Syllignakis and Kouretas, 2009). However, the increased interest of foreigners after the EU accession indicates that some foreign investors may have refrained from the markets before the EU enlargement in particular because of institutional or political risk.

[9] I follow the work of Koeke and Schroeder (2003) and use the international investment position in equity securities from the International Financial Statistics (IMF, 2008b, 2009, line 79 ldd) for measuring foreign investment in the stock markets. This approach might underestimate the true holdings by foreigners, as some equity holdings are part of FDI.

[10] The corresponding figures for Austria, Germany, and the US in 2006 were 45, 37, and 14 percent, respectively.

The developments of the Central European markets appear to be significantly influenced by their accession to the EU in May 2004. Around this date, a sharp increase in the size as well as in the attractiveness of the markets to foreign investors can be observed. I turn to investigate in the following whether this date also meant stronger integration of the markets into the global economy.

2.3 Data

For capturing the stock market movements, I collected data of weekly closing price indices for the three Central European markets, the Western European market, and the US and Russian markets. All the data have been obtained from the Thompson Financial Datastream database. To avoid the distorting effects of using different types of local stock market indices for the emerging markets, the standardized IFC Investable (IFCI) indices are used for representing the Czech, Hungarian, Polish and Russian markets. Moreover, these indices are designed to feature the type of assets that are legally and practically available to a foreign portfolio investor. Since stronger linkages between the recent and the "old" EU members are expected, the Western European countries are of particular interest for analysis. The limitations regarding a reasonable number of markets in the cointegrated VAR model suggest including only a single representative of the Western European market; thus, the DJ Stoxx 600 is used. The S&P 500 is chosen to represent the US market.

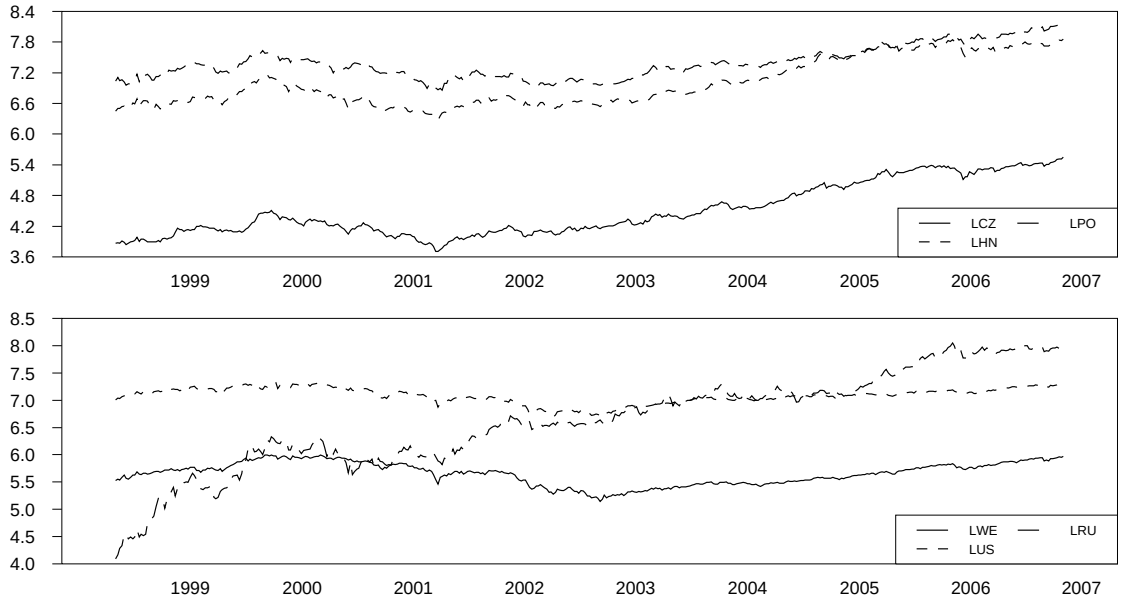
Following Jochum, Kirchgassner, and Platek (1999) and Voronkova (2004), all indices are measured in local currency.[11] The data are converted to the natural logarithms and denoted by LCZ, LHN, LPO, LWE, LUS, and LRU for the Czech, Hungarian, Polish, Western European, US, and Russian markets, respectively.

The data were collected for the time period between October 30, 1998, and May 4, 2007. The end of the period is limited by the data availability when starting the analysis, but the sample period still covers three years after the EU enlargement on May 1, 2004. The choice of the start of the period is motivated first by the attempt to avoid the distorting impacts of the emerging market crises in 1997/1998 and the Russian financial crises in August/September 1998 and second by the intention to obtain a period of three years before the EU enlargement when the accession date was still unclear.

[11] In case of the DJ Stoxx 600, the currency used is Euro.

Although the accession negotiation for all of the three investigated Central European countries had already been opened, on March 31, 1998, a significant turning point in the negotiations appeared to be November 2001. In this month, the European Commission announced the EU enlargement in its Annual Progress Reports on Enlargement and provided a timetable for the enlargement (see Dvorak and Podpiera, 2006). Since then, foreign investors anticipated that the three Central European countries would enter the EU in 2004. Figure 2.1 shows that a significant rise in the Central European market prices can be observed after this date, whereas the developed markets did not follow this pattern.

Figure 2.1: Logarithms of the Stock Market Indices



Notes: LCZ, LHN, LPO, LWE, LUS, and LRU stand for the logarithms of the Czech, Hungarian, Polish, Western European, US, and Russian indices, respectively.

The timing of the two influential events – the announcement of the EU enlargement and the EU enlargement *per se* – led me to the decision to split the data into three periods:

- the pre-accession period, from October 30, 1998, to November 2, 2001 (three years),
- the accession period, from November 3, 2001, to April 30, 2004 (two and a half years),
- the post-accession period, from May 1, 2004, to May 4, 2007 (three years).

Since the accession to the EU is to a large extent a gradual process, the accession period is viewed as a transition period, in which the long-run equilibrium relations are likely to be unstable, modified or changed. Therefore, I investigate this period only marginally and focus rather on the comparison of the pre- and post-accession periods. Using weekly data, both the pre- and the post accession periods cover exactly 158 observations and thus are well comparable.[12]

The logarithmic transformation enables the interpretation of the first differences as continuous stock market returns. Table 2.2 provides means and standard deviations of the return series in the pre- and post- accession periods. Except for Russia, all means are higher in the post-accession period, though the increase is never found to be statistically significant. Regarding the standard deviations, the volatility of all the markets in the post-accession period is significantly lower and indicates a more stable situation in all the markets.

Table 2.2: Descriptive Statistics of the Stock Market Returns

	Pre-accession period		Post-accession period		T-test for difference	
	mean	S.D.	mean	S.D.	mean	S.D.
Czech Republic	0.00074	0.034	0.0057	0.031	0.18	0.09
Hungary	0.00094	0.046	0.0051	0.035	0.37	0.00
Poland	0.00045	0.042	0.0048	0.029	0.30	0.00
Russia	0.01139	0.082	0.0048	0.040	0.37	0.00
West Europe	0.00092	0.028	0.0030	0.015	0.43	0.00
US	0.00010	0.030	0.0018	0.014	0.53	0.00

Notes: The table presents means and standard deviations (S.D.) of the continuous (log) return series in the pre- and post- accession periods. In the last two columns, p-values of the t-test for difference in means and standard deviations of the two periods are reported.

The post-accession period is also characterized by higher correlations among the return series, as evidenced in Table 2.3. This suggests that the short-run linkages among the markets are stronger after the EU enlargement as the markets became more synchronized. Surprisingly, a significant increase occurred, especially in the correlations between the Central European markets and the Russian market, but not between the Central and Western European markets. However, the correlations with the Russian market started at very low levels in the pre-accession period, which might still reflect a rather non-standard behavior of the Russian market after the financial crises in 1998.

[12]The time span of three years is similar to the lengths of periods used in other studies (e.g., Jochum, Kirchgassner, and Platek, 1999; Yang, Hsiao, Li, and Wang, 2006) that also analyze long-run stock market equilibrium relations.

Table 2.3: Correlations of the Stock Market Returns

	Pre-accession period						Post-accession period					
	CZE	HUN	POL	RUS	WE	US	CZE	HUN	POL	RUS	WE	US
CZE	1						1					
HUN	0.54	1					0.59	1				
POL	0.49	**0.52**	1				0.58	**0.72**	1			
RUS	**0.23**	**0.31**	**0.27**	1			**0.52**	**0.55**	**0.48**	1		
WE	0.40	0.54	0.47	0.34	1		0.50	0.51	0.57	0.44	1	
US	**0.23**	0.39	0.38	0.31	0.74	1	**0.43**	0.49	0.49	0.36	0.76	1

Notes: The table shows correlations of the continuous (log) return series in the pre- and post- accession periods. CZE, HUN, POL, RUS, WE, and US stand for Czech, Hungarian, Polish, Russian, Western European, and US markets, respectively. Significantly different correlations (at a 10 percent level) between the two periods are indicated by boldface.

2.4 Methodology

For modeling the long-run relationships among the stock markets, I apply the cointegrated VAR model introduced by Johansen (1991). This method is very applicable for my type of data because it is specifically designed for non-stationary stochastic processes, and stock market prices are indeed usually integrated of order one (I(1) hereafter). The stock market indices chosen follow this pattern, as indicated by Figure 2.1 and by the results of the augmented Dickey Fuller tests.[13]

The cointegration method assumes that the time series can be modeled by a VAR(k) model. Denoting the vector of the six stock market indices in logarithms in period t by $\boldsymbol{X}_t$, this means that

$$\boldsymbol{X}_t = \boldsymbol{\Pi}_1 \boldsymbol{X}_{t-1} + \cdots + \boldsymbol{\Pi}_k \boldsymbol{X}_{t-k} + \boldsymbol{\varepsilon}_t, \quad \text{where} \quad \boldsymbol{\varepsilon}_t \sim \boldsymbol{IN}_6(0, \boldsymbol{\Omega}) \quad \text{and} \quad t = 1, \ldots, T. \tag{2.1}$$

Hence, the error terms $\boldsymbol{\varepsilon}_t$ are assumed to be independently normally distributed with a constant variance-covariance matrix. To meet these assumptions, I use weekly frequency data rather than daily data. The reason is that the lower-frequency data suffer less from the "stylized facts" of the financial time series such as heavy-tailed distributions or ARCH effects. Moreover, the information loss due to the lower frequency is not very important in the cointegration framework, since the length of the period, and not

[13] I conducted the univariate augmented Dickey Fuller tests with a constant and with a constant and a time trend, both for lag 1 to 3. In particular, the tests applied on the return series revealed that the data in levels are at most I(1) and thus suitable for cointegration analysis in the I(1) framework. This pattern was later confirmed when analyzing the multivariate models.

the frequency, is important for the detection of the long-run relations. Furthermore, the disturbing effects of different market closing times (European vs. Russian vs. US market) are eliminated.

A more convenient way of working with the VAR(k) model in the cointegration framework is to rewrite the model in the vector equilibrium correction model (VECM) form:

$$\Delta \boldsymbol{X}_t = \boldsymbol{\Pi} \boldsymbol{X}_{t-1} + \boldsymbol{\Gamma}_1 \Delta \boldsymbol{X}_{t-1} + \cdots + \boldsymbol{\Gamma}_{k-1} \Delta \boldsymbol{X}_{t-k+1} + \boldsymbol{\varepsilon}_t, \tag{2.2}$$

$$\text{where} \quad \Delta \boldsymbol{X}_t = \boldsymbol{X}_t - \boldsymbol{X}_{t-1}, \quad \boldsymbol{\Pi} = -(\boldsymbol{I} - \sum_{j=1}^{k} \boldsymbol{\Pi}_j), \quad \boldsymbol{\Gamma}_i = -\sum_{j=i+1}^{k} \boldsymbol{\Pi}_j,$$

and $\boldsymbol{I}$ denotes the identity matrix. This representation allows one to directly deal with the non-stationary pattern in the data that is now concentrated exclusively in $\boldsymbol{\Pi} \boldsymbol{X}_{t-1}$, as it is the only term in levels in Equation (2.2). So the $\boldsymbol{\Pi}$ matrix captures all information about the long-run effects, and its rank r cannot be full. Supposing that the rank were full, a *stationary* process $\Delta \boldsymbol{X}_t$ would be equal to a *non-stationary* term $\boldsymbol{\Pi} \boldsymbol{X}_{t-1}$ (plus several stationary terms), which leads to a contradiction. Hence, $\boldsymbol{\Pi}$ can be partitioned as

$$\boldsymbol{\Pi} = \boldsymbol{\alpha} \boldsymbol{\beta}',$$

where $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$ are $6 \times r$ matrices and $r < 6$. The rank r (or the cointegration rank) can be determined using the trace test, also called the Johansen test. This procedure discriminates between (r) significant and $(6 - r)$ insignificant eigenvalues λ_i, $i = 1, \ldots, 6$, on which the maximum likelihood estimation of the model is based (see Johansen, 1996, Chapter 6). Consequently, each significant eigenvalue is related to one stationary cointegration relation, which can be viewed as a long-run equilibrium relation among the markets. The r stationary relations are represented by $\boldsymbol{\beta}' \boldsymbol{X}_{t-1}$. The coefficients of $\boldsymbol{\alpha}$ capture the adjustment of markets to the cointegration relations and are called loadings. The $\boldsymbol{\Gamma}_i$ matrices contain information about the short-run linkages.

The model can be extended by the inclusion of deterministic components (a constant, a deterministic trend or different dummy variables) that are partitioned into those restricted to enter only the cointegration relations and the unrestricted ones (see Juselius, 2007, Chapter 6). My modeling strategy is to allow for a relatively rich structure at the beginning of the analysis. Hence, I include an unrestricted constant and, eventually, unrestricted dummy variables. The time trend is restricted to enter only

the cointegration relations to avoid a quadratic trend in the level data.[14] Later on, I try to reduce the rich model into a more parsimonious one by examining the significance of the corresponding coefficients.

In general, the stability of the model can be investigated by several recursive tests. The idea is to choose a baseline period (e.g., the first year), on which the first model is estimated, and then recursively test whether additional observations follow the same model. In this way, I study the constancy of $\boldsymbol{\beta}$ and significant λ_i estimates as well as the stability of the full model using the log-likelihood function. In addition, I check the validity of imposed restrictions throughout the different time periods.

A useful tool for the recursive tests of constancy is to distinguish between two types of $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$ estimates, the first based on the VECM ("X-form") and the others based on the concentrated model ("R-form"). The latter model is motivated by the idea of the Frisch-Waugh Theorem (Frisch and Waugh, 1933) and enables the obtaining of "cleaner" estimates of the long-run structure after the short-run dynamics and the deterministic components have been concentrated out (see Juselius, 2007, Chapter 7). In particular, if the constancy of the "X-form" coefficients is rejected as opposed to the "R-form" coefficients, the non-stability is likely to come from the short-run structure.

2.5 Results

2.5.1 Pre-accession Period

I start with the estimation of the VAR(k) model using data for the pre-accession period. The basic model includes an unrestricted constant, a restricted trend, but no dummy variable. As a starting point, I use a lag length of 3. The theoretical specification in Equation (2.1) requests two residual assumptions, namely normality and independence. The results of misspecification tests indicate that both assumptions are clearly violated for this basic model. To improve the model specification, I include several dummy variables, which turned out to be economically relevant as well as statistically significant.

[14] Although a quadratic trend could improve the fit within the sample, it would lead to the implausible economic result that the stock markets follow quadratic trends.

- An unrestricted transitory shock dummy for the first two weeks in January 1999 (January 8 and 15)[15] is related to a stock market over-reaction after the introduction of the Economic and Monetary Union (EMU) on January 1, 1999 in most of the "old" EU countries. It corrects particularly for the volatile behavior of the Western European markets in the first two weeks in January.

- An unrestricted blip (impulse) dummy on April 14, 2000[16] captures a temporal drop of the US market following the burst of the dot-com bubble. Therefore, the corresponding coefficient is highly negatively significant especially for the US market.

- Three unrestricted blip dummy variables for three weeks after the September 11 terrorist attacks (September 14, 21, and 28, 2001) account for the substantial market instability, mainly in the US market, followed by the Western European markets.

Furthermore, I exclude insignificant short-run coefficients and thus adjust the lag length of the model. The resulting model meets the required assumptions and is used in the following (see Appendix 2.A.1 for a more detailed discussion on the specification of the model).

As an indicator for the number of cointegration relations, I use the trace test (Table 2.4). Since the model contains a trend in the cointegration relation and several dummy variables, I do not report the results of the standard test; instead, I simulate an asymptotic trace test distribution by the program developed in Nielsen (2004). The results suggest rank 1, because $H_0 : r = 0$ is rejected, but $H_0 : r = 1$ cannot be rejected. In addition, the graphical analysis of the first cointegration relation in Figure 2.3 in Appendix 2.A.2 proposes stationarity. Hence, the evidence suggests the existence of one long-run equilibrium relation among the indices in the pre-accession period.

After the rank determination, I examine the stability of the model. All tests of constancy in Figures 2.5, 2.6, and 2.7 shown in Appendix 2.A.3 suggest a good stability of the model. In particular, Figure 2.7 confirms constancy of the long-run equilibrium relation. Due to the satisfactory results of these tests, further adjustment of the model such as inclusion of structural breaks does not seem to be necessary.

[15] A transitory dummy is modeled by the inclusion of $\boldsymbol{d}_{tr} = (\ldots, 0, 1, -1, 0, \ldots)$ to the explanatory variables in the VECM form. 1 and -1 correspond to January 8 and 15, respectively. For more details on the dummy variables, see Juselius (2007, Chapter 6).

[16] An impulse dummy is modeled by the inclusion of $\boldsymbol{d}_p = (\ldots, 0, 1, 0, \ldots)$, where 1 corresponds to April 14.

Table 2.4: Trace Test for the Pre-accession Period

H_0 :	Eigenvalue	Trace	Trace*	Frac95	P-Value	P-Value*
r=0	0.27	121.7	111.2	108.7	0.01	0.03
r=1	0.15	72.2	65.4	82.3	0.23	0.47
r=2	0.12	46.5	38.7	59.5	0.40	0.76

Notes: The results of the asymptotic trace test and corresponding eigenvalues are reported. A length of 158 random walks (the same as the length of the sample) and 5000 replications were used for the simulation. Frac95 denotes the 95% quantile from the simulated trace test distribution. Trace* and P-Value* refer to the results of a small sample Bartlett correction introduced in Johansen (2002).

I turn now to the question of whether the cointegration relation involves all the markets simultaneously or only some of them. In particular, I am interested whether the cointegration relation links the Central European markets to the other markets such as the Western European market, thereby suggesting the integration of these markets. A test of exclusion clearly indicates that this is not the case, since the Western European, US, and Russian markets can be individually (Table 2.5) as well as jointly ($\mathcal{H}_1$ in Table 2.6)[17] excluded from the cointegration relation, contrary to the Central European markets. This means that the cointegration relation detected involves only the three Central European markets and that there are no long-run linkages to their mature counterparts or the Russian market in the pre-accession period.

Table 2.5: Tests of Restrictions on β and α in the Pre-accession Period

Test	DF	CV	LCZ	LHN	LPO	LRU	LWE	LUS
Exclusion	1	3.84	23.13	4.86	19.67	0.28	0.08	0.02
			(0.00)	(0.03)	(0.00)	(0.60)	(0.78)	(0.89)
Unit vector	5	11.07	7.82	42.18	27.46	34.41	35.37	35.65
in α			(0.17)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

The table reports likelihood ratio test statistics of exclusion restrictions on $\boldsymbol{\beta}$ ($H_0 : \beta_{1,i} = 0$ for a particular market i) and of unit vector in $\boldsymbol{\alpha}$ ($H_0 : \alpha_{i,1} = 0$ for all i except one) under the rank 1 assumption. LCZ, LHN, LPO, LWE, LUS, and LRU stand for the logarithms of the Czech, Hungarian, Polish, Western European, US, and Russian indices, respectively. All the test statistics are χ^2 distributed, DF denotes the degree of freedoms and CV the corresponding 5% critical value. P-values are reported in the parentheses.

The magnitude of the coefficients under $\mathcal{H}_1$ in Table 2.6 lead me to further test for the price homogeneity of the Czech, Polish and Hungarian markets, denoted by $\mathcal{H}_2$.[18] The accepted homogeneity means that a common stochastic trend exists that drives the markets to move in the same direction by a similar amount.[19] This is particularly inconvenient for the stock market investors, as the portfolio diversification among the

[17] $\mathcal{H}_1 : \beta_{1,LRU} = \beta_{1,LWE} = \beta_{1,LUS} = 0$

[18] $\mathcal{H}_2 : \beta_{1,LCZ} + \beta_{1,LHN} + \beta_{1,LPO} = 0$ & $\beta_{1,LRU} = \beta_{1,LWE} = \beta_{1,LUS} = 0$. The time trend, though very small in magnitude, is significant, and its exclusion is rejected.

[19] This interpretation can be derived from the MA representation of the model (see also Juselius, 2007, Chapter 14).

three Central European markets is strongly limited. I also examine the stationarity of the spread between the Czech and Polish market ($\mathcal{H}_3$).[20] The result suggests that $(LCZ - LPO)$ can be regarded as stationary, which implies a strong integration of the two markets and even no benefits of portfolio diversification between them in the long run.[21] The reason is that under this scenario, the two markets are driven by exactly one common stochastic trend, which pushes them to move in the same direction and by the same amount, meaning that they follow on average the same random walk. Nevertheless, $\mathcal{H}_3$ implies the exclusion of the Hungarian market, which is in conflict with the test for individual exclusion of the Hungarian market. Moreover, the p-value of the test for $\mathcal{H}_3$ is quite low compared to the test for $\mathcal{H}_2$. Therefore, I consider the homogeneity restrictions in $\mathcal{H}_2$ to be more plausible than the spread restrictions, and I use them in the following.

Table 2.6: Estimates of β under Different Restrictions in the Pre-accession Period

Test	LCZ	LHN	LPO	LRU	LWE	LUS	trend	DF	χ^2	p-value
$\mathcal{H}_1$	1	-0.23	-0.74	0	0	0	-0.00	3	0.95	0.81
$\mathcal{H}_2$	1	-0.22	-0.78	0	0	0	-0.00	4	0.88	0.93
$\mathcal{H}_3$	1	0	-1	0	0	0	0	6	7.20	0.30

Notes: The table presents the estimated coefficients under different restrictions on $\boldsymbol{\beta}$ and the results of likelihood ratio test statistics of these restrictions. LCZ, LHN, LPO, LWE, LUS, and LRU stand for the logarithms of the Czech, Hungarian, Polish, Western European, US, and Russian indices, respectively. All the test statistics are χ^2 distributed. DF denotes the degree of freedoms.

The analysis of the long-run relation captured by $\boldsymbol{\beta}$ does not indicate which of the markets are adjusting to the cointegration relation and which are following only their own stochastic trends. For this, the $\boldsymbol{\alpha}$ coefficients are investigated. The tests for a unit vector in $\boldsymbol{\alpha}$ reported in Table 2.5 suggest that the Czech market can be considered the only adjusting one. This means that shocks to the Czech market have no permanent effect on any market in the system, not even on itself, and that the "random walk" movements of the Czech market are driven by permanent shocks to the other two markets involved in the equilibrium relation.

This finding is not surprising, when considering that the Czech market in the pre-accession period is the smallest of the three Central European markets and also the most open to foreign capital (see Table 2.1). The differences are especially pronounced when comparing the Czech and the Polish markets. In 2000, the capitalization of the Polish stock market exceeded nearly three times the Czech market capitalization,

[20] $\mathcal{H}_3 : \beta_{1,LCZ} - \beta_{1,LPO} = 0$ & $\beta_{1,LHN} = \beta_{1,LRU} = \beta_{1,LWE} = \beta_{1,LUS} = \beta_{1,trend} = 0$

[21] I also tested the stationarity of other market spreads, but none of them was found to be stationary.

but only 17 percent of investment going to the Polish market originated abroad, in contrast to 28 percent of foreign investment going to the Czech market. Hence, the Polish market is much more likely to reflect only the local developments, and the Czech market is adjusting accordingly. The importance of the Polish market to the Czech market adjustment is also manifested by the large coefficient of $\beta_{1,LPO}$ as compared to $\beta_{1,LHN}$ and the borderline stationarity of the Czech-Polish spread.

The joint restrictions on $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$ coefficients (i.e., the unit vector in $\boldsymbol{\alpha}$ for the Czech market and the homogeneity restrictions $\mathcal{H}_2$ on $\boldsymbol{\beta}$) are also not rejected, and the recursive likelihood ratio test based on the "R-form" estimates indeed suggests a validity of the imposed restrictions throughout the sample (see Figure 2.8 in Appendix 2.A.3).[22] The final estimates are summarized in Table 2.7.

Table 2.7: Final Model in the Pre-accession Period

Likelihood ratio test of the restricted model:					$\chi^2(9) = 8.14$, p-value = 0.52		
	LCZ	LHN	LPO	LRU	LWE	LUS	trend
β_1'	1	-0.27	-0.73	0	0	0	-0.00
	(.)	(-2.98)	(-8.16)	(.)	(.)	(.)	(-2.57)
	Δ LCZ	Δ LHN	Δ LPO	Δ LRU	Δ LWE	Δ LUS	
α_1'	-0.28	0	0	0	0	0	
	(-5.75)	(.)	(.)	(.)	(.)	(.)	

Notes: The table reports the likelihood ratio test for the joint restrictions on $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$ and the resulting coefficients. The corresponding t-statistics are shown in parentheses, and some of them are missing due to the imposed restrictions. *LCZ*, *LHN*, *LPO*, *LWE*, *LUS* and *LRU* stand for the logarithms of the Czech, Hungarian, Polish, Western European, US, and Russian indices, respectively.

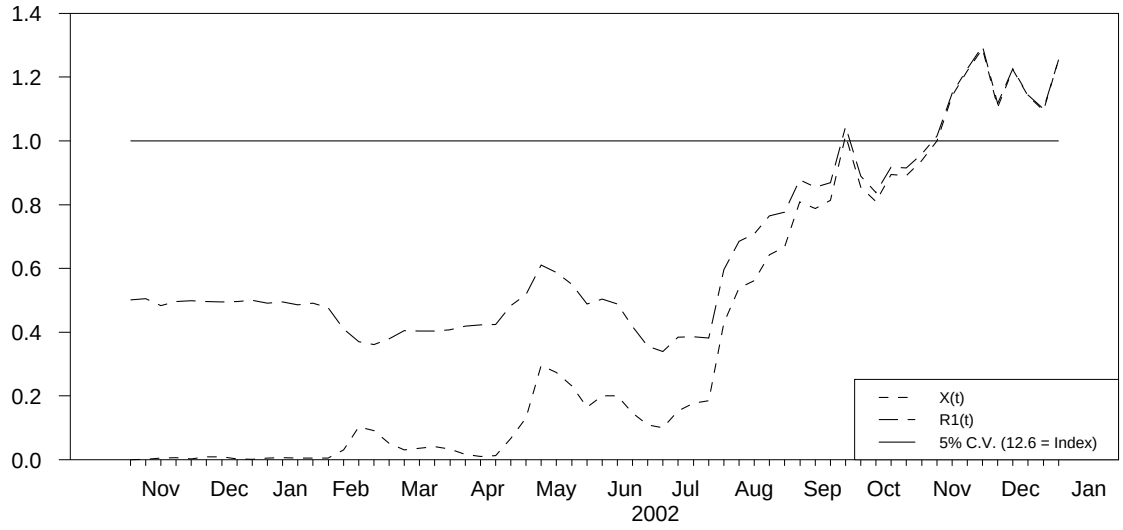
2.5.2 Accession Period

Having a reasonable model with one cointegration relation for the pre-accession period, the applicability of the model can be tested also for the following period, the accession period. For this, I conduct a recursive test of $H_0 : \boldsymbol{\beta} =$ "known $\boldsymbol{\beta}$". This test provides evidence for whether the cointegration relation found in the pre-accession period remains similar in the accession period as well. Therefore, the "known $\boldsymbol{\beta}$" refers to the estimated $\boldsymbol{\beta}$ based on the pre-accession period and, consequently, its similarity to $\boldsymbol{\beta}$ coefficients estimated for longer periods is tested. Figure 2.2 shows that the cointegration relation from the pre-accession period persisted for approximately one year in

[22] The rejection of the restrictions for the shortest subsamples using the "X-form" appears to be caused by the instability of the short-run coefficients (e.g., Γ_1 and Γ_2) and thus does not indicate a serious distortion of the results for the long run.

the accession period and that later on, around November 2002, the relation changed permanently. Hence, no clear support for a dramatic change in the cointegration relation due to the EU enlargement announcement in November 2001 is delivered by this test. Nevertheless, a permanent change occurred later in the accession period, and the timing of the change corresponds roughly to the end of the admission negotiations on December 13, 2002.

Figure 2.2: Test of β = "known β" in the Accession Period



Notes: The "known β" estimates are based on the pre-accession period. The scaling of the test is consistent, with 1 being the 5 % rejection line.

2.5.3 Post-accession Period

Similarly to the pre-accession period, the residuals of the basic VAR(3) model for the post-accession period do not meet all the required assumptions. The difficulties can be solved by the inclusion of the following unrestricted blip dummy variables, which account for the largest residuals in the model.

- Blip dummies for three weeks (March 18, October 14, November 11) in 2005 correct for the temporal instability in the Czech and Hungarian market.
- Four blip dummies (May 19, June 9, 16, 30) in 2006 account for the high volatility in the emerging markets. The volatility appears to be a result of a sharp correction in the price of riskier assets after almost three years of significant gains.

- One blip dummy in March 2, 2007 captures a global downturn of all the markets following a sharp fall of China's domestic stock markets.

Having included these dummies, the lag length 1 in the VAR model turns out to be sufficient for modeling the short-run dynamics and the resulting model appears to be reasonably specified (for more details see Appendix 2.A.1).

The simulated values for the trace test in Table 2.8 indicate cointegration rank 2 at a 5 percent confidence level and rank 3 at a 10 percent confidence level. Moreover, considering a very small difference in magnitude between the second (0.17) and third eigenvalue roots (0.16), it seems reasonable to prefer rank 3 to rank 2. Furthermore, Figure 2.4 in Appendix 2.A.2 suggests stationarity of the third long-run equilibrium relation and, therefore, cointegration rank 3 is chosen.

Table 2.8: Trace Test for the Post-accession Period

H_0 :	Eigenvalue	Trace	Trace*	Frac95	P-Value	P-Value*
r=0	0.22	125.9	123.5	108.1	0.00	0.00
r=1	0.17	87.7	86.3	81.4	0.02	0.02
r=2	0.16	58.4	57.8	59.6	0.06	0.07
r=3	0.10	31.7	31.5	40.5	0.27	0.29

Notes: The results of the asymptotic trace test and the corresponding eigenvalues are reported. The simulation framework is the same as for the pre-accession period, i.e., a length of 158 random walks (the same as the length of the sample) and 5000 replications were used. Frac95 denotes the 95% quantile from the simulated trace test distribution. Trace* and P-Value* refer to the results of a small sample Bartlett correction introduced in Johansen (2002).

Several recursive tests are again conducted to check the assumption of constant parameters. The tests for constancy of the log-likelihood function and of the $\boldsymbol{\beta}$ parameters (see Figures 2.9 and 2.11 in Appendix 2.A.3) do not indicate a violation of the constancy assumption. However, the development of eigenvalues in Figure 2.10 in Appendix 2.A.3 clearly detects non-constancy, particularly in the two largest eigenvalues corresponding to the first two stationary relations. This in turn indicates non-constant $\boldsymbol{\alpha}$ parameters.[23] Therefore, I cannot consider the estimates of $\boldsymbol{\alpha}$ to be reliable and concentrate only on the examination of the $\boldsymbol{\beta}$ coefficients.

Compared to the pre-accession period, the higher number of stationary relations suggests stronger integration among the six markets in general. However, it is not clear whether new relations between the Central European and the Western European markets emerged or whether the linkages among the Central European markets

[23] Since the eigenvalues are linear functions of the corresponding $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$ parameters and the constancy of $\boldsymbol{\beta}$ parameters is not violated, the rejection occurs due to the non-constant $\boldsymbol{\alpha}$ parameters.

strengthened, and it is not clear which role is played by the other markets, the US and the Russian markets. To learn more about this, the long-run structure needs to be identified.

As a starting point, the tests of exclusion in Table 2.9 show that no market can be excluded from all three cointegration relations simultaneously, meaning that each market is involved in at least one cointegration relation.

Table 2.9: Tests of Exclusion Restrictions on $\boldsymbol{\beta}$ in the Post-accession Period

Test	DF	CV	LCZ	LHN	LPO	LRU	LWE	LUS
exclusion	3	7.81	10.81	9.33	17.19	14.44	14.93	16.68
			(0.01)	(0.03)	(0.00)	(0.00)	(0.00)	(0.00)

Notes: The table reports likelihood ratio test statistics of exclusion restrictions on $\boldsymbol{\beta}$ under the rank 3 assumption. The null hypothesis is $\beta_{1,i} = \beta_{2,i} = \beta_{3,i} = 0$ for a particular market i. LCZ, LHN, LPO, LWE, LUS, and LRU stand for the logarithms of the Czech, Hungarian, Polish, Western European, US, and Russian indices, respectively. The test statistics are χ^2 distributed, DF denotes the degree of freedoms and CV the corresponding 5% critical value. P-values are reported in the parentheses.

An interesting question arises in relation to the pre-accession period, namely, whether the same or a similar cointegration relation can be found among the Central European markets in the post-accession period as well. Therefore, I test for joint exclusion of all the non-Central European markets from a single relation, and it is not rejected, as shown in Table 2.10 under $\mathcal{H}_1$. The homogeneity of the Central European markets under $\mathcal{H}_2$ is also not rejected, thought the estimated coefficients are very different from those in the pre-accession period. The change in $\boldsymbol{\beta}$ coefficients is in line with the finding for the accession period that the estimated $\boldsymbol{\beta}$ from the pre-accession period do not remain constant. In particular, the importance of the Hungarian market has increased at the expense of the Polish market, and there is even some evidence for spread stationarity between the Czech and Hungarian markets ($\mathcal{H}_3$), provided that the time trend is included. This indicates, on the one side, a very strong link between the Czech and Hungarian markets that significantly limits the diversification benefits in the post-accession period, as the two markets share one common driving trend. On the other side, the diversification possibilities between the Czech and Polish market have increased compared to the pre-accession period, as their spread is not found to be stationary anymore, and the markets follow different paths.[24]

I prefer the initial cointegration relation under $\mathcal{H}_1$ to the restricted homogeneity ($\mathcal{H}_2$) and spread ($\mathcal{H}_3$) relations due to the highest p-value. I regard this relation as

[24]Regarding other markets, stationarity of their spreads is always rejected, meaning that no other markets are so strongly linked as the Czech and Hungarian market in the post-accession period.

the first identified cointegration relation in the model for the post-accession period and label it the "Central European relation". This relation is irreducible in the sense that it is not a linear combination of two "smaller" separate stationary relations. As a result, both of the two remaining cointegration relations has to involve the non-Central European markets. In fact, the rejection of joint exclusion of the three Central European markets under $\mathcal{H}_4$ indicates that the two remaining cointegration relations bridge the two groups of markets, the non-Central European and the Central European markets, which is a new pattern arising in the post-accession period.

Table 2.10: Estimates of β under Different Restrictions in the Post-accession Period

Test	LCZ	LHN	LPO	LRU	LWE	LUS	trend	DF	χ^2	p-value
$\mathcal{H}_1$	1	-0.78	-0.57	0	0	0	0.00	1	0.59	0.44
$\mathcal{H}_2$	1	-0.81	-0.19	0	0	0	-0.00	2	2.25	0.32
$\mathcal{H}_3$	1	-1	0	0	0	0	-0.00	3	5.02	0.17
$\mathcal{H}_4$	0	0	0	-0.08	1	-0.82	-0.00	1	5.01	0.03
$\mathcal{H}_5$	-1.05	0.87	0	0	1	0	-0.00	1	0.01	0.92
$\mathcal{H}_6$	-1	0.82	0	0	1	0	-0.00	2	0.01	0.99

Notes: The table presents the estimated coefficients under different restrictions on $\boldsymbol{\beta}$ and the results of likelihood ratio test statistics of these restrictions. *LCZ*, *LHN*, *LPO*, *LWE*, *LUS*, and *LRU* stand for the logarithms of the Czech, Hungarian, Polish, Western European, US, and Russian indices, respectively. All the test statistics are χ^2 distributed. DF denotes the degree of freedoms.

Since I expect that the Central European markets are particularly linked to the Western European markets after the EU accession, I look for a stationary relation involving some of these markets. One convenient candidate for such a relation consists of that between the Czech, Hungarian and Western European markets ($\mathcal{H}_5$) because of its high p-value.[25] The p-value even increases by the additional restriction $\beta_{2,LCZ} = -\beta_{2,LWE}$ under $\mathcal{H}_6$. Since the joint hypothesis for $\mathcal{H}_6$ and the "Central European relation" in $\mathcal{H}_1$ is also not rejected ($\chi^2(3) = 2.26$ with a p-value of 0.52), the relation under $\mathcal{H}_6$ is included in the cointegration space and labeled as the "new EU relation". It clearly captures a new linkage between the Central European and the Western European markets that emerged in the post-accession period and could not be detected in the pre-accession period. The fact that the relation includes the Czech and Hungarian markets but not the Polish one can be explained by the two smaller countries' higher openness towards foreign capital and stronger trade integration with the EU. For instance, Czech and Hungarian exports to the EU in the post-accession

[25] Note that the exclusion of *LRU* and *LUS* from a single relation is trivial and leads to a just-identified relation in the model achieved by rotation of the cointegration space, but not by testable over-identifying restrictions.

period account for more than 50 and 40 percent of their GDPs, respectively, compared to less than 25 percent reported for Poland (IMF, 2008a).

As there is no economic prior for the third relation, it is just-identified by the exclusion of the Czech and the Hungarian market and links the Polish market to the non-Central European markets.[26] The resulting estimate of the whole $\boldsymbol{\beta}$ matrix is reported in Table 2.11. Although the third cointegration relation also contains the Russian market, and although the market cannot be excluded according to the t-test, the estimated coefficient of $\beta_{3,LRU}$ is relatively small.[27] This suggests a rather minor importance of the Russian market in the long-run structure. Even in the case that the Russian market represented an important driving force in the model, the deviations from the long-run equilibrium relations due to the Russian market movements would not be very large.

Table 2.11: Final Model in the Post-accession Period

Likelihood ratio test of the restricted model:					$\chi^2(3) = 2.27$, p-value = 0.52		
	LCZ	LHN	LPO	LRU	LWE	LUS	trend
β_1'	1	-0.77	-0.63	0	0	0	0.00
	(.)	(-13.50)	(-7.90)	(.)	(.)	(.)	(2.00)
β_2'	-1	0.82	0	0	1	0	-0.00
	(.)	(13.94)	(.)	(.)	(.)	(.)	(-4.03)
β_3'	0	0	-0.36	-0.05	1	-0.35	-0.00
	(.)	(.)	(-5.61)	(-5.12)	(.)	(-7.90)	(-1.54)

Notes: The table reports the likelihood ratio test for the over-identifying restrictions on $\boldsymbol{\beta}$, the resulting coefficients as well as their t-statistics in the parentheses. Some t-statistics are missing due to the imposed restrictions. LCZ, LHN, LPO, LWE, LUS, and LRU stand for the logarithms of the Czech, Hungarian, Polish, Western European, US, and Russian indices, respectively.

To check the stability of the imposed over-identifying restrictions, I again conduct a recursive likelihood ratio test. The joint restrictions in Table 2.11 seem to be plausible for most of the subsamples, as can be seen in Figure 2.12 in Appendix 2.A.3. The only problematic period appears in August 2005, when the restrictions are rejected. But as this is only borderline and temporary, the detected instability is not serious.

[26] Note that just-identification of the third cointegration relation can generally be achieved by the exclusion of any market pair from the group of the Czech, Hungarian, Polish and the Western European market. Hence, the relation represents a linkage among all the markets.

[27] The relatively small size of $\beta_{3,LRU}$ is also found under the other identification schemes.

2.5.4 Robustness Checks

To see if important information is lost by using weekly instead of daily data, I replicate the models with the Tuesday closing prices instead of the Friday closing prices. I adjust only the inclusion of dummies. For instance, since September 11, 2001 was Tuesday, the corresponding dummy is shifted 3 days ahead from Friday to Tuesday. The results show that the cointegration rank and the identified long-run relations are robust to the day of the week used in both the pre- and post-accession periods. More specifically, the same restrictions on the $\boldsymbol{\beta}$ coefficients are not rejected, and the magnitudes of the estimated coefficients remain similar. Certain differences are found only in the estimated $\boldsymbol{\alpha}$ coefficients, since the Hungarian market in the pre-accession period is suggested to be adjusting to the long-run relation in addition to the Czech market. Considering the similarity of the Hungarian and Czech markets in terms of their size and openness, this finding appears to be plausible and underlines the importance of Polish market movements for the whole Central European region. The $\boldsymbol{\alpha}$ estimates in the post-accession period are found to be unstable as in the case of the Friday data. To further investigate the choice of the data, I also use data in US dollars instead of the local currencies. My analysis confirms the findings in Yang et al. (2006), Koch and Koch (1991) and Bessler and Yang (2003) that the results do not depend substantially on the currency used. In particular, the number of detected equilibrium relations is found to be the same regarding both periods.

As a last robustness check, I examine alternative model specifications. Including the three dummies for the instability after September 11, 2001, the characteristics of the long-run relation in the pre-accession period do not substantially depend on the lag length of the model or on additional dummies used. Nevertheless, the results for the post-accession period are found to be more sensible to the choice of lag length or the inclusion of dummy variables. Under alternative model specifications, I find stronger support for preferring rank 2 to rank 3 according to the trace test. The two equilibrium relations detected still bridge the Central European and the non-Central European markets, but the "pure Central European relation" is no longer found to be stationary. Hence, the main result that new linkages between the Central European and the other markets emerge in the post-accession period remains unchanged. On the contrary, the degree of cointegration between the Central European markets seems to decrease using some of the different model specifications. However, most of these specifications seriously violate the residual or constancy assumptions and thus does not appear to be reliable. The detected differences in the results deliver further evidence

about the importance of fulfilled model assumptions for statistical inference.

2.6 Conclusions

The Central European countries have been the leaders of the transition process from centrally planned towards free market economies. A substantial role in the process of transition has been played by developed countries, especially those in Western Europe. For instance, large capital inflows, especially in the form of FDI, have represented one important channel for tightening economic relations. Consequently, the Central European countries became members of the EU in May 2004.

This study shows that the EU accession resulted also in stronger financial integration of these countries with the global economy in general and with the "old" EU countries in particular. Based on a cointegration analysis applied on stock market movements, this is evidenced by the emergence of two new equilibrium relations in the post-accession period that link the movements of the Central European markets to the movements of the Western European, US, and Russian markets, whereas no such relations can be detected before the EU enlargement. One new long-run relation could be identified as the "new EU relation" because it connects the developments of the Czech and the Hungarian market to the development of the Western European market representing the "old" EU. The accepted exclusion of the Polish market from this relation can be explained by less openness towards foreign investment and weaker trade integration of the Polish market with the EU compared to the two smaller Central European markets. The second new equilibrium relation represents a linkage among the Western European, US and Russian markets as well as the Central European markets, though the role of the Russian market is found to be relatively limited. Hence, the existence of the relation points to the importance of the US stock market to the Central European markets, in addition to the influence from the Western European market, detected after the EU enlargement.

Considering only the three Central European markets, their degree of integration is found to be the same in the period before and after the EU enlargement, since I detect one cointegration relation linking the three Central European markets in both periods. However, the characteristics of the relation changed over time. Between November

1998 and October 2001, this relation can be characterized by a strong adjustment of the Czech market to movements of the Polish market. Using an alternative day of the week, I also find some evidence for adjustment of the Hungarian market to the Polish market movements. These results suggest a major importance of the Polish market for the Central European region before the EU enlargement. This is not surprising as the Polish market represented the largest stock market in the region, whose movements were likely to reflect especially local market events, because only a relatively low fraction of investment to the market originated abroad. Nevertheless, the characteristics of the relation changed permanently around November 2002, which roughly corresponds to the end of the EU admission negotiations on December 13, 2002. In particular, the importance of the Polish market is indicated to be smaller after the EU accession in 2004, since a strong link between the Czech and Hungarian markets is found. Considering the rich long-run structure in the post-accession period, the Polish market as an initial driving force of the "Central European relation" in the pre-accession period was likely to be substituted later on by the stochastic trends of the mature markets, in particular by the Western European market. Unfortunately, recursive tests of parameter constancy detect serious instability of the $\boldsymbol{\alpha}$ coefficients, which impedes the confirmation of this hypothesis by the data.

This study finds evidence for a significantly stronger financial integration of the Central European markets with the global economy after the EU enlargement in 2004, particularly with the "old" EU. I have shown that new long-run linkages between the Central European markets and the developed markets in Western Europe and the US emerged after the EU accession, though no such relation could be found before the EU enlargement. The increased linkages among the markets mean that the Central European stock markets became more vulnerable to shocks hitting developed economies on the one hand but more resistant to shocks originating domestically on the other hand. From the perspective of stock market investors, the results suggest that the benefits of long-run portfolio diversification between the developed and the Central European markets were reduced.

2.A Appendices to Chapter 2

2.A.1 Model Specifications

Pre-accession Period

As shown in Table 2.12, the normality of the residuals is clearly rejected for the basic VAR(3) model in the pre-accession period without any dummy variables.[28] The assumption of independent residuals implies no autocorrelation. This is violated for model with lag 2, but not with lag 3 and 1. Furthermore, the tests for ARCH effects reject the null hypothesis of no autocorrelation in second moments and detect heteroscedasticity in the residuals for every lag length reported. Moreover, several large standardized residuals (over 3.5) could be detected. Therefore, the specification of the model is not satisfactory and the situation does not improve when additional lags are included.

Table 2.12: Misspecification Tests

		Pre-accession period		Post-accession period	
Test	DF	Basic model	Adjusted model	Basic model	Adjusted model
Normality:	12	62.3 (0.00)	**17.2 (0.14)**	29.1 (0.00)	**14.0 (0.30)**
Autocorrelation:					
LM(1):	36	44.8 (0.15)	34.1 (0.56)	39.1 (0.33)	**35.6 (0.49)**
LM(2):	36	56.3 (0.02)	34.3 (0.55)	31.4 (0.69)	36.0 (0.47)
LM(3):	36	41.1 (0.26)	**33.7 (0.58)**	31.8 (0.67)	34.0 (0.56)
ARCH effects:					
LM(1):	441	545.7 (0.00)	516.1 (0.01)	485.9 (0.07)	**364.7 (0.99)**
LM(2):	882	1038.6 (0.00)	943.4 (0.07)	1059.8 (0.00)	905.8 (0.28)
LM(3):	1323	1519.1 (0.00)	**1479.3 (0.00)**	1487.6 (0.00)	1319.2 (0.52)

Notes: The table reports misspecification tests for multivariate normality proposed in Doornik and Hansen (2008) (H_0 : normality), Lagrange Multiplier tests for autocorrelation (H_0 : no autocorrelation) as well as ARCH effects (H_0 : no autocorrelation in second moments) in the residuals for models with one to three lags (Anderson, 2003; Rao, 1973). All the test statistics are χ^2 distributed. DF denotes degree of freedom. P-values are reported in parenthesis. Adjusted model refers to the model with dummies (and, in addition, with specific lag length in the pre-accession period). The results of tests for the models used for the cointegration analysis are indicated by boldface.

Working with financial data, we cannot expect to entirely get rid of the heavy-tailed (non-normal) distribution as well as the strong ARCH effects. This is not a crucial obstruction, since the estimates of the VAR model are generally robust to

[28] The usual 5% significance level is used for all conducted tests, when not stated differently.

deviations from normality (Juselius, 2007, page 128) and presence of ARCH effects (Gonzalo, 1994; Lee and Tse, 1996). However, appropriate dummy variables might mitigate autocorrelation by the elimination of large residuals and improve the skewness and kurtosis of the residual distribution. Therefore, I include several dummies, as listed in Section 2.5.1.

I further adjust the lag length of the model. Generally, it is set to 3, because no autocorrelation in residuals is rejected for the VAR(2) model, but not for the VAR(3) model. A longer lag structure appears to be redundant, and a shorter structure is rejected by the tests for lag reduction. Nevertheless, the examination of the coefficients of the Γ_1 and Γ_2 matrices in the VECM specification[29] indicates that the columns $\Gamma_{1,LRU}, \Gamma_{2,LWE}$ and $\Gamma_{2,LUS}$ contain only insignificant coefficients and can be individually as well as jointly excluded. For instance, the likelihood ratio test statistic of the joint hypothesis of exclusion is $LR = 2(3333.8 - 3322.7) = 11.1$, which is smaller than the critical value $\chi^2_{0.95}(18) = 28.9$. Therefore, I use this more parsimonious structure of lags.

The misspecification tests for the resulting model (Table 2.12, Adjusted model) show that both no autocorrelation and normality of the residuals have improved substantially. Hence, the extended model is preferred to the basic one.

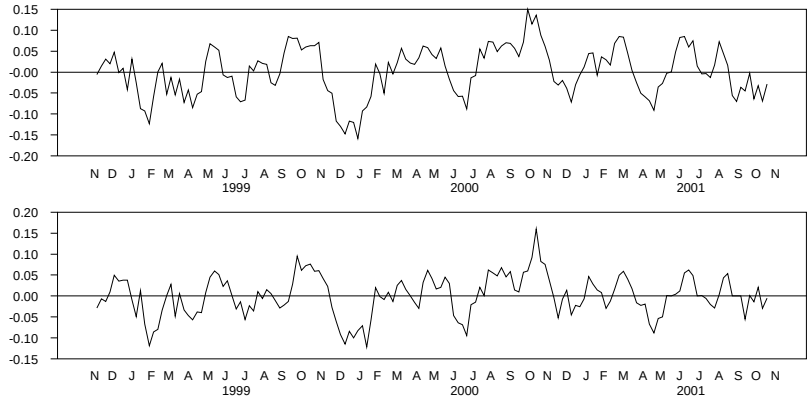
Post-accession Period

The basic VAR model for the post-accession period surprisingly does not suffer from autocorrelation in residuals (using any lag of 1 to 3). However, non-normality, ARCH effects and large residuals are still detected (Table 2.12, Basic model). The inclusion of the dummies introduced in Section 2.5.3 improve the model substantially (see Table 2.12, Adjusted model). Furthermore, the lag length is set to 1 for two reasons. First, the likelihood ratio tests for reducing lag length from 3 to 1 ($\chi^2(72) = 82.9$ with a p-value 0.18) and from 2 to 1 ($\chi^2(36) = 39.98$ with a p-value 0.30) do not reject the hypothesis of the sub-model with lag length 1. Second, the misspecification tests for this model do not detect any residual autocorrelation, non-normality or even presence of ARCH effects and thus the model is used for the following cointegration analysis.

[29] Note that the lag length of 3 in the VAR form corresponds to the lag length of 2 in the VECM form and, thus, to only two "Γ" matrices.

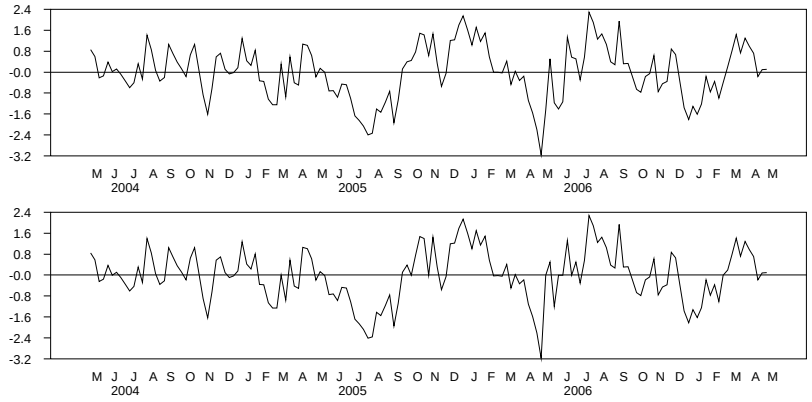
2.A.2 Cointegration Relations

Figure 2.3: The First Cointegration Relation in the Pre-accession Period



Notes: The figure plots the first cointegration relation in the pre-accession period in the "X-form" (upper part) and "R-form" (lower part).

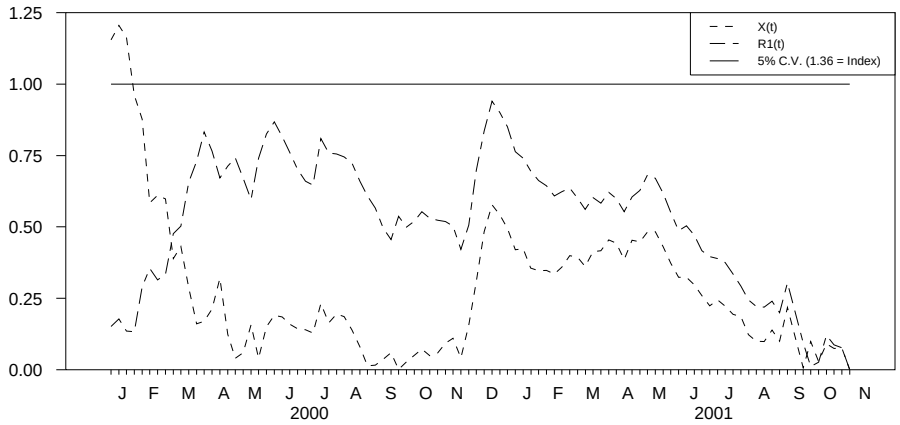
Figure 2.4: The Third Cointegration Relation in the Post-accession Period



Notes: The figure plots the third cointegration relation in the post-accession period in the "X-form" (upper part) and "R-form" (lower part).

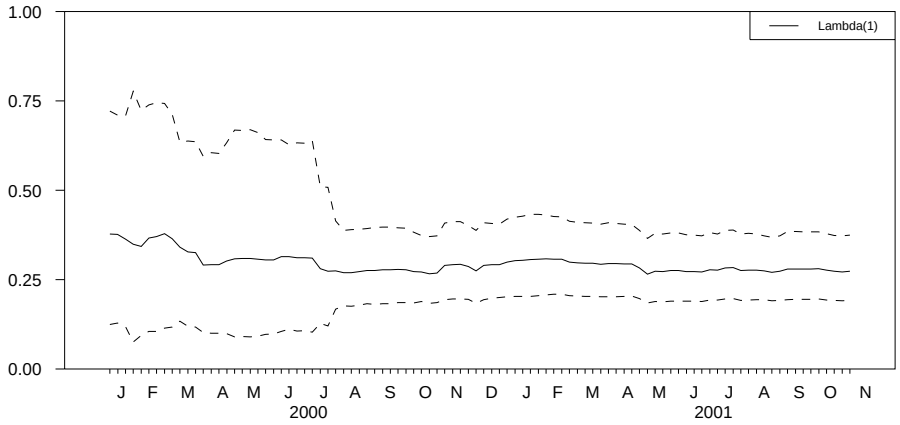
2.A.3 Constancy of Parameters

Figure 2.5: Test for Constancy of Log-likelihood Function in the Pre-accession Period



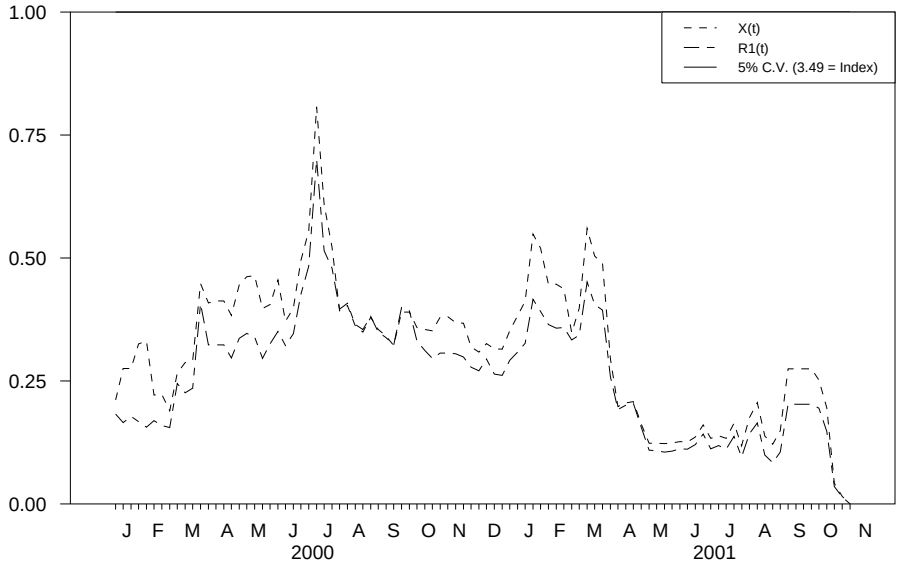
Notes: The scaling of the test is consistent, with 1 being the 5 % rejection line. The values under the rejection line indicate no violation of the constancy assumption. The line of R1(t) refers to the concentrated model in the "R-form".

Figure 2.6: Development of the First Eigenvalue in the Pre-accession Period



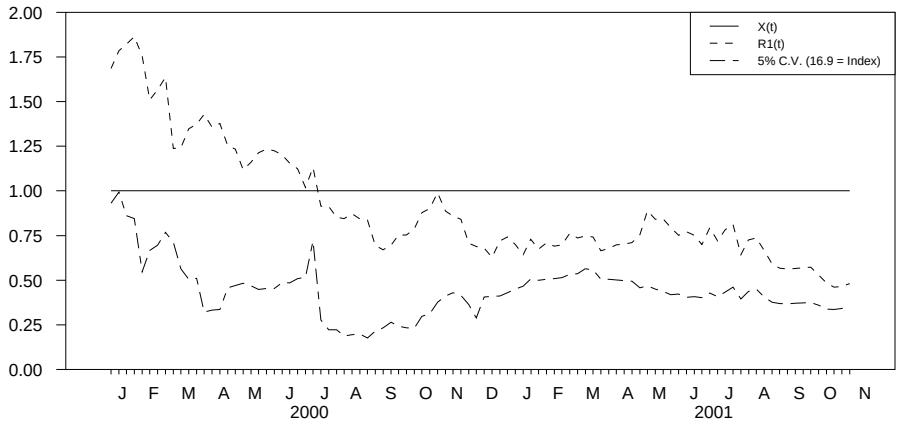
Notes: The dashed lines refer to 5 % confidence bounds. If the eigenvalue lies within the narrowest confidence bounds, the assumption of the eigenvalue's constancy is not violated.

Figure 2.7: Test of β constancy in the Pre-accession Period



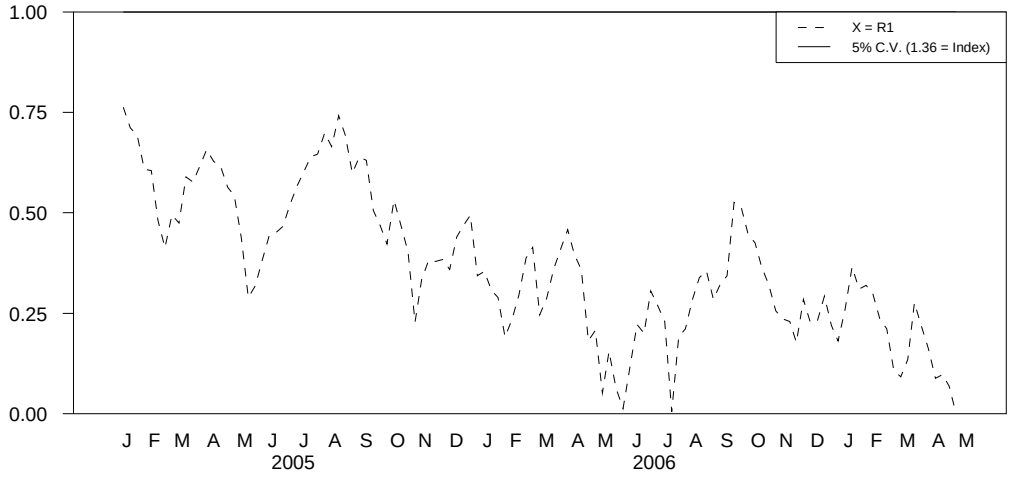
Notes: The scaling of the test is consistent, with 1 being the 5 % rejection line. The values under the rejection line indicate no violation of the constancy assumption. The line of R1(t) refers to the concentrated model in the "R-form".

Figure 2.8: Likelihood Ratio Test of Restrictions in the Pre-accession Period



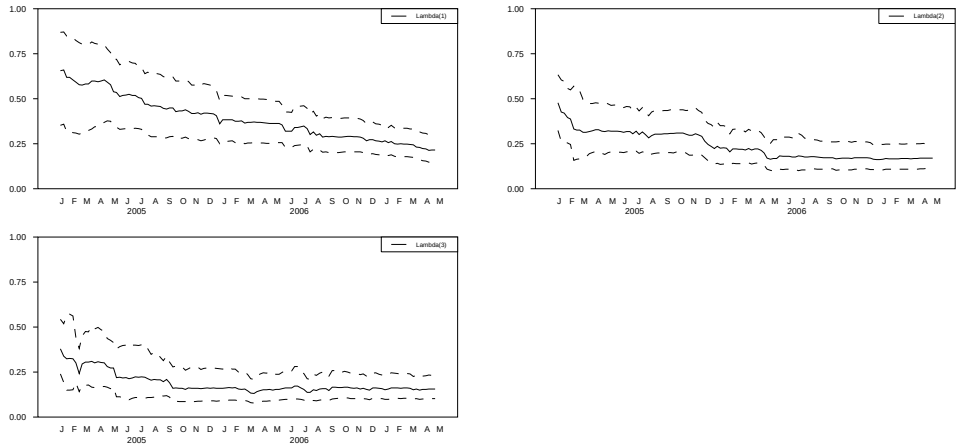
Notes: The scaling of the test is consistent, with 1 being the 5 % rejection line. The values under the rejection line indicate that the imposed restrictions are not rejected. The line of R1(t) refers to the concentrated model in the "R-form".

Figure 2.9: Test for Constancy of Log-likelihood Function in the Post-accession Period



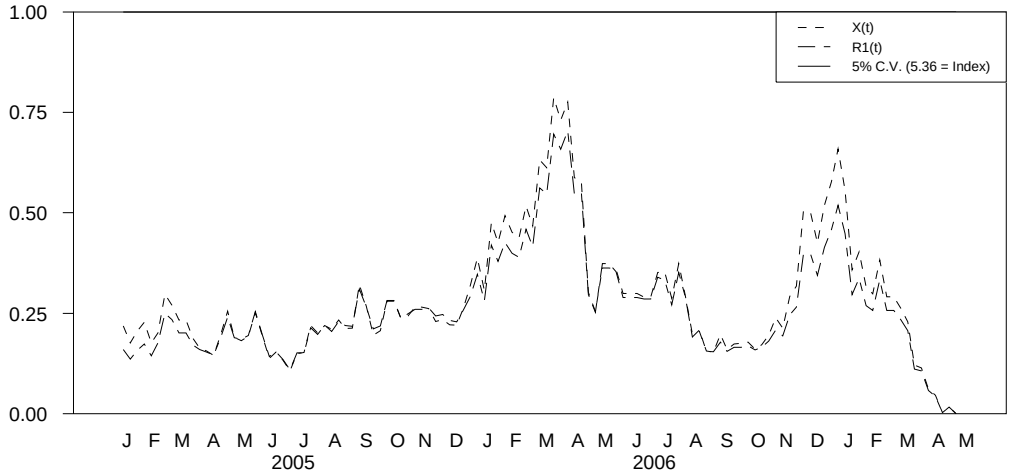
Notes: The scaling of the test is consistent, with 1 being the 5 % rejection line. The values under the rejection line indicate no violation of the constancy assumption. Due to lag length of 1 in the VAR model (i.e. zero lag in the VECM form), the test statistics for the "X-" and "R-form" are the same.

Figure 2.10: Development of the Three Eigenvalues in the Post-accession Period



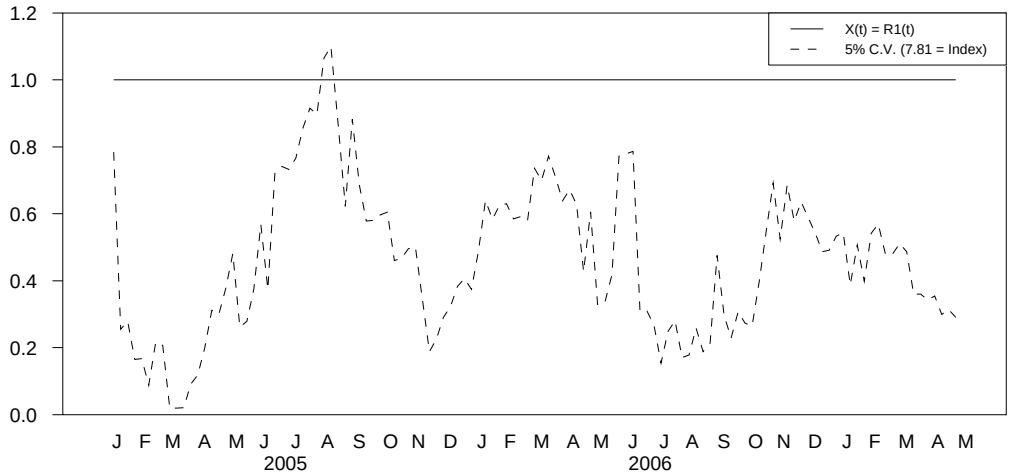
Notes: The dashed lines refer to 5 % confidence bounds. If the eigenvalue lies within the narrowest confidence bounds, the assumption of the eigenvalue's constancy is not violated.

Figure 2.11: Test of β constancy in the Post-accession Period



Notes: The scaling of the test is consistent, with 1 being the 5 % rejection line. The values under the rejection line indicate no violation of the constancy assumption. The line of R1(t) refers to the concentrated model in the "R-form".

Figure 2.12: Likelihood Ratio Test of Restrictions in the Post-accession Period



Notes: The scaling of the test is consistent, with 1 being the 5 % rejection line. The values under the rejection line indicate that the imposed restrictions are not rejected. Due to lag length of 1 in the VAR model (i.e., zero lag in the VECM form), the test statistics for the "X-" and "R-form" are the same.

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Chapter 3

Do Multinationals Transplant their Business Model?*

3.1 Introduction

Recent literature on international trade has established that the most productive firms of a country tend to become multinationals.[1] One reason is that more productive firms appear to be better able to cover the large fixed costs of entering a foreign country. How much, however, of this productivity advantage of multinational firms is translated to the host countries in which these firms invest? Marin (2004) finds that German multinationals increase the productivity level of their subsidiaries in Central Eastern Europe (including Russia, Ukraine and other former Soviet Union countries) to, on average, 60 percent of their parent firms in Germany compared with national firms in Central Eastern Europe which produce 23 percent of the productivity level of German firms during the late 1990s. Austrian multinationals in Eastern Europe reach 32 percent of the productivity level of parent firms in Austria. Similarly, Bloom, Sadun, and van Reenen (2007) find that US multinationals are more productive than non-US multinationals and national firms in the UK. They attribute this to the better management practices and the more decentralized internal organization of US firms (see Bloom, Sadun, and van Reenen, 2009).

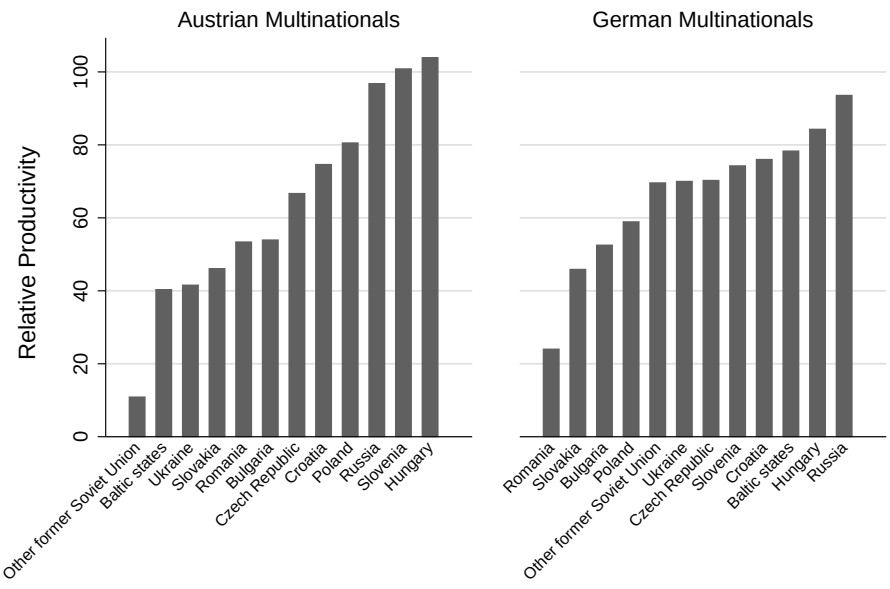
Figure 3.1, however, reveals a surprisingly wide variation in productivity levels of German and Austrian subsidiaries in Eastern Europe relative to their parent firms in Germany and Austria, suggesting that the ability of multinational firms to trans-

*This chapter is based on joint work with Dalia Marin, University of Munich.

[1]See Helpman, Melitz, and Yeaple (2004); Antras and Helpman (2004).

plant their home productivity advantage to other countries is by no means secure. The startling differences in productivity levels by the same firms across different host countries may be because of differences in the market and regulation environment that multinationals face in host countries, or because of sectoral differences, or differences in the ability of multinationals to transplant their business model to other countries. If organizational capital is key to understanding firms' productivity performance, as suggested by Bloom, Sadun, and van Reenen (2007) and Marin and Verdier (2008a), then the question arises as to what determines whether multinationals export their business model to the countries they invest in.[2]

Figure 3.1: Productivity of Foreign Affiliates in Host Countries in Percentage of Parent Firms



Notes: The figures plot the productivity of foreign affiliates in host countries relative to Austrian and German parent firms, respectively, in percentages. "Other former Soviet Union" refers to Azerbaijan, Armenia, Belarus, Georgia, Moldova, Kazakhstan, Tajikistan, Turkmenistan, and Uzbekistan; and "Baltic states" to Estonia, Latvia, and Lithuania. The aggregation achieves at least eight observations per bar.

To answer this question we need detailed information on the internal organization of multinational parents and their subsidiaries. Therefore, we analyze unique matched data of 660 parent firms in Austria and Germany with 2200 subsidiaries in Eastern Europe including Russia, Ukraine and other former Soviet Union countries. We designed

[2]Marin and Rousová (2009) indeed find that subsidiaries tend to be more productive when they use the same business model as their parent firms.

and collected these data from a full population of firms in Austria and Germany investing in Eastern Europe in the years between 1990 and 2001. The sample represents 80 percent of German foreign direct investment and 100 percent of Austrian foreign direct investment in Eastern Europe between 1998 and 2000.

As a measure of internal organization of parent and subsidiary firms we use the level of decentralization of thirteen corporate decisions such as decisions on acquisitions, new strategy, transfer prices or budget (see Table 3.14 in Appendix 3.A.2 for a full list of corporate decisions for which we have information on the hierarchical level at which these decisions are taken). Furthermore, we use two proxies for the transplantation of business culture of multinationals to their subsidiaries, one via taking the firm organization abroad and one via taking the CEO abroad. More specifically, we use a similarity measure counting the number of corporate decisions which are taken at the same hierarchical level in parent and subsidiary firms and we use the information whether or not parent firms send one or more managers from the home country to run the subsidiary.

Table 3.1 takes a first look at whether or not multinationals in Austria and Germany transplant their organization to the host countries. Some 50 per cent of multinationals do not transplant (the responsibility for five or more corporate decisions is allocated to different hierarchical levels in subsidiaries compared with parent firms), 27 percent of these firms transplant partially (the allocation of power differs for two to four corporate decisions between subsidiaries and parents) and 24 percent of firms transplant fully (all corporate decisions have the same allocation in subsidiaries as in parent firms or the allocation of one corporate decision differs).

Furthermore, the table looks at whether the organizational mode of multinational parent firms significantly affects their ability to transplant their organization to another country. It appears that decentralized parent firms transplant their organization significantly more often than centralized parent firms. Some 37 percent of foreign affiliates use the same business model as parent firms when their parent firms are decentralized compared with 24 percent of subsidiaries for all parent firms and 67 percent of subsidiaries use a different business model from parent firms when their parent firms are centralized compared with 50 percent of subsidiaries for all parent firms.

As a result the average levels of decentralization differ between parent firms and their subsidiaries as shown in Table 3.2, which looks at whether multinational parent

Table 3.1: Transplantation via Organization

		Subsidiaries with Parents' Organization Transplanted			All parent firms
		Not[1]	Partially[1]	Fully[1]	
Decentralization of Parent Firm[2]	Centralized[3]	290	69	77	436
		66.5 %	15.8%	17.7%	32.7%
	Cooperative[3]	260	212	132	604
		43.0%	35.1%	21.9%	45.2%
	Decentralized[3]	112	74	109	295
		38.0 %	25.1%	36.9%	22.1%
All subsidiary firms		662	355	318	1335
		49.6%	26.6%	23.8%	100%

Notes: The table reports absolute number of cases and row percentages, except for the column "All parent firms", where column percentages are given. The Person's χ^2 test rejects the null hypothesis that the transplantation of the business model is independent of the level of decentralization of parent firms at any conventional significance level ($\chi^2(4) = 76.8$, p-value = 0.000).
[1] The degree of transplantation via organization (full, partial and no transplantation) depends on the number of corporate decisions which are taken at the same hierarchical level in parent and subsidiary firms. For a listing of corporate decisions see Table 3.14 in Appendix 3.A.2. The organization is fully transplanted if each corporate decision obtained the same hierarchical rank for the subsidiary firm as for the parent firm or if only one corporate decision differs. It is partially transplanted if two to four corporate decisions differ in hierarchical rank and the organization is not transplanted if five or more corporate decisions are different.
[2] Mean of ranking between one (centralized) and five (decentralized) of several corporate decisions depending on whether the headquarters of the parent firm (centralized) or the CEO (decentralized) takes the decision. The CEO is the subsidiary manager for *decentralization of subsidiary firm* or the divisional manager for *decentralization of parent firm* (see Table 3.12 in Appendix 3.A.1 for more details). For a listing of corporate decisions see Table 3.14 in Appendix 3.A.2.
[3] A firm is centralized when the level of decentralization is in the range of 1.0 to 2.5, it is cooperative in the range of 2.51 to 3.5 and decentralized in the range of 3.51 to 5.

firms and subsidiaries have a similar decision-making structure. On average parent firms are more centralized than subsidiary firms. The table also shows that the level of decentralization of parent firms has a strong influence on the way the level of command is organized in subsidiaries. Centralized parent firms tend to have significantly more centralized subsidiaries and decentralized parents have significantly more decentralized subsidiaries. Some 58 percent of subsidiaries have centralized decision-making when their parents are centralized compared with 27 percent of all subsidiaries and 42 percent of subsidiaries with decentralized parents are decentralized compared with 22 percent of subsidiaries for all parent firms.

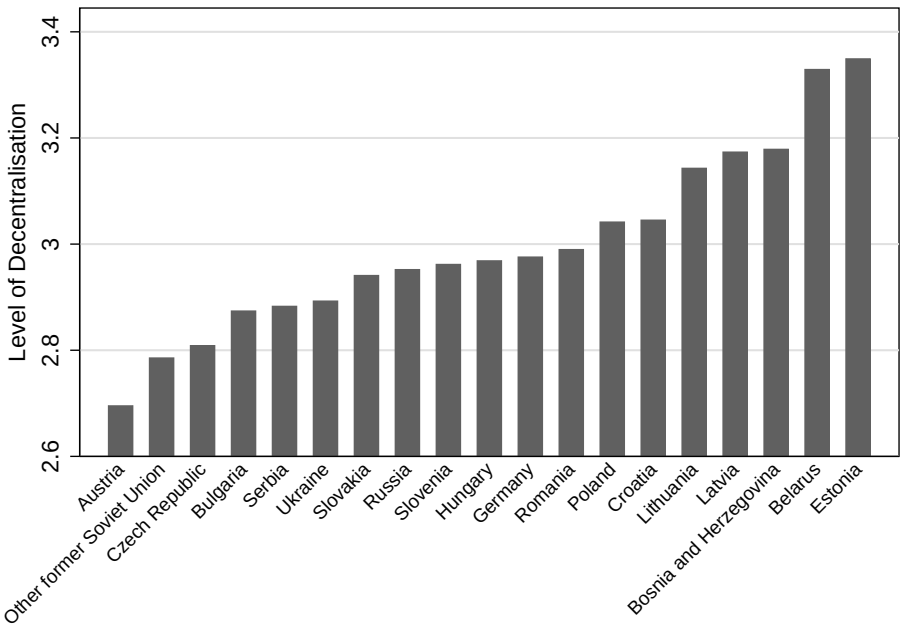
These numbers suggest that multinationals are quite often able to imprint their business culture on foreign affiliates. Nevertheless, Figures 3.2 and 3.3 reveal a startling variation in the organization of subsidiaries across host countries. Foreign affiliates of Austrian and German firms differ substantially with respect to their level of decentralization as well as in the degree to which they implement the business model of their parent firms. This suggests that home countries differ with respect to how attractive the conditions in their markets are to firms with a foreign business culture wishing to operate in their markets.

Table 3.2: Level of Command of Parent and Subsidiary Firms

		Decentralization of Subsidiary Firms[1]			All parent
		Centralized[2]	Cooperative[2]	Decentralized[2]	firms
Decentralization of Parent Firms[1]	Centralized[2]	251	156	29	436
		57.6 %	35.8%	6.7%	32.7%
	Cooperative[2]	104	363	137	604
		17.2%	60.1%	22.7%	45.2%
	Decentralized[2]	7	163	125	295
		2.4%	55.3%	42.4%	22.1%
All subsidiary firms		362	682	291	1335
		27.1%	51.1%	21.8%	100%

Notes: The table reports absolute number of cases and row percentages, except for the column "All parent firms", where column percentages are given. The Person's χ^2 test rejects the null hypothesis that the level of decentralization of subsidiary firms is independent of the level of decentralization of parent firms at any conventional significance level ($\chi^2(4) = 371.5$, p-value = 0.000).
[1] Mean of ranking between one (centralized) and five (decentralized) of several corporate decisions depending on whether the headquarters of the parent firm (centralized) or the CEO (decentralized) takes the decision. The CEO is the subsidiary manager for *decentralization of subsidiary firm* or the divisional manager for *decentralization of parent firm* (see Table 3.12 in Appendix 3.A.1 for more details). For a listing of corporate decisions see Table 3.14 in Appendix 3.A.2.
[2] A firm is centralized when the level of decentralization is in the range of 1.0 to 2.5, it is cooperative in the range of 2.51 to 3.5 and decentralized in the range of 3.51 to 5.

Figure 3.2: Level of Decentralization of Parent Firms and their Affiliates in Host Countries



Notes: Level of decentralization is a mean of ranking between one (centralized) and five (decentralized) of several corporate decisions depending on whether the headquarters of the parent firm (centralized) or the CEO (decentralized) takes the decision. The CEO is the subsidiary manager in host countries or the divisional manager in Austria or Germany (see Table 3.12 in Appendix 3.A.1 for more details). For a listing of corporate decisions see Table 3.14 in Appendix 3.A.2. "Other former Soviet Union" refers to Azerbaijan, Armenia, Georgia, Moldova, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan. The aggregation achieves at least eight observations per bar.

Figure 3.3: Multinationals' Transplantation of Business Model

Figure 3.3a: Transplantation via Organization

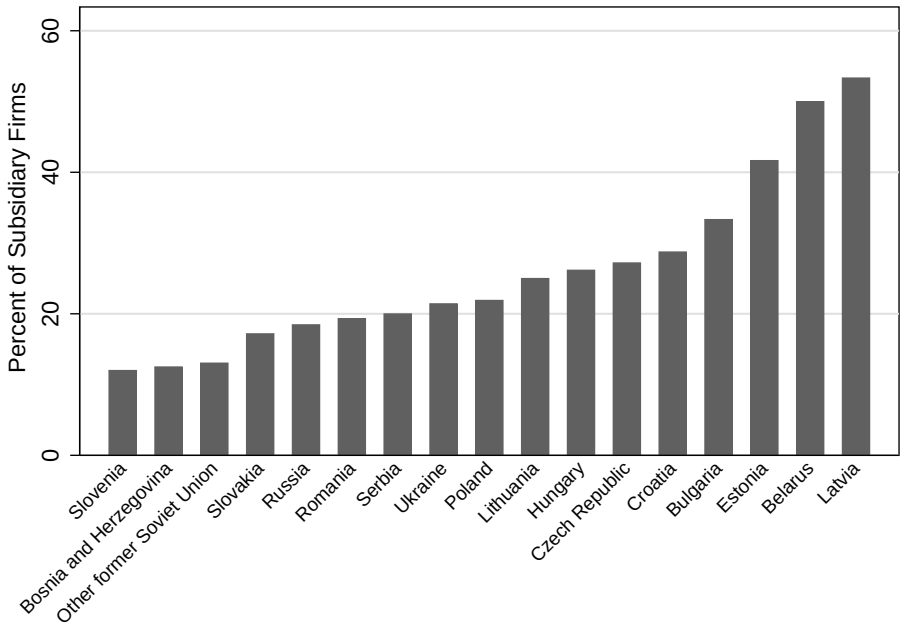
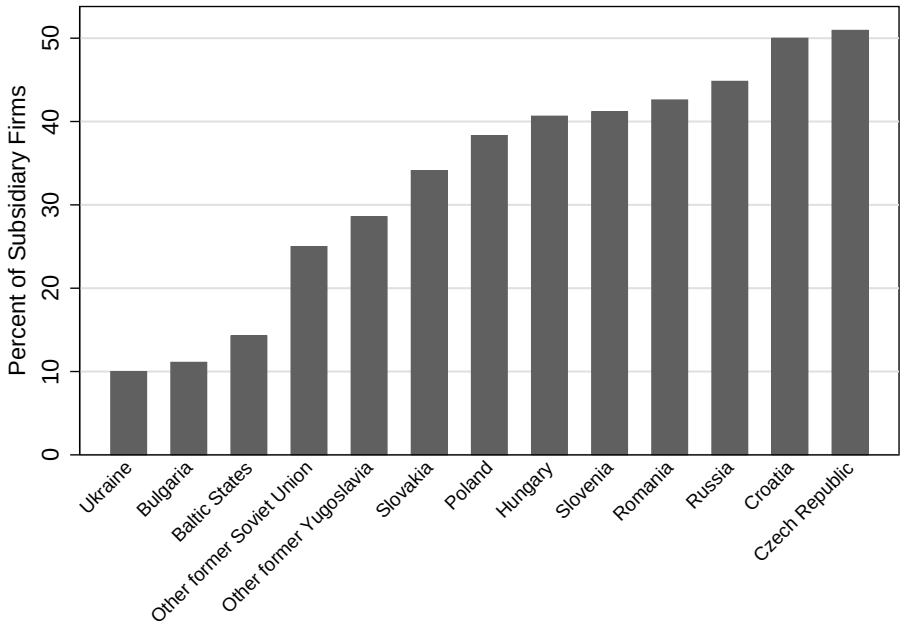


Figure 3.3b: Transplantation via CEO



Notes to Figure 3.3a: Figures are given for full *transplantation via organization* in which either each corporate decision in subsidiaries has the same rank as in parent firms or only one corporate decision differs. For a listing of corporate decisions see Table 3.14 in Appendix 3.A.2. "Other former Soviet Union" refers to Azerbaijan, Armenia, Georgia, Moldova, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan. The aggregation achieves at least eight observations per bar.
Notes to Figure 3.3b: Figures are given for subsidiary firms to which at least one manager has been sent by the parent firm. "Other Eastern Europe" refers to Albania, Macedonia, Turkmenistan and Uzbekistan; "other former Soviet Union" to Moldova, Turkmenistan, and Uzbekistan; "other former Yugoslavia" to Bosnia and Herzegovina, Macedonia, and Serbia; and "Baltic states" to Estonia, Latvia, and Lithuania. The aggregation achieves at least eight observations per bar.

In this chapter, we examine the factors that determine whether or not multinationals export their business culture to other countries. So far this has been little understood. Previous research on organizations in international trade has focused on how firms' home productivity advantage determines the mode of organization firms choose abroad (Helpman, Melitz, and Yeaple, 2004; Antras and Helpman, 2004) and how a greater exposure to international trade influences the business model firms choose at home (Marin and Verdier, 2004, 2007, 2008b). The research on the transportation of culture across countries has so far not focused on firm organization but rather on whether the fertility rates of second-generation immigrants in the US reflect the culture in the US or that of their parents in their home country (Fernández and Fogli, 2009) or on parking fine behavior of diplomats (Fisman and Miguel, 2008).

More recently, empirical literature on firm decentralization has emerged with a focus on national firms. The literature examines the trend of decentralization of US firms (Rajan and Wulf, 2006) and how information technology (Acemoglu, Aghion, Lelarge, van Reenen, and Zilibotti, 2007), international trade and competition (Marin and Verdier, 2004, 2007; Guadalupe and Wulf, 2008), and trust and hierarchical religion (Bloom, Sadun, and van Reenen, 2009) affect the level of decentralization of firms. The paper by Bloom, Sadun, and van Reenen (2009) is the closest our analysis, since their firm sample includes information on multinational firms. Their data on multinationals, however, do not include matched parent and foreign affiliate information, which is what we use in this chapter. Therefore, they are not able to answer how the characteristics of parent firms and their country of origin are influencing the ability of multinational firms to transport their business culture abroad. Our matched parent and affiliate data sample allows us to quantify to what extent affiliates' organizations reflect the cultural traits of their parents and to what extent they are a response to the market environment subsidiary firms face in host countries.

The rest of the chapter is organized as follows. Section 3.2 introduces the various data used. In particular, it describes how we measure organization of multinational firms and transplantation of their business culture to foreign affiliates. Section 3.3 examines the determinants of these two measures and their estimated effects. Section 3.4 concludes.

3.2 Data

We collected survey data for 660 multinational corporations in Austria (200) and Germany (460) with 2200 subsidiaries in Eastern Europe including the former Soviet Union countries during the period 1990 to 2001. The survey questions refer typically to the years 1998 and 1999, when the data represented 100 percent of Austrian and 80 percent of German direct investment in Eastern Europe. This dataset is unique, since it includes matched information on the organization of 600 parent firms in Austria and Germany and 2200 of their subsidiaries in Eastern Europe.[3] In particular, we have information about the level of decentralization of parent firms and their subsidiaries which is measured by the level of decision-making within the corporation. This in turn enables us to study when the business model of parent firms is transplanted to their subsidiaries.

3.2.1 Measuring Organization

Measuring Decentralization

Our measure of decentralization of parent firms is based on the survey question: "Who decides on the following issues concerning your corporation: the headquarters or the divisional manager?" The issues involve thirteen corporate decisions for Austrian and German parent firms, i.e. decisions on acquisitions, finances, new strategy, wage increase, R&D expenditure, budget, transfer and product prices, introducing a new product, changing a supplier, hiring two and 20 new workers as well as a new secretary. See also Table 3.14 in Appendix 3.A.2 for the listing of the decisions. Responses ranged between one and five with one as a centralized decision, taken entirely at headquarters, and five as a decentralized decision, taken at the divisional level. We use a simple mean of the available ranking to measure the overall level of decentralization of the firm and call it the *decentralization of parent firm*. A counterpart, *decentralization of subsidiary firm*, is obtained from answers to the question "Who decides on the following issues concerning your corporation: the headquarters of the parent firm or the manager of the subsidiary firm in the host country?"

[3] For a detailed overview of all variables and their descriptive statistics see Tables 3.12 and 3.13, respectively, in Appendix 3.A.1.

Table 3.14 in Appendix 3.A.2 shows that the most centralized decision is the decision on acquisitions with a mean ranking of 1.34 and 1.41 for parent and subsidiary firms, respectively, followed by the decision on a new strategy (with a respective mean ranking of 1.90 and 1.88). Not surprisingly, the most decentralized decisions tend to be the decision on hiring a secretary (mean ranking of 4.15 and 4.65) and the decision on hiring two new workers, whereas the decision on R&D and the decision to introduce a new product tend to be taken cooperatively between headquarters and subsidiary managers in the host country (with a respective mean ranking of 2.58 and 2.80).

Measuring Transplantation

We use two indicators to proxy for the transplantation of the business model from parent firms to foreign affiliates. The first proxy is a dummy variable *transplantation via organization* which indicates whether or not the organization of the parent firm is fully transplanted to the subsidiary. It takes a value of one if each individual corporate decision has the same hierarchical rank or if one of the decisions differs in hierarchical rank between parent and subsidiary firms.

Table 3.15 in Appendix 3.A.2 looks at the similarity in the hierarchical levels of corporate decisions in parent and subsidiary firms. The hierarchical level ranges between one (centralized) and five (decentralized) in subsidiaries and parent firms for each of the corporate decisions individually. When parent and subsidiaries allocate an individual decision at the same hierarchical level, we consider the decision to be fully transplanted to the subsidiary and the similarity index in Panel A becomes zero, otherwise it takes values in the interval (-4,4). We obtain this measure by subtracting the hierarchical level of the subsidiary firm from that of the parent firm.

Panel A gives a quantitative measure of transplantation by providing the percentages of subsidiaries where a particular decision is taken at the same hierarchical level as in parent firms ($= 0$) and at different hierarchical levels ($\neq 0$). It shows that the most centralized and the most decentralized corporate decisions tend to be transplanted most often to foreign affiliates (compare Tables 3.14 and 3.15 in Appendix 3.A.2). In 78 percent, 70 percent, and 64 percent of the affiliates the decision on acquisitions, hiring a secretary, and hiring two new workers, respectively, are taken at the same hierarchical level in foreign affiliates as in parent firms. The least often transplanted decisions tend to be in the middle of the corporate ladder such as the decision on finances and R&D.

Only in about half of the affiliates are these two decisions at the same hierarchical level in subsidiaries as in parent firms.

Panel B gives a qualitative measure of transplantation by listing in addition which corporate decisions in the subsidiary are more (> 0) or less decentralized (< 0) than in the parent firm. As can be seen from Panel B, when subsidiaries deviate in the allocation of decision power from their parent firms they tend to decentralize more than their parent firms. One exception is the decision on R&D which is more decentralized in parent firms than in subsidiary firms. Of the 49 percent of foreign affiliates which differ in their allocation of decision power over R&D from their parent firms, 30 percent of subsidiaries are more centralized compared with parent firms (< 0) and 19 percent are more decentralized (> 0).

Finally, Panel C reports the degree of transplantation by listing the degree to which the decisions in foreign affiliates deviate from their parent firms. When affiliates differ in their decision-making from their parent firms they do not choose a radical departure from their parent firms. Mostly, they tend to decentralize or to centralize by one or two hierarchical levels more compared with their parent firms.

As a second proxy for the transplantation of parent firms' business model we use a dummy variable *transplantation via CEO*. It takes a value of one if at least one manager is sent from the parent firm to the subsidiary in the host country. The idea here is that parent firms use their own managers to implement the corporation's business culture in the subsidiary abroad. The dummy is constructed from the survey question "How many of your managers from the parent firm are sent to the subsidiary firm?" In more than 40 percent of foreign affiliates the parent firm has sent at least one manager to run the subsidiary and to transfer the organizational knowledge. This high frequency of *transplantation via CEO* suggests that the two proxies for the transplantation of the business model are complements rather than substitutes. We indeed find that the two measures are weakly positively correlated (see Table 3.3).

Other Organizational Information

Our sample provides additional information on the organizational structure of the multinational corporation. We construct dummy variables to distinguish four different categories of the *parent firms' organization*: when the parent firm is a family firm

Table 3.3: Multinationals' Transplantation of Business Model

		Transplantation via CEO[1] = 0	Transplantation via CEO[1] = 1	All subsidiary firms
Transplantation via Organization[2]	= 0	348	232	580
		60.0%	40.0%	80.8%
	= 1	73	65	138
		52.9%	47.1%	19.2%
All subsidiary firms		421	297	718
		58.6%	41.4%	100%

Notes: The table reports absolute number of cases and row percentages, except for the column "All subsidiary firms", where column percentages are given. The Person's χ^2 test rejects the null hypothesis that the transplantation via organization is independent of transplantation via CEO at 15 percent significance level ($\chi^2(1) = 2.32$, p-value = 0.13).
[1] A dummy that takes a value of one if at least one manager is sent from the parent firm to the subsidiary and zero otherwise.
[2] A dummy that takes a value of one if the organization is fully transplanted from the parent firm to its subsidiary and zero otherwise. The organization is fully transplanted if each corporate decision obtained the same rank for the subsidiary firm as for the parent firm or if only one corporate decision differs.

(*parent is a family firm*), a domestic multinational (*parent is a domestic MNE*) or a subsidiary of a larger foreign multinational enterprise (*parent is a subsidiary of foreign MNE*) or of a domestic multinational firm (*parent is a subsidiary of domestic MNE*). In addition, a dummy *parent is a subsidiary* captures the two latter cases together and takes a value of one if the parent firm is a subsidiary of either a foreign or a domestic multinational. Some 16 percent of parent firms are family firms, 36 percent are domestic multinationals and 48 percent are a subsidiary of a domestic or foreign multinational (see Table 3.13 in Appendix 3.A.1 for the descriptive statistics).

The survey includes further information on the organization of subsidiary firms. The variable *horizontal investment* is calculated as the share of output of the subsidiary firm which is sold at the local market. It ranges between 0 and 100 percent with a mean of 82 percent. Two indicators of how tightly foreign affiliates are linked to their parent firms are the variables parent firms' ownership share in the subsidiary and the importance of intra-firm trade. *Parent's ownership share* measures the parent firms' stakes in the foreign venture with a mean ownership share of 86 percent. Hence, Austrian and German firms tend to have a high involvement in their subsidiaries in Eastern Europe. The variable *intra-firm trade* gives the share of imports from the subsidiary firm to the parent firm in percentage of parent firm's sales. On average, parent firms import two percent of sales from each of their subsidiary firm in Eastern Europe either as input or final goods. Furthermore, the variable *distance* between parent and subsidiary firm is a measure of cultural differences between the parent firms and the host regions. The further away the foreign affiliate from the parent firm the more important becomes the local knowledge and the less able are headquarters to monitor the subsidiary firm.

Finally, we have information on how innovative the technology is that the parent firm transfers to the subsidiary firm. The innovativeness of the technology is captured by a dummy *technology is innovative* which takes a value of one if the technology is new, a dummy *technology is established* with value of one if the technology is relatively established and a dummy *technology is outdated* refers to a fully established or even outdated technology. The size of the multinational corporation is measured by the number of employees as the *size of parent firm* and the *size of subsidiary firm*. Another measure of size is the total *number of affiliates* in Eastern Europe which is recorded for each parent firm, though we put nine and more affiliates into one category to avoid outliers.

3.2.2 Measuring Competition and Trade

We use several data sources to measure product market competition and exposure to international trade. First we obtain from our survey data of 660 Austrian and German multinationals with their 2200 foreign affiliates two subjective measures of competition as perceived by parent and subsidiary firms. They are dummy variables indicating for each parent or subsidiary firm whether the firm faces *many domestic competitors* and *many world competitors* rather than few competitors, respectively. Second, we use the AMADEUS database from Bureau van Dijk (2005) to calculate the *Lerner* index of competition based on a large number of firms in the two home countries of the headquarters of multinational firms and in all host countries of their affiliates at the three-digit ISIC industry level. The *Lerner* index is defined as (1 - average profits/sales), where the average is taken, first, across all firms available in a three-digit industry in a specific country and, second, over the years 1996 to 2000. Finally, we use trade and tariff data from the WITS UN COMTRADE and TRAINS databases (World Bank, 2009) as well as data on domestic production from the INDSTAT 4 (UNIDO, 2008) and STAN (OECD, 2009) databases to proxy for the exposure to international trade of the sector of parent and subsidiary firms. From these types of data, we calculate the *import share* (defined as total imports divided by domestic production), the *export share* (defined as total exports divided by domestic production), and the average effective *tariff* rates on imports. These variables are calculated for each country at the three-digit industry level. If data at the three-digit industry level are missing, the two-digit level is used.

3.2.3 Social Capital in Host Countries

We consider additional characteristics of the subsidiaries' market environment. In particular, the variable *contract enforcement* reflects the perception by parent firms of ten possible risk factors that the subsidiary faces in host countries. The variable is calculated as the mean of ranking between one and five with one as a very important and five as an unimportant risk factor. The risk factors include the risk of profit transfer, exchange rate volatility, expropriation, changes in taxes or tariffs, property rights, macro-economic instability, political turnaround, corruption, crime and mafia, and banking sector collapse.

Further characteristics of the market environment of host countries are captured by the variables *trust* and *hierarchical religion*. *Trust* measures the proportion of people who answer "Most people can be trusted" to the question: "Generally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people?" *Hierarchical religion* captures the proportion of the population belonging to a "hierarchical religion" such as Roman and Greek Catholic, Orthodox, Gregorian and Armenian Apostolic Church, or Islam. Both sets of data come from the World Value Survey undertaken by the WVS Organization (2009).

3.3 Empirical Specification and Results

We are interested in two different, though inter-linked questions: What favors decentralization of the subsidiary firm? What determines the transplantation of the business model from the parent firm to the subsidiary firm? We start with the first question.

3.3.1 What Favors Decentralization in Foreign Affiliates of Multinationals?

The Organization of the Multinational Corporation

We first look in Table 3.4 at the baseline model which examines how the organization of the multinational corporation influences the level of decentralization of foreign affiliates

as measured by *decentralization of subsidiary firm*. We start with the organization of parent firms. As can be seen from Table 3.4, subsidiary firms are more decentralized when their parent firms are more decentralized, when parent firms themselves are a subsidiary of a domestic multinational (with *parent is a family firm* as the omitted category) and when parent firms have more affiliates in other countries, though the effect is nonlinear. Subsidiary firms will, however, be more centralized when their parent firms are larger and located in Germany and when they are themselves a subsidiary of a foreign multinational. The significant and positive coefficient of *decentralization of parent* of 0.42 suggests that when parent firms become more decentralized by one rank (a 25 percent increase in the possible range of the level of decentralization) the level of decentralization of subsidiary firms increases by 10.5 percent. We obtain this number by multiplying 1 (an increase of one rank) with the coefficient of 0.42 resulting in an increase of the level of decentralization in the subsidiary of 0.42, which is 10.5 percent of the possible range of levels of decentralization of subsidiaries. Hence, the level of decentralization of parent firms is an economically important variable determining how decentralized the subsidiary is.

The organization of subsidiary firms also matters for the level of decentralization. Subsidiaries tend to be more decentralized when they are a horizontal foreign investment in which they sell mostly at the local market, when they are larger and further away from headquarters. Subsidiaries are, however, more centralized when they are more tightly linked to their parent firms. This is the case when headquarters has a larger ownership stake in subsidiaries and when the subsidiary is part of a global supply chain (measured by the volume of intra-firm trade) when it primarily provides inputs and final goods to headquarters.

All estimated coefficients are mostly significant at conventional levels and robust to the inclusion of host country and industry fixed effects. The inclusion of industry fixed effects substantially contributes to the explanatory power of the regression in columns (3) and (4) as the R^2 increases from 0.28 to 0.46. The inclusion of host country fixed effects appears less important (column (2)). We include both types of fixed effects in the following analysis. The organizational variables together account for about 50 percent of the variation in the level of decentralization of foreign affiliates (column (9)) which leaves room for other variables to play a role.

Table 3.4: Level of Decentralization in Subsidiary Firms
The Basic Model

Dependent Variable	Decentralization of Subsidiary Firm[1]								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Decentralization of parent firm[1]	0.42***	0.40***	0.43***	0.42***	0.43***	0.42***	0.42***	0.41***	0.41***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Parent is located in Germany	-0.11***	-0.12***	-0.19***	-0.19***	-0.17***	-0.20***	-0.23***	-0.24***	-0.29***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Parent is a subsidiary of foreign MNE[2]	-0.049	-0.059	-0.12*	-0.12*	-0.16**	-0.12*	-0.13**	-0.12*	-0.13**
	(0.37)	(0.29)	(0.07)	(0.06)	(0.02)	(0.06)	(0.05)	(0.06)	(0.04)
Parent is a subsidiary of domestic MNE[2]	0.10**	0.090*	0.13**	0.13**	0.043	0.13**	0.12**	0.14***	0.14***
	(0.04)	(0.07)	(0.01)	(0.01)	(0.42)	(0.01)	(0.02)	(0.01)	(0.01)
Parent is a domestic MNE[2]	-0.042	-0.046	-0.020	-0.0089	-0.036	-0.014	-0.019	-0.031	-0.045
	(0.41)	(0.37)	(0.73)	(0.87)	(0.53)	(0.80)	(0.74)	(0.58)	(0.43)
Log (Size of parent firm)	-0.042***	-0.040***	-0.039***	-0.039***	-0.046***	-0.035***	-0.040***	-0.029**	-0.027**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.03)
Log (Size of subsidiary firm)	0.023*	0.033**	0.045***	0.059***	0.050***	0.056***	0.059***	0.063***	0.060***
	(0.06)	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Number of affiliates	0.11***	0.11***	0.098**	0.095**	0.11**	0.093**	0.099**	0.083*	0.088*
	(0.00)	(0.01)	(0.03)	(0.04)	(0.02)	(0.04)	(0.03)	(0.07)	(0.06)
(Number of affiliates)^2	-0.0093***	-0.0095***	-0.0090**	-0.0091**	-0.011***	-0.0088**	-0.0094**	-0.0082**	-0.0084**
	(0.00)	(0.00)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.04)	(0.03)
Intra-firm trade					-0.21				
					(0.43)				
Parent's ownership share						-0.23***			-0.18**
						(0.00)			(0.03)
Log (Distance)							0.068*		0.065*
							(0.06)		(0.08)
Horizontal investment								0.27***	0.25***
								(0.00)	(0.01)
Country dummies	NO	YES	NO	YES	YES	YES	YES	YES	YES
Industry dummies (3d)	NO	NO	YES	YES	YES	YES	YES	YES	YES
Observations	1157	1157	1157	1157	1078	1154	1157	1111	1108
Adjusted R^2	0.28	0.28	0.46	0.47	0.50	0.47	0.47	0.49	0.49

* significant at 10%, ** significant at 5%, ***significant at 1%

Notes: Coefficients obtained by OLS with robust standard errors. P-values reported in parentheses. See Table 3.12 in Appendix 3.A.1 for the definition of variables.

[1] Mean of ranking between one (centralized) and five (decentralized) of several corporate decisions depending on whether the headquarters of the parent firm (centralized) or the CEO (decentralized) takes the decision. The CEO is the subsidiary manager for *decentralization of subsidiary firm* or the divisional manager for *decentralization of parent firm* (see Table 3.12 in Appendix 3.A.1 for more details). For a listing of corporate decisions see Table 3.14 in Appendix 3.A.2.

[2] *Parent is a family firm* is the omitted category of *parent firm's organization*.

Market Competition and International Trade

Next, we turn to the influence of the market environment in host countries on the ability of foreign affiliates to decentralize. We start with the role of competition and international trade in Table 3.5. In their theory of decentralization Marin and Verdier (2004, 2007, 2008b) suggest that the level of competition and international trade needs to reach a critical level before firms start to decentralize. Firms trade off the profit gain from having control against the profit loss from losing the initiative of middle managers. When competition becomes sufficiently strong the latter effect on profits dominates and firms decentralize to empower middle managers. In contrast to the previous empirical literature on the decentralization of national firms (Marin and Verdier, 2007; Marin, 2008; Guadalupe and Wulf, 2008; Bloom, Sadun, and van Reenen, 2009) we find that foreign affiliates of multinational corporations tend to centralize in response to more competition in host countries. Column (1) shows that the level of decentralization of subsidiaries declines with *many domestic competitors* rather than *few competitors* (the omitted category). When subsidiaries face *many domestic competitors* rather than few competitors they reduce the level of decentralization by a rank of 0.11 which is 2.75 percent.

One problem with the subjective firm level measure of competition is that it may suffer from reverse causality. More decentralized firms may face less tough competition (because they may empower their knowledge workers to bring new ideas to the firm resulting in higher quality of products) rather than that firms facing less tough competition decentralize more, as we postulate here. To prevent the possibility of a single firm influencing the market outcome we introduce a more exogenous measure of competition at the sectoral level for the host country markets given by the *Lerner* index. Column (2) reports the results and shows that the previous result in column (1) is robust to the measure of competition as subsidiaries tend to centralize with an increase in the *Lerner* index. An increase in the *Lerner* index in the affiliates' markets by ten percent reduces the level of decentralization in affiliates by a rank of 0.14 which is 3.5 percent.

A possible explanation for the contrasting results with the empirical literature on national firms is that subsidiaries in host countries of Eastern Europe (including the former Soviet Union) may face less competition compared with firms in developed market economies and hence they do not reach the threshold level of competition suggested by Marin and Verdier (2007) and they stay centralized. A comparison of

Table 3.5: Level of Decentralization in Subsidiary Firms The Role of Competition and Trade: OLS Estimates

Dependent Variable	Decentralization of Subsidiary Firm[1]					
	(1)	(2)	(3)	(4)	(5)	(6)
Decentralization of parent firm[1]	0.41***	0.40***	0.41***	0.35***	0.35***	0.35***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Parent is located in Germany	-0.32***	-0.30***	-0.31***	-0.47***	-0.47***	-0.34***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Parent is a subsidiary of foreign MNE[2]	-0.20***	-0.10	-0.18***	0.011	0.0100	-0.14
	(0.00)	(0.13)	(0.01)	(0.94)	(0.94)	(0.32)
Parent is a subsidiary of domestic MNE[2]	0.15***	0.17***	0.17***	0.31***	0.31***	0.16
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.11)
Parent is a domestic MNE[2]	-0.065	0.010	-0.053	0.044	0.044	-0.12
	(0.26)	(0.86)	(0.36)	(0.70)	(0.71)	(0.28)
Log (Size of parent firm)	-0.023*	-0.027*	-0.029**	0.0070	0.0065	0.0014
	(0.07)	(0.05)	(0.02)	(0.84)	(0.85)	(0.97)
Log (Size of subsidiary firm)	0.062***	0.063***	0.060***	0.068**	0.069**	0.087***
	(0.00)	(0.00)	(0.00)	(0.04)	(0.04)	(0.00)
Number of affiliates	0.098**	0.11**	0.081*	0.30***	0.30***	0.23***
	(0.04)	(0.03)	(0.08)	(0.00)	(0.00)	(0.00)
(Number of affiliates)^2	-0.0091**	-0.011***	-0.0076*	-0.029***	-0.028***	-0.023***
	(0.02)	(0.01)	(0.05)	(0.00)	(0.00)	(0.00)
Parent's ownership share	-0.21**	-0.16*	-0.21**	-0.24*	-0.24*	-0.29**
	(0.01)	(0.08)	(0.01)	(0.07)	(0.06)	(0.03)
Log (Distance)	0.043	0.076*	0.055	0.15**	0.15**	0.11
	(0.26)	(0.06)	(0.14)	(0.01)	(0.01)	(0.13)
Horizontal investment	0.25***	0.26***	0.26***	0.11	0.11	0.11
	(0.01)	(0.01)	(0.01)	(0.44)	(0.43)	(0.45)
Many domestic competitors[3]	-0.11**					
	(0.01)					
Subsidiary market Lerner		-0.014**				
		(0.03)				
Many world competitors[3]			0.089*			
			(0.09)			
Import share				-0.028*		
				(0.09)		
Export share					-0.032**	
					(0.02)	
Tariffs						-0.00098
						(0.46)
Country dummies	YES	YES	YES	YES	YES	YES
Industry dummies (3d)	YES	YES	YES	YES	YES	YES
Observations	1090	960	1083	373	375	372
Adjusted R^2	0.50	0.47	0.50	0.54	0.55	0.52

* significant at 10%, ** significant at 5%, ***significant at 1%

Notes: Coefficients obtained by OLS with robust standard errors. P-values reported in parentheses. See Table 3.12 in Appendix 3.A.1 for the definition of variables.

[1] Mean of ranking between one (centralized) and five (decentralized) of several corporate decisions depending on whether the headquarters of the parent firm (centralized) or the CEO (decentralized) takes the decision. The CEO is the subsidiary manager for *decentralization of subsidiary firm* or the divisional manager for *decentralization of parent firm* (see Table 3.12 in Appendix 3.A.1 for more details). For a listing of corporate decisions see Table 3.14 in Appendix 3.A.2.

[2] *Parent is a family firm* is the omitted category of *parent firm's organization*.

[3] *Many domestic competitors* and *many world competitors* refer to the subsidiary firm's market.

the Lerner index and the firm level measure of domestic competition in Austria and Germany with those in host countries (see Tables 3.13, 3.16 and 3.17 in Appendix 3.A.3) reveals, however, that competition does not seem to be weaker in host countries. It appears then that the results are driven by the fact that the firms in our data sample are multinational rather than national firms. Austrian and German multinationals relocate activities to Eastern Europe and the former Soviet Union in order to exploit the lower labor costs there. When competition intensifies in host countries the level of costs matters more for profits and hence multinationals centralize foreign affiliates to avoid the possibility that subsidiary managers choose activities which are more favorable to them than to the profits of the firm. The profit gain from having control dominates the profit loss from losing the initiative of subsidiary managers when multinationals relocate activities to low-cost host countries to save labor costs.

Furthermore, we find that subsidiaries centralize their organization in response to a greater exposure to international trade as measured by the import and export ratios at the sectoral level given in columns (4) and (5). The effect of a change in the trade ratios on the level of command in affiliates is, however, almost negligible. An increase in the trade ratios in host countries by ten percentage points reduces the level of decentralization in foreign affiliates by a rank of approximately 0.003 which is 0.08 percent. The negligible effect of the trade ratios on the level of decentralization of affiliates is, however, not surprising. The average trade ratio of a sector hides the true exposure to trade of individual firms. As suggested by recent literature on trade and firm heterogeneity (see Melitz, 2003; Bernard, Jensen, Redding, and Schott, 2007) the distribution of individual firms' trade exposure in a sector is particularly skewed. Only a small proportion of firms in a sector engage in trade activities (the extensive margin of trade) and produce a significant share of their output for the world market (the intensive margin of trade). Therefore, an increase in the trade ratio of the sector does not expose the mass of subsidiary firms in the sector to the critical level of international competition as is suggested by Marin and Verdier (2007) and thus affiliate firms do not significantly change the level of decentralization.

We introduce the firm level measure of trade *many world competitors* which is supposed to be better able to capture firms' true exposure to trade. Interestingly, we find that *many world competitors* is positively associated with the level of decentralization of affiliates (column (3)). When subsidiaries are faced with many foreign competitors rather than a few, they increase the level of decentralization by a rank of 0.09 which is 2.25 percent. We interpret the contrasting results of the two measures of trade as

suggesting that affiliates with a large number of foreign competitors reach the critical level of international competition and thus decentralize, whereas an increase in the trade ratio of the sector does not expose a sufficient number of firms in the sector to this critical level of trade and thus they remain centralized.[4]

Note that the estimated coefficients of the organizational variables do not change with the inclusion of the different measures of competition. The size of the estimated coefficients does, however, change with the inclusion of the trade ratios. This is, nevertheless, a result of a substantial drop in the sample size owing to the unavailability of data on trade shares for some of the Eastern European countries.

Surprisingly, the effective tariff rates on imports have no significant effect on the level of decentralization of foreign affiliates. A closer inspection of the data reveals, however, that Eastern European countries tend to have higher tariffs on imports in less productive sectors with lower profits. Hence, import tariffs and profits tend to be negatively (rather than positively) correlated.

Endogeneity

We proceed next to address the problem of endogeneity associated with using the level of decentralization of parent firms as a determinant of the level of decentralization of foreign affiliates. It could be argued that the level of decentralization of subsidiary firms may influence the level of command in parent firms rather than the other way around. Parent firms' involvement in foreign affiliates may crowd out the CEO's ability to monitor and control at headquarters. This trade-off between monitoring at home and abroad may then force parent firms to decentralize. In this case we would underestimate the true effect of the parents' level of decentralization on subsidiary firms. We address the potential endogeneity problem in Table 3.6.

We introduce the toughness of competition at the headquarters' firms' markets as an instrument for the level of decentralization of parent firms. The relevance of this instrument is motivated by the theory of decentralization of firms suggested by

[4] When we aggregate the firm level measure of trade *many world competitors* over all host countries and compare it with the firm level measure of trade for the two home countries Austria and Germany, we indeed find that host countries are on average much less exposed to international competition. About 30 percent of subsidiaries in host countries face *many world competitors* compared with 73 percent of parent firms in Austria and Germany. See Table 3.13 in Appendix 3.A.1.

Table 3.6: Level of Decentralization in Subsidiary Firms The Role of Competition and Trade: IV Estimates

Dependent Variable	Decentralization of Subsidiary Firm[1]					
	(1)	(2)	(3)	(4)	(5)	(6)
Decentralization of parent firm[1]	0.67***	0.60***	0.63***	0.36	0.38	0.28
	(0.00)	(0.00)	(0.00)	(0.45)	(0.43)	(0.29)
Parent is located in Germany	-0.30***	-0.28***	-0.29***	-0.47***	-0.46***	-0.35***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Parent is a subsidiary of foreign MNE[2]	-0.18***	-0.098	-0.17***	0.00085	-0.014	-0.088
	(0.01)	(0.12)	(0.01)	(1.00)	(0.97)	(0.71)
Parent is a subsidiary of domestic MNE[2]	0.048	0.11	0.089	0.31	0.30	0.19
	(0.55)	(0.16)	(0.23)	(0.21)	(0.24)	(0.18)
Parent is a domestic MNE[2]	-0.15	-0.067	-0.13	0.035	0.021	-0.077
	(0.12)	(0.45)	(0.18)	(0.92)	(0.95)	(0.68)
Log (Size of parent firm)	-0.052***	-0.047**	-0.054***	0.0056	0.0031	0.0097
	(0.01)	(0.02)	(0.00)	(0.92)	(0.96)	(0.79)
Log (Size of subsidiary firm)	0.045**	0.047**	0.047**	0.068***	0.069***	0.088***
	(0.02)	(0.02)	(0.01)	(0.00)	(0.00)	(0.00)
Number of affiliates	0.052	0.078*	0.040	0.29**	0.29*	0.26**
	(0.27)	(0.08)	(0.39)	(0.04)	(0.05)	(0.01)
(Number of affiliates)^2	-0.0056	-0.0079**	-0.0046	-0.028**	-0.028**	-0.026***
	(0.18)	(0.05)	(0.28)	(0.03)	(0.04)	(0.01)
Parent's ownership share	-0.14	-0.14	-0.15*	-0.24*	-0.24*	-0.30**
	(0.10)	(0.12)	(0.07)	(0.08)	(0.09)	(0.02)
Log (Distance)	0.047	0.087**	0.057	0.16*	0.16*	0.098
	(0.19)	(0.01)	(0.10)	(0.08)	(0.08)	(0.12)
Horizontal investment	0.26***	0.27***	0.29***	0.11	0.11	0.11
	(0.00)	(0.00)	(0.00)	(0.25)	(0.24)	(0.25)
Many domestic competitors[3]	-0.11**					
	(0.01)					
Subsidiary market Lerner		-0.013**				
		(0.04)				
Many world competitors[3]			0.14***			
			(0.01)			
Import share				-0.029		
				(0.32)		
Export share					-0.033	
					(0.27)	
Tariffs						-0.00099
						(0.61)
Country dummies	YES	YES	YES	YES	YES	YES
Industry dummies (3d)	YES	YES	YES	YES	YES	YES
Observations	1039	955	1032	373	375	371
Adjusted R^2	0.41	0.43	0.43	0.54	0.55	0.52
First Stage:						
Parent market Lerner[4]	0.033***	0.032***	0.035***	0.027	0.026	0.043**
	(0.00)	(0.00)	(0.00)	(0.21)	(0.22)	(0.03)
F-statistics[5]	19.29	16.55	21.25	1.59	1.53	4.96

* significant at 10%, ** significant at 5%, ***significant at 1%

Notes: Coefficients obtained by instrumental variable technique. P-values reported in parentheses. The instrument for the decentralization of parent firm is the variable *Parent market Lerner*. See Table 3.12 in Appendix 3.A.1 for the definition of variables.

[1] Mean of ranking between one (centralized) and five (decentralized) of several corporate decisions depending on whether the headquarters of the parent firm (centralized) or the CEO (decentralized) takes the decision. The CEO is the subsidiary manager for *decentralization of subsidiary firm* or the divisional manager for *decentralization of parent firm* (see Table 3.12 in Appendix 3.A.1 for more details). For a listing of corporate decisions see Table 3.14 in Appendix 3.A.2.

[2] *Parent is a family firm* is the omitted category of *parent firm's organization*.

[3] *Many domestic competitors* and *many world competitors* refer to the subsidiary firm's market.

[4] Estimated coefficients of the instrument *parent market Lerner* in the first stage regression.

[5] F-statistics for the significance of the instrument in the first stage regression.

Marin and Verdier (2007). They argue that the level of decentralization of firms will be governed by the toughness of competition in the market and they indeed find that the intensity of competition has a statistically significant effect on the level of decentralization of Austrian and German firms. We measure the instrument toughness of competition in headquarters' firms' markets by the Lerner index and denote it as *parent market Lerner*. The instrument can be considered as exogenous to the decentralization of subsidiary firms as it reflects the competitive conditions in parent firms' markets rather than in subsidiaries' firms' markets and the Lerner index for the headquarters' firms' markets is based on a large sample of firms at the three-digit ISIC level from the AMADEUS data. Therefore, we can safely exclude feedback effects from the level of decentralization of subsidiaries on the intensity of competition in parent firms' markets.

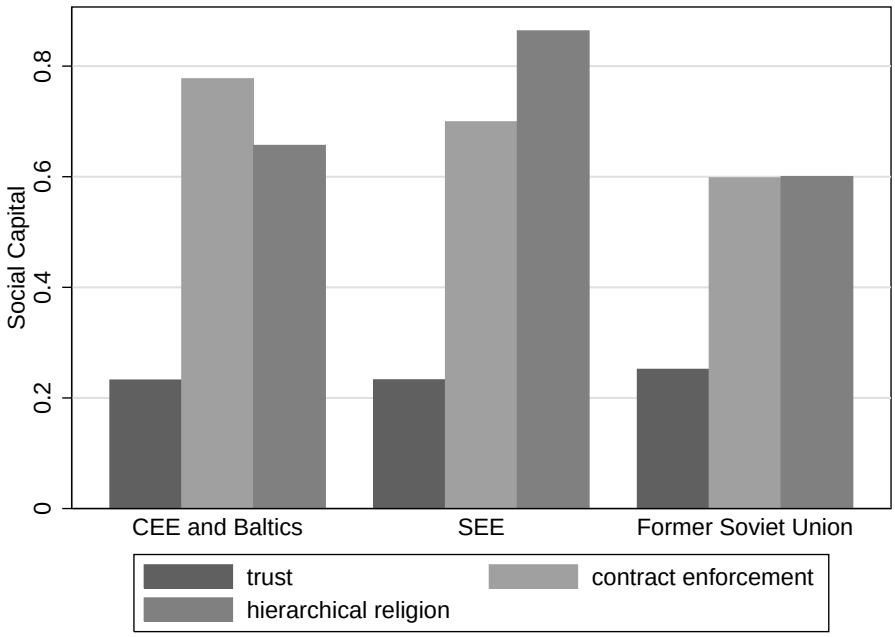
In Table 3.6 we indeed find that the level of competition in parent firms' markets is a relevant instrument as more competition is estimated to significantly increase the level of decentralization of parent firms in the first stage regressions (columns (1) to (3)). Moreover, the estimated effect of the parent firms' decentralization on the level of command in subsidiaries indeed turns out to be underestimated in the OLS regressions as the estimated coefficients increase now to over 0.6 compared with 0.4 before. In the IV regressions in columns (1) to (3) some of the other organizational variables now become insignificant or weakly significant, whereas the firm level measure of trade *many world competitors* now has a much stronger effect on the level of decentralization of subsidiaries. Turning to the results with the sectoral measures of trade in columns (4) to (6), we find that the Lerner index of headquarters' firms' markets is only a weak instrument and the level of decentralization of parent firms as well as the trade ratios becomes insignificant. We do not, however, have the same confidence in these regressions since the sample size drops to one-third and the sectoral trade ratios are less able to capture firms' true exposure to trade. Still, the sign of the estimated coefficients remains the same as in the OLS regressions and thus the direction of the estimated effects appears robust to the use of the alternative estimation technique.

Social Capital: Contract Enforcement, Trust, and Religion

Finally, we turn to other characteristics of the market environment which may have helped foreign affiliates to decentralize. Bloom, Sadun, and van Reenen (2009) have found that social capital as proxied by trust and the rule of law are positively associated with the level of decentralization in 4000 firms in the US, Europe, and Asia. We expect

these variables to play an even more important role in our data sample as our affiliates are often located in countries with very weak legal institutions and low protection of property rights. When contracts are not respected, trust and religion may become critical mechanisms for obtaining cooperation between parent firms and their subsidiary managers. Figure 3.4 indeed shows for three groups of host countries that contracts and trust appear to be substitutes as they are weakly negatively correlated.[5] Therefore, we include these measures of social capital in Table 3.7. We exclude the country fixed effects in the regressions when *trust* and *hierarchical religion* are included, since both are country-specific variables.

Figure 3.4: Social Capital in Host Regions



Notes: CEE refers to Central Eastern European countries (Czech Republic, Hungary, Slovakia, Slovenia, Poland), Baltics to Baltic countries (Estonia, Latvia, Lithuania), SEE to South Eastern European countries (Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Macedonia, Romania, Serbia), and Former Soviet Union includes Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan. The level of contract enforcement is used as a mean of ranking between one (important) and five (not important) factors affecting contract enforcement divided by five to obtain a measure in the range zero and one (for a listing of the factors see Table 3.12 in Appendix 3.A.1). The level of hierarchical religion is the proportion of people that list a hierarchical religion (Roman Catholic, Greek Catholic, Orthodox, Islam, Gregorian or Armenian Apostolic Church) to the question: "Do you belong to a religious denomination? If yes: Which one?" The level of trust is the proportion of people that answer "Most people can be trusted" to the question: "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?"

We find that multinationals tend to give subsidiary managers more autonomy when they perceive that contracts are well enforced in host countries. An improvement in *contract enforcement* by one rank in host countries (a 25 percent increase in the possible

[5]See also Figures 3.5, 3.6, and 3.7 in Appendix 3.A.3 for the level of contract enforcement, trust, and hierarchical religion in host countries, respectively.

Table 3.7: Level of Decentralization in Subsidiary Firms The Role of Contracts, Trust, and Religion

Dependent Variable	Decentralization of Subsidiary Firm[1]					
	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) IV	(6) IV
Decentralization of parent firm[1]	0.41***	0.41***	0.41***	0.41***	0.57***	0.56***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Parent is located in Germany	-0.28***	-0.28***	-0.27***	-0.28***	-0.27***	-0.27***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Parent is a subsidiary of foreign MNE[2]	-0.058	-0.041	-0.042	-0.054	-0.064	-0.060
	(0.41)	(0.55)	(0.54)	(0.44)	(0.31)	(0.34)
Parent is a subsidiary of domestic MNE[2]	0.21***	0.23***	0.23***	0.22***	0.15*	0.16**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.05)	(0.04)
Parent is a domestic MNE[2]	0.058	0.072	0.067	0.064	-0.028	-0.015
	(0.36)	(0.25)	(0.29)	(0.31)	(0.76)	(0.87)
Log (Size of parent firm)	-0.029**	-0.027*	-0.028**	-0.028*	-0.045**	-0.042**
	(0.04)	(0.06)	(0.05)	(0.05)	(0.01)	(0.01)
Log (Size of subsidiary firm)	0.067***	0.059***	0.059***	0.062***	0.054***	0.051***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Number of affiliates	0.12**	0.12***	0.12***	0.12**	0.091**	0.092**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.04)	(0.04)
(Number of affiliates)^2	-0.012***	-0.012***	-0.012***	-0.012***	-0.0092**	-0.0092**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.02)
Parent's ownership share	-0.21**	-0.22**	-0.21**	-0.21**	-0.18**	-0.19**
	(0.03)	(0.02)	(0.03)	(0.02)	(0.04)	(0.03)
Log (Distance)	0.069*	0.062**	0.050**	0.064**	0.082**	0.073***
	(0.09)	(0.01)	(0.04)	(0.01)	(0.02)	(0.00)
Horizontal investment	0.23**	0.23**	0.24**	0.24**	0.26***	0.26***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.00)	(0.00)
Subsidiary market Lerner	-0.014**	-0.015***	-0.011**	-0.016***	-0.014**	-0.015***
	(0.02)	(0.00)	(0.02)	(0.00)	(0.03)	(0.01)
Contract enforcement	0.10***	0.095***	0.092***	0.10***	0.13***	0.13***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Trust		0.55		1.56**		1.52**
		(0.28)		(0.01)		(0.02)
Hierarchical religion			0.089	0.27**		0.26**
			(0.30)	(0.01)		(0.02)
Country dummies	YES	NO	NO	NO	YES	NO
Industry dummies (3d)	YES	YES	YES	YES	YES	YES
Observations	946	946	946	946	941	941
Adjusted R^2	0.48	0.48	0.48	0.48	0.45	0.46
First Stage:						
Parent market Lerner[3]					0.040***	0.041***
					(0.00)	(0.00)
F-statistics[4]					26.69	27.52

* significant at 10%, ** significant at 5%, ***significant at 1%

Notes: OLS estimates with robust standard errors in columns (1) to (4) and IV estimates in columns (5) and (6). P-values reported in parentheses. The instrument for the decentralization of parent firm is the variable *parent market Lerner*. See Table 3.12 in Appendix 3.A.1 for the definition of variables.

[1] Mean of ranking between one (centralized) and five (decentralized) of several corporate decisions depending on whether the headquarters of the parent firm (centralized) or the CEO (decentralized) takes the decision. The CEO is the subsidiary manager for *decentralization of subsidiary firm* or the divisional manager for *decentralization of parent firm* (see Table 3.12 in Appendix 3.A.1 for more details). For a listing of corporate decisions see Table 3.14 in Appendix 3.A.2.

[2] *Parent is a family firm* is the omitted category of *parent firm's organization*.

[3] Estimated coefficients of the instrument *parent market Lerner* in the first stage regression.

[4] F-statistics for the significance of the instrument in the first stage regression.

range between one and five) induces affiliates to decentralize by a rank of 0.13 which is 3.25 percent. In other words, multinational parent firms in Austria and Germany appear not to delegate responsibility in decision-making to their subsidiary managers in host countries with weak legal institutions, because they may fear that subsidiary managers will exploit the opportunity and misuse the firms' assets under their control when the likelihood of punishment by the legal system is low. Similarly, we find that *trust* facilitates decentralization. A ten percentage point increase in the share of people who trust others leads to an increase in the level of decentralization of 0.16 ranks which is four percent. The estimated coefficient of *hierarchical religion* contradicts the findings of Bloom, Sadun, and van Reenen (2009). We find that a larger proportion of the population in a country belonging to a hierarchical religion (believing in authority) favors decentralization rather than centralization. One possible explanation is that non-hierarchical religions such as the Protestant Christian church are not very prevalent in Eastern Europe and the former Soviet Union. Therefore, the variable hierarchical religion may capture the total proportion of religious people in a country. In our sample, the correlation between these two variables is indeed 0.93. Note, however, that when the two variables are included separately in the estimation they cease to be significant.

Lastly, we show in columns (5) and (6) that the estimated coefficients of the variables on social capital are robust, when we instrument for parent firms' decentralization.

3.3.2 When Does Transplantation Happen?

The previous section has shown that multinationals are often able to imprint the level of decentralization on their foreign affiliates. At the same time, however, Table 3.1 shows that only 24 percent of foreign affiliates use the same organization as their parent firms. Why do multinationals transplant so infrequently? What determines whether or not multinationals transplant their business model across countries? Does this depend on "home-made", "host-made" or "organization-made" factors? In other words, are German firms by being located in a larger more competitive domestic market than Austrian firms better able to export their business culture abroad? Or is it the other way around and the likelihood to transplant does not depend on the natural advantage of the home market of multinationals but rather on how favorable host countries' markets are toward foreign affiliates with a different business model from that

of domestic firms?[6] Or is the ability or willingness to transplant driven by the global business organization of the multinational corporation rather than the characteristics of home and host countries' markets? We examine these questions in Tables 3.8 to 3.11.

Transplantation via Organization

In Table 3.8 we estimate the probability of transplantation in a Probit model in which the dependent variable is a dummy variable *transplantation via organization*. The dummy takes a value of one if each corporate decision has the same hierarchical rank in foreign affiliates as in parent firms or if one corporate decision differs in rank. In this case the organization is fully transplanted, otherwise (when more than one corporate decision differs in hierarchical rank) we consider the organization as not transplanted.[7]

In column (1) we estimate the baseline model including all variables determining the global business organization of the multinational corporation such as the level of *decentralization* of parent and subsidiary firms, *parent is subsidiary*, *number of affiliates*, *size of subsidiary*, *parent firms' ownership share* in the foreign affiliate and *distance*. We find that multinationals are more likely to transplant their business model to foreign affiliates in host countries when parent firms are more decentralized, the affiliates are larger and when multinationals have a larger number of affiliates (although the effect is nonlinear). Multinationals are, however, less likely to transplant when the affiliates are more decentralized and further away, when the parent firm is itself a subsidiary and when it has a larger stake in the subsidiary. The level of decentralization of the parent firm has an economically important effect on the likelihood to transplant. When the level of decentralization increases by one rank (the parent firm becomes more decentralized by 25 percent) then the probability to transplant the business model to the foreign affiliate increases by about 16 percentage points (for the partial effects of Table 3.8 see Table 3.9).

One variable stands out by virtue of its importance in the likelihood to transplant via organization, namely, the level of innovation of the *technology* transferred to foreign

[6] Bloom, Sadun, and van Reenen (2009) indeed find that multinationals tend to operate with a different business model by being more decentralized than national firms.

[7] As a robustness check we also use softer versions of full transplantation of organization with very similar results.

Table 3.8: Transplantation via Organization
The Role of Competition, Contracts, and Religion

Dependent Variable	Transplantation via Organization[1]					
	(1)	(2)	(3)	(4)	(5)	(6)
Decentralization of parent firm	0.75***	0.74***	0.79***	0.69***	0.79***	0.73***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Decentralization of subsidiary firm	-0.62***	-0.64***	-0.63***	-0.58***	-0.58***	-0.58***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Parent is located in Germany	0.51***	0.59***	0.50***	0.32*	0.66***	0.20
	(0.00)	(0.00)	(0.00)	(0.09)	(0.00)	(0.26)
Parent is a subsidiary	-0.24**	-0.27**	-0.37***	-0.39***	-0.40***	-0.33**
	(0.04)	(0.02)	(0.00)	(0.00)	(0.00)	(0.01)
Log (Size of subsidiary)	0.070*	0.085**	0.10**	0.10**	0.095**	0.077*
	(0.08)	(0.05)	(0.02)	(0.04)	(0.04)	(0.10)
Number of affiliates	0.56***	0.60***	0.62***	0.57***	0.68***	0.58***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
(Number of affiliates)^2	-0.044***	-0.048***	-0.051***	-0.046***	-0.057***	-0.047***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Log (Distance)	-0.23***	-0.35***	-0.36***	-0.33***	-0.40***	-0.21**
	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)
Parent's ownership share	-0.82***	-1.02***	-0.85***	-0.81***	-0.65**	-0.76***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)
Technology is established[2]	0.40***	0.46***	0.56***	0.37**	0.46***	0.38**
	(0.01)	(0.00)	(0.00)	(0.03)	(0.01)	(0.02)
Technology is innovative[2]	1.24***	1.22***	1.29***	1.27***	1.25***	1.32***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Many domestic competitors-subsidiary			0.72***			
			(0.00)			
Many domestic competitors-parent			-0.17			
			(0.30)			
Subsidiary market Lerner				0.045*		0.039*
				(0.09)		(0.06)
Parent market Lerner				0.084***		0.086***
				(0.00)		(0.00)
Many world competitors-subsidiary					0.43***	
					(0.01)	
Many world competitors-parent					-0.43***	
					(0.00)	
Contract enforcement						0.059
						(0.60)
Trust						-0.87
						(0.71)
Hierarchical religion						-0.46
						(0.25)
Country dummies	NO	YES	YES	YES	YES	NO
Industry dummies (2d)	YES	YES	YES	YES	YES	YES
Observations	933	920	887	794	865	785
Pseudo R^2	0.29	0.32	0.35	0.36	0.35	0.35

* significant at 10%, ** significant at 5%, ***significant at 1%

Notes: Probit estimates with robust standard errors. P-values reported in parentheses. See Table 3.12 in Appendix 3.A.1 for the definition of variables.

[1] A dummy that takes a value of one if the organization is fully transplanted and zero otherwise. The organization is fully transplanted if each corporate decision obtained the same hierarchical rank for the parent firm as for the subsidiary firm or if only one corporate decision differs.

[2] *Technology is outdated* is the omitted category of *technology*.

Table 3.9: Transplantation via Organization
The Role of Competition, Contracts, and Religion: Partial Effects[1]

Dependent Variable	Transplantation via Organization[2]					
	(1)	(2)	(3)	(4)	(5)	(6)
Decentralization of parent firm	16.5	16.1	14.6	14.4	15.4	15.0
Decentralization of subsidiary firm	-13.7	-13.9	-11.6	-12.1	-11.2	-12.3
Parent is located in Germany	13.7	14.9	10.9	7.3	15.7	6.8
Parent is a subsidiary	-5.2	-5.8	-7.0	-8.1	-7.9	-7.6
Log (Size of subsidiary)	1.5	1.8	1.9	2.1	1.8	2.0
Number of affiliates	12.3	13.0	11.6	11.8	13.2	12.6
Number of affiliates^2	-1.0	-1.0	-0.9	-1.0	-1.1	-1.0
Log (Distance)	-5.0	-7.7	-6.6	-6.9	-7.7	-6.4
Parent's ownership share	-18.1	-22.1	-15.7	-16.8	-12.6	-16.3
Technology is established[3]	8.5	9.6	9.7	7.3	8.4	7.9
Technology is innovative[3]	40.1	39.0	38.5	40.0	38.2	40.1
Many domestic competitors-subsidiary			13.6			
Many domestic competitors-parent			-3.1			
Subsidiary market Lerner				0.9		1.0
Parent market Lerner				1.8		1.8
Many world competitors-subsidiary					9.4	
Many world competitors-parent					-9.3	
Contract enforcement						0.8
Trust						0.0
Hierarchical religion						0.0
Country dummies	NO	YES	YES	YES	YES	NO
Industry dummies (2d)	YES	YES	YES	YES	YES	YES
Observations	933	920	887	794	865	785
Pseudo R^2	0.29	0.32	0.35	0.36	0.35	0.35

[1] Marginal effects at mean in percentage points for continuous variables and discrete changes from zero to one in percentage points for dummy variables based on Probit estimates with robust standard errors in Table 3.8. See Table 3.12 in Appendix 3.A.1 for the definition of variables.
[2] A dummy that takes a value of one if the organization is fully transplanted and zero otherwise. The organization is fully transplanted if each corporate decision obtained the same hierarchical rank for the parent firm as for the subsidiary firm or if only one corporate decision differs.
[3] *Technology is outdated* is the omitted category of *technology*.

affiliates. When the parent firm transfers an innovative technology rather than a fully established or even outdated technology (the omitted category) then the probability to transplant the organization to subsidiary firms is increased by 40 percentage points. It appears that technology transfer and organizational transfer are complements and go together.[8]

[8] This corresponds to evidence in Acemoglu, Aghion, Lelarge, van Reenen, and Zilibotti (2007); Bloom, Sadun, and van Reenen (2007). Bloom, Sadun, and van Reenen find that US firms do IT better than European firms because they are more decentralized, giving more flexibility and power to those workers that are implementing the technology.

Taken together the "organization-made" factors appear to be most important for the probability determining whether or not multinationals transplant their business model to foreign affiliates.

The positive and significant coefficient of the home country dummy *parent is located in Germany* rather than Austria does support the notion that "home-made" factors are also important for the likelihood to transplant. Multinational firms located in Germany rather than Austria are by some 15 percentage points more likely to transplant. This effect acts beyond and above the fact that German parent firms tend to be more decentralized than Austrian parent firms (which is already captured by the positive coefficient of decentralization of parent in the regression). Another important "home-made" factor is the level of competition and the exposure to trade in the home markets where headquarters' firms are located. It appears that more domestic competition in the parent firms' market increases the likelihood that transplantation takes place (as is suggested by *parent market Lerner*, but the firm level measure of competition *many domestic competitors* in the parent market is not significant at conventional levels). An increase of *parent market Lerner* by ten percentage points increases the probability to transplant by eighteen percentage points. This effect of competition on the probability to transplant is beyond and above the effect of decentralization of parent firms on the probability to transplant. This result indeed suggests that Germany is the more favorable home market for transplantation.[9] Furthermore, we find that when parent firms face *many world competitors* rather than a few they are less likely to transplant by nine percentage points.

We turn now to the influence of "host-made" factors on the probability to transplant the organization to subsidiary firms in host countries. In column (2) of Table 3.8 we include the host country dummies in the regression which increase the pseudo R^2 from 0.29 to 0.32, suggesting that "host-made" factors do play a role in explaining the probability to transplant. As in home countries, we expect the level of competition and trade in host countries to be important for the ability of multinationals to transplant. We indeed find this. The *Lerner* index and the firm level measure of *domestic competition* as well as *world competition* for the subsidiaries markets all indicate that transplantation is more likely when competition is tougher and trade exposure is stronger in host countries. An increase in the *subsidiary market Lerner* by ten percentage points increases the likelihood to transplant by nine percentage points and the

[9] Marin and Verdier (2007) show that more intense competition in the parents' markets has led parent firms to decentralize their organization. This finding is also in line with our first stage regression results in Table 3.6.

probability to transplant is fourteen and nine percentage points, respectively, larger when the subsidiary firm faces many rather than few domestic and foreign competitors (see columns (3) to (5) of Table 3.9).

Interestingly, contracts, trust, and hierarchical religion appear not to affect the probability to transplant via organization (column (6)).

Transplantation via CEO

Alternatively to transplanting via organization, the multinational firm may affect the business culture of the subsidiary firm by sending one or more managers from the parent firm to the host country to run the foreign affiliate. This seems to be a common practice, since more than 40 percent of foreign affiliates are run by CEOs of parent firms (see Table 3.1). We examine the probability of sending at least one manager to the foreign affiliate in Tables 3.10 and 3.11.

We run Probit regressions with the dependent variable *transplantation via CEO* which takes a value of one if at least one manager is sent from the parent firm to its subsidiary firm. Parent firms are more likely to send their own managers to run the affiliate firm when the parent and subsidiary firm is larger, when the parent firm is located in Austria rather than Germany, when the subsidiary firm is centralized and has little autonomy, when the multinational firm does not have too many affiliates and when the technology transferred to the foreign affiliate is innovative. Among these determinants, being an Austrian multinational which transfers a new technology to a foreign affiliate with little autonomy from the parent firm maximizes the chances that the multinational firm will send one or more CEOs to its foreign affiliate (see Table 3.11). As sending a manager is more likely when the subsidiary has little autonomy from the parent firm, the two ways of transplanting appear to be complements which reinforce each other in helping the parent firm to exert control over its subsidiary firm. In addition, it appears that Austrian multinationals are less likely to *transplant via organization* but rather imprint their business culture on their subsidiaries by sending CEOs.

We now turn to the influence of the market environment on the probability of sending a CEO to the subsidiary given in columns (2) to (4) of Tables 3.10 and 3.11.

Table 3.10: Transplantation via CEO
The Role of Competition, Contracts, and Religion

Dependent Variable	Transplantation via CEO[1]							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Decentralization of parent firm	0.016	0.087	0.037	-0.085	0.012	0.0073	0.0045	0.0073
	(0.88)	(0.41)	(0.74)	(0.42)	(0.91)	(0.95)	(0.97)	(0.95)
Decentralization of subsidiary firm	-0.34***	-0.44***	-0.40***	-0.22	-0.40***	-0.35**	-0.34**	-0.34**
	(0.01)	(0.00)	(0.00)	(0.11)	(0.01)	(0.01)	(0.02)	(0.02)
Parent is located in Germany	-1.08***	-1.29***	-0.95***	-0.98***	-1.41***	-1.44***	-1.48***	-1.50***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Log (Size of parent firm)	0.20***	0.24***	0.15**	0.24***	0.27***	0.24***	0.25***	0.25***
	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Log (Size of subsidiary firm)	0.11*	0.11**	0.14**	0.12**	0.075	0.091*	0.080	0.078
	(0.06)	(0.05)	(0.03)	(0.05)	(0.19)	(0.08)	(0.13)	(0.13)
Number of affiliates	-0.083***	-0.10***	-0.085**	-0.11***	-0.10***	-0.12***	-0.12***	-0.12***
	(0.01)	(0.00)	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Technology is established[2]	0.25	0.17	0.36*	0.24	0.17	0.12	0.12	0.12
	(0.17)	(0.35)	(0.08)	(0.19)	(0.34)	(0.50)	(0.49)	(0.51)
Technology is innovative[2]	0.67**	0.67**	0.80***	0.71**	0.60**	0.66**	0.62**	0.60**
	(0.02)	(0.01)	(0.01)	(0.01)	(0.03)	(0.02)	(0.02)	(0.03)
Many domestic competitors-subsidiary		-0.60***			-0.61***	-0.48**	-0.49**	-0.49**
		(0.01)			(0.01)	(0.03)	(0.03)	(0.03)
Many domestic competitors-parent		0.48**			0.45**	0.42*	0.42*	0.43*
		(0.03)			(0.04)	(0.06)	(0.06)	(0.06)
Subsidiary market Lerner			-0.049*					
			(0.10)					
Parent market Lerner			0.0095					
			(0.74)					
Many world competitors-subsidiary				-0.40*				
				(0.06)				
Many world competitors-parent				-0.39*				
				(0.06)				
Contract enforcement					-0.46***	-0.28**	-0.31**	-0.32**
					(0.00)	(0.02)	(0.01)	(0.01)
Trust						0.81		-1.33
						(0.56)		(0.46)
Hierarchical religion							-0.57*	-0.76*
							(0.08)	(0.07)
Country dummies	YES	YES	YES	YES	YES	NO	NO	NO
Industry dummies (3d)	YES	YES	YES	YES	YES	YES	YES	YES
Observations	552	549	480	547	549	559	559	559
Pseudo R^2	0.24	0.26	0.23	0.26	0.27	0.24	0.25	0.25

* significant at 10%, ** significant at 5%, ***significant at 1%

Notes: Probit estimates with robust standard errors. P-values reported in parentheses. See Table 3.12 in Appendix 3.A.1 for the definition of variables.

[1] A dummy that takes a value of one if at least one manager is sent from the parent firm to the subsidiary firm and zero otherwise.

[2] *Technology is outdated* is the omitted category of *technology*.

Table 3.11: Transplantation via CEO
The Role of Competition, Contracts, and Religion: Partial Effects[1]

Dependent Variable	Transplantation via CEO[2]							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Decentralization of parent firm	-13.1	-17.1	-15.1	-8.5	-15.2	-13.3	-12.9	-13.0
Decentralization of subsidiary firm	0.6	3.3	1.4	-3.3	0.5	0.3	0.2	0.3
Parent is located in Germany	-32.8	-36.1	-28.1	-30.5	-37.5	-38.1	-38.6	-38.9
Log (Size of parent)	7.6	9.3	5.7	9.1	10.4	9.2	9.6	9.6
Log (Size of subsidiary)	4.1	4.3	5.1	4.5	2.9	3.5	3.0	3.0
Number of affiliates	-3.2	-3.9	-3.2	-4.3	-4.0	-4.6	-4.5	-4.5
Technology is established[3]	9.4	6.5	13.3	9.3	6.6	4.5	4.5	4.4
Technology is innovative[3]	26.2	26.3	31.0	27.8	23.5	25.8	24.2	23.5
Many domestic competitors-subsidiary		-22.8			-22.9	-18.2	-18.5	-18.6
Many domestic competitors-parent		18.2			17.1	16.0	16.1	16.2
Subsidiary market Lerner			-1.9					
Parent market Lerner			0.4					
Many world competitors-subsidiary				-14.9				
Many world competitors-parent				-15.3				
Contract enforcement					-17.8	-10.8	-11.9	-12.3
Trust						30.8		-50.8
Hierarchical religion							-21.6	-29.1
Country dummies	YES	YES	YES	YES	YES	NO	NO	NO
Industry dummies (3d)	YES	YES	YES	YES	YES	YES	YES	YES
Observations	552	549	480	547	549	559	559	559
Pseudo R^2	0.24	0.26	0.23	0.26	0.27	0.24	0.25	0.25

[1] Marginal effects at mean in percentage points for continuous variables and discrete changes from zero to one in percentage points for dummy variables based on Probit estimates with robust standard errors in Table 3.10. See Table 3.12 in 3.A.1 for the definition of variables.
[2] A dummy that takes a value of one if at least one manager is sent from the parent firm to the subsidiary firm and zero otherwise.
[3] *Technology is outdated* is the omitted category of *technology*.

We start with the host countries' markets. More domestic competition in the subsidiary firms' markets (given by the *subsidiary market Lerner* and by the firm level measure *many domestic competitors*) as well as a stronger exposure to trade (measured by *many world competitors*) makes it less likely that the parent firms will send their own managers to run the subsidiary. A possible explanation is that when the subsidiary is faced with tough domestic and foreign competition, the local knowledge of the market becomes more important and hence local rather than foreign CEOs tend to be employed to run the subsidiary. Turning to the parent firms' markets, we find that more domestic competition favors engaging the parent firm's CEO in the foreign affiliate (at least according to the firm level measure of domestic competition), whereas a greater exposure to trade of the parent firm tends to make it less likely that the multinational will send its manager to the affiliate. A possible explanation for the latter result is given by the model of Marin and Verdier (2004) and the evidence in Marin (2009). With a greater exposure to trade in the parent firms' market a "war for manager talent" may be leading foreign firms to compete with incumbent firms for manager talent, making the available managers in the parent firms' market more scarce. This trade-induced scarcity of managers in the parent firms' market makes it less likely that parent firms will send additional managers to their affiliates in host countries. The parent and subsidiary firm's market conditions are economically important for the probability of sending a CEO. *Many world competitors* at the parent market or *many domestic competitors* at the subsidiary market rather than few make it less likely by 15 to 23 percentage points that a manager is sent to the affiliate.

Interestingly, although the social capital variables do not change the probability to transplant the organization to the affiliate, they do affect the probability to send a manager to the affiliate. In host countries with working legal institutions and good contract enforcement it is less likely (and probably less important) that the multinational firm will send its own manager to control the subsidiary. A larger proportion of the population in the host countries belonging to hierarchical religion and thus believing in authority makes it also less likely that a parent firm's manager is employed in the subsidiary. One possible reason is that the belief in authority does not extend to foreign managers. Another possible explanation is that in countries with a larger proportion of religious people in the population it is less likely that workers shirk their duty and hence it is less important to exert control.

3.4 Conclusions

In this chapter we investigate with unique data on 660 headquarters' firms in Austria and Germany with their 2200 foreign affiliates in Eastern Europe including the former Soviet Union countries the conditions under which foreign affiliates decentralize their decision-making and implement the business model of their multinational parent firms.

We find that one variable stands out in terms of importance for the level of decentralization of subsidiary firms, namely the level of decentralization of parent firms. We also identify other organizational variables as central in the decision to decentralize the subsidiary such as the size of the multinational corporation and whether the foreign affiliate is a horizontal rather than a vertical foreign direct investment. In addition, the competitive and trading environments in host countries play a role in the level of decentralization of subsidiaries. Interestingly, we find in contrast to the available empirical literature on national firms that multinational firms centralize their subsidiaries with more competition than national firms. The trade exposure, in turn, turns out to favor decentralization of the subsidiary. The effect of competition on the level of decentralization of the subsidiaries is robust to different measures of competition. Moreover, the results remain unchanged when we deal with the possible problem of endogeneity of the parent's firm organization. We use the parent firms' level of competition in their home market as an instrument for their organization. Finally, we somewhat confirm the results of the importance of social capital for the level of decentralization found in a previous paper on national firms, namely, that trust and contract enforcement tend to facilitate decentralization.

In contrast to the decision to decentralize, the decision to transplant the business model to the foreign affiliate is more strongly affected by the market conditions in both the home and host country, whereas trust, contracts and religion in host countries appear to be less decisive. We examine two ways of transplanting the multinational business model to the foreign affiliate, one via transplanting the organization and one via transplanting the CEO. We find that tougher domestic and foreign competition in the subsidiary markets favors transplantation via organization but hinders transplantation via manager. Tougher domestic competition in the parent market, however, favors both types of transplantation whereas foreign competition in parent markets decreases the likelihood that multinationals transplant via organization as well as via CEO. Transplantation of organization and of CEO appear to be weak complements

although German multinationals tend to go for transplanting via the organization and Austrian multinationals for transplanting via the CEO.

3.A Appendices to Chapter 3

3.A.1 Data and Descriptives

Table 3.12: Description of Variables and Data Sources

Variable	Description
1. Organization of the Multinational Corporation	
Organization of the Parent Firm	
Decentralization of parent firm	mean of ranking between one (centralized) and five (decentralized) of several corporate decisions depending on whether the headquarters (centralized) or the divisional manager of the parent firm (decentralized) takes the decision; see Table 3.14 for a listing of corporate decisions
Parent is located in Germany	dummy that takes a value of one if the parent firm is located in Germany and zero otherwise
Parent firm's organization	categorical variable with four categories: parent is a family firm, parent is a subsidiary of a foreign MNE, parent is a subsidiary of domestic MNE and parent is a domestic MNE; a more detailed description of the categories follows
↪ Parent is a family firm	dummy that takes a value of one if the parent firm is a family firm (i.e. independent firm with subsidiaries only in Eastern Europe) and zero otherwise
↪ Parent is a subsidiary of foreign MNE	dummy that takes a value of one if the parent firm is a subsidiary of foreign multinational and zero otherwise
↪ Parent is a subsidiary of domestic MNE	dummy that takes a value of one if the parent firm is a subsidiary of domestic (Austrian/German) multinational and zero otherwise
↪ Parent is a domestic MNE	dummy that takes a value of one if the parent firm is a domestic (Austrian/German) multinational and zero otherwise
Parent is a subsidiary	dummy that takes a value of one if the parent firm is a subsidiary of a larger (foreign or domestic) multinational and zero otherwise
Organization of the Subsidiary Firm	
Decentralization of subsidiary firm	mean of ranking between one (centralized) and five (decentralized) of several corporate decisions depending on whether the headquarters of the parent firm (centralized) or the subsidiary manager (decentralized) takes the decision; see Table 3.14 for a listing of corporate decisions

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Variable	Description
Transplantation via organization	dummy that takes a value of one if the organization is fully transplanted from the parent firm to its subsidiary and zero otherwise; full transplantation means that either each corporate decision obtained the same hierarchical rank for the parent firm as for the subsidiary firm or only one corporate decision differs
Transplantation via CEO	dummy that takes a value of one if at least one manager is sent from the parent firm to the subsidiary and zero otherwise
Intra-firm trade	share of intra-firm imports from the subsidiary firm to the parent firm in parent sales
Parent's ownership share	parent firm's ownership share in the subsidiary firm
Distance	distance between the parent and the subsidiary firm in km
Horizontal investment	share of output sold by the subsidiary firm at its domestic market
Technology	categorical variable with three categories: technology is outdated, established, and new; a more detailed description of the categories follows
↪ Technology is outdated	dummy that takes a value of one if the technology of the investment project is fully established or outdated and zero otherwise
↪ Technology is established	dummy that takes a value of one if the technology of the investment project is relatively established and zero otherwise
↪ Technology is innovative	dummy that takes a value of one if the technology of the investment project is new and zero otherwise
Country dummies	country dummies for the location of subsidiary firm
Industry dummies (3d)	three-digit industry dummies for the subsidiary firm based on ISIC Rev. 3
Industry dummies (2d)	two-digit industry dummies for the subsidiary firm based on ISIC Rev. 3
2. Size of the Multinational Corporation	
Size of parent firm	number of employees of parent firm
Size of subsidiary firm	number of employees of subsidiary firm
Number of affiliates	number of affiliates in Eastern Europe of parent firm; more than nine subsidiaries are coded as nine subsidiaries
3. Market Environment	
Competition	
Many domestic competitors ↪ subsidiary/parent	dummy that takes a value of one if the subsidiary/parent firm has many competitors at the domestic market and zero otherwise

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Variable	Description
Lerner ↪ subsidiary/parent market	for a three-digit ISIC Rev. 3 industry j of country k: $$\text{Lerner}_{jk} = \left(1 - \frac{1}{N_{jk}} \sum_{i \in jk} \frac{\text{profit before taxes}_i}{\text{operating revenue}_i}\right) * 100\%,$$ where N_{jk} denotes the number of firms i in industry j of country k; a simple average over the years 1996 to 2000 is taken in addition; parent market and subsidiary market Lerner denotes the Lerner index calculated for host countries and for Austria/Germany, respectively *Data source: AMADEUS database (Bureau van Dijk, 2005)*
Trade	
Many world competitors ↪ subsidiary/parent	dummy that takes a value of one if the subsidiary/parent firm has many competitors worldwide and zero otherwise
Import share	total imports divided by domestic production at the three-digit ISIC Rev. 3 level in host countries and averaged over the years 1996 to 2000; when the three-digit level information is missing, the two-digit ISIC level is used
Export share	total exports divided by domestic production at the three-digit ISIC Rev. 3 level in host countries and averaged over the years 1996 to 2000; when the three-digit level information is missing, the two-digit ISIC level is used *Source of trade data: WITS - UN COMTRADE database (World Bank, 2009)* *Source of production data: INDSTAT 4 (three-digit), STAN (two-digit) database (UNIDO, 2008; OECD, 2009)*
Tariffs	average effective tariffs on imports in host countries over the years 1996 to 2000 at the three-digit ISIC Rev. 3 level; when the three-digit level information is missing, the two-digit ISIC level is used *Data source: WITS - TRAINS database (World Bank, 2009)*
Social Capital in Host Countries	
Contract enforcement	mean of ranking between one (important) and five (not important) factors affecting contract enforcement; these factors include the risk of profit transfer, exchange rate volatility, expropriation, changes in taxes resp. tariffs, property rights, macro-economic instability, political turnaround, corruption, crime and mafia, and banking sector collapse
Trust	proportion of people that answer "Most people can be trusted" to the question: "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?" *Data source: World Values Survey, wave 1995–1999 (WVS Organization, 2009)*

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Variable	Description
Hierarchical religion	proportion of people that list a hierarchical religion (Roman Catholic, Greek Catholic, Orthodox, Islam, Gregorian or Armenian Apostolic Church) to the question: "Do you belong to a religious denomination? If yes: Which one?" *Data source: World Values Survey, wave 1995–1999 (WVS Organization, 2009)*

Notes: If not reported otherwise, the data come from a survey of 660 German and Austrian firms with 2200 investment projects in Eastern Europe, conducted by the Chair of International Economics at the University of Munich.

Table 3.13: Descriptive Statistics

Variable	Obs.	Mean	Min	Max	Std. Dev.	Obs. with dummy = 1
1. Organization of the Multinational Corporation						
Organization of the Parent Firm						
Decentralization of parent firm	1472	2.81	1	5	0.84	.
Parent is located in Germany	2123	0.56	0	1	0.50	1186
Parent is a family firm	2123	0.16	0	1	0.36	333
Parent is a subsidiary of foreign MNE	2123	0.18	0	1	0.38	372
Parent is a subsidiary of domestic MNE	2123	0.31	0	1	0.46	657
Parent is a domestic MNE	2123	0.36	0	1	0.35	761
Parent is a subsidiary	2123	0.48	0	1	0.50	1029
Organization of the Subsidiary Firm						
Decentralization of subsidiary firm	1388	2.95	1	5	0.69	.
Transplantation via organization	1335	0.24	0	1	0.43	318
Transplantation via CEO	751	0.41	0	1	0.49	306
Intra-firm trade	1934	0.021	0	1	0.090	.
Parent's ownership share	2093	0.86	0	1	0.23	.
Distance	2122	903.04	17	6000	799.24	.
Horizontal investment	1981	0.82	0	1	0.36	.
Technology is outdated	1826	0.32	0	1	0.47	585
Technology is established	1826	0.60	0	1	0.49	1099
Technology is innovative	1826	0.08	0	1	0.27	142
2. Size of the Multinational Corporation						
Size of parent firm	1993	6970.20	1	233000	25233.78	.
Size of subsidiary firm	1921	346.61	1	49000	1660.02	.
Number of affiliates	2123	5.41	1	9	3.01	.
3. Market Environment						
Competition						
Many domestic competitors-subsidiary	1978	0.46	0	1	0.50	900
Many domestic competitors-parent	2058	0.46	0	1	0.50	940
↪ Austria	936	0.45	0	1	0.50	424
↪ Germany	1122	0.46	0	1	0.50	516
Subsidiary market Lerner	1900	96.57	54.73	124.56	4.42	.
Parent market Lerner	2053	93.68	73.15	121.58	6.14	.
↪ Austria	890	92.83	77.52	121.58	6.58	.
↪ Germany	1163	94.32	73.15	119.61	5.69	.
Trade						
Many world competitors-subsidiary	1938	0.29	0	1	0.45	563
Many world competitors-parent	2010	0.73	0	1	0.45	1463
↪ Austria	934	0.72	0	1	0.45	675
↪ Germany	1076	0.73	0	1	0.44	788
Import share	827	0. 67	0.0028	23.74	1.18	.
Export share	843	0.53	0.0039	25.17	1.07	.
Tariffs	875	10.17	0	246.08	19.37	.
Social Capital in Host Countries						
Contract enforcement	2064	3.73	1	5	0.71	.
Trust	2101	0.23	0.082	0.52	0.045	.
Hierarchical religion	2100	0.68	0.17	0.98	0.21	.

3.A.2 Corporate Decisions

Table 3.14: Corporate Decisions in Subsidiary and Parent Firms

Corporate decision[1]	Mean level of decentralization[2]	
	Subsidiary firms	Parent firms
on acquisitions	1.41	1.34
on a new strategy	1.88	1.90
on transfer prices	2.43	2.45
financial decisions	2.54	1.90
on R&D expenditure	2.58	2.79
on budget	2.72	2.70
to introduce a new product	2.80	2.76
to hire 20 new workers	2.82	2.51
to change of a supplier	3.23	3.09
on product price	3.75	3.48
on wage increase	4.10	3.45
to hire two new workers	4.26	3.67
to hire a new secretary	4.65	4.15

[1] The corporate decisions listed were collected for both German and Austrian parent firms as well as all subsidiary firms and are sorted from the most centralized to the most decentralized based on subsidiaries.
[2] Mean over the rank of one to five with one (centralized) in which solely the headquarters of the parent firm take the decision and five (decentralized) in which the decision is delegated to the divisional manager (parent firm) or to the subsidiary manager (subsidiary firm).

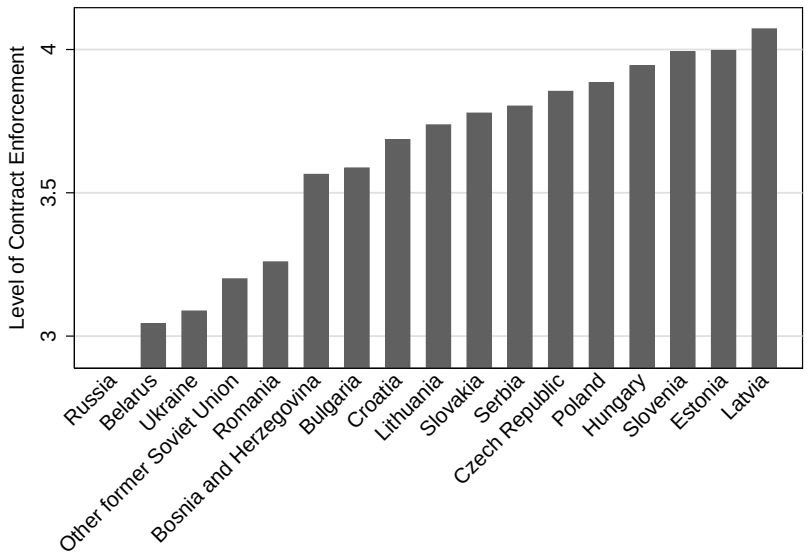
Table 3.15: Similarity of Corporate Decisions between Subsidiaries and Parent Firms

	Panel A		Panel B		Panel C							
Subsidiaries with decision:	**same**	**different**	**more centralized**	**more decentralized**	**more centralized**					**more decentralized**		
Decision[1] on	**Similarity index[2] =0**	**≠ 0**	**Similarity index[2] <0**	**>0**	**-4**	**-3**	**-2**	**-1**	**1**	**2**	**3**	**4**
acquisitions	1008	288	151	137	2	1	23	125	61	46	8	22
	78%	22%	12%	11%	0%	0%	2%	10%	5%	4%	1%	2%
to hire a	897	387	90	297	9	0	34	47	80	53	48	116
new secretary	70%	30%	7%	23%	1%	0%	3%	4%	6%	4%	4%	9%
to hire two	820	468	77	391	1	2	11	63	123	136	55	77
new workers	64%	36%	6%	30%	0%	0%	1%	5%	10%	11%	4%	6%
to change	714	448	159	289	20	13	38	88	203	46	7	33
a supplier	61%	39%	14%	25%	2%	1%	3%	8%	17%	4%	1%	3%
on transfer	660	417	208	208	22	32	52	102	116	58	6	28
prices	61%	39%	19%	19%	2%	3%	5%	9%	11%	5%	1%	3%
on budget	793	520	256	264	4	8	129	115	119	121	13	11
	60%	40%	19%	20%	0%	1%	10%	9%	9%	9%	1%	1%
to hire 20	752	521	146	375	0	31	45	70	160	174	25	16
new workers	59%	41%	11%	29%	0%	2%	4%	5%	13%	14%	2%	1%
to introduce	661	532	266	266	16	35	69	146	108	110	20	28
a new product	55%	45%	22%	22%	1%	3%	6%	12%	9%	9%	2%	2%
on wage	699	574	137	437	12	12	53	60	115	134	59	129
increase	55%	45%	11%	34%	1%	1%	4%	5%	9%	11%	5%	10%
on product	659	570	212	358	17	44	66	85	125	134	42	57
price	54%	46%	17%	29%	1%	4%	5%	7%	10%	11%	3%	5%
on a new	702	588	298	290	6	12	112	168	173	106	5	6
strategy	54%	46%	23%	22%	0%	1%	9%	13%	13%	8%	0%	0%
financial	610	556	113	443	0	12	40	61	174	130	71	68
decisions	52%	48%	10%	38%	0%	1%	3%	5%	15%	11%	6%	6%
on R&D	235	230	141	89	11	16	61	53	30	40	14	5
expenditure	51%	49%	30%	19%	2%	3%	13%	11%	6%	9%	3%	1%

Notes: The table reports absolute number of subsidiary firms and percent of subsidiary firms.
[1] Corporate decisions are sorted from the most similar decisions in subsidiary firms compared with parent firms to the least similar decisions.
[2] The similarity index is computed as the hierarchical level at which the decision is taken in the subsidiary firm minus the hierarchical level at which the decision is taken in the parent firm. Since the possible hierarchical levels are 1, 2, . . . , 5 for both the parent and the subsidiary firm, the similarity index takes values in the interval (-4, 4).

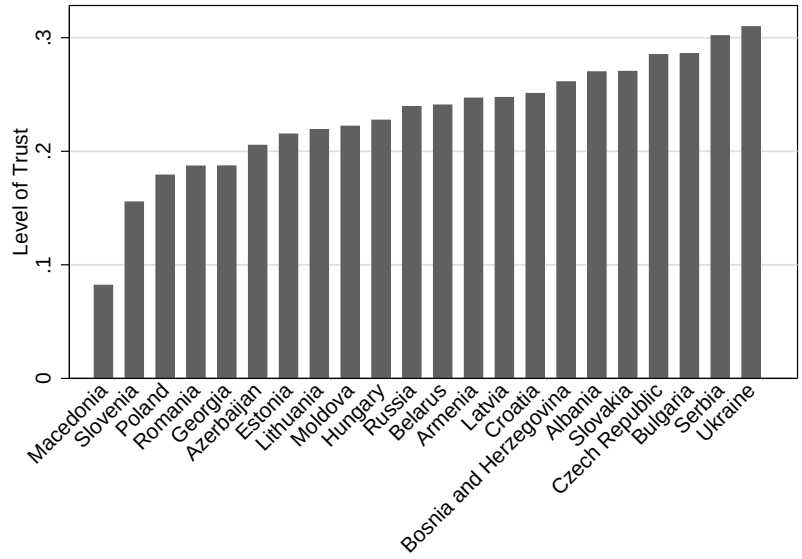
3.A.3 Market Environment in Host Countries

Figure 3.5: Level of Contract Enforcement in Host Countries



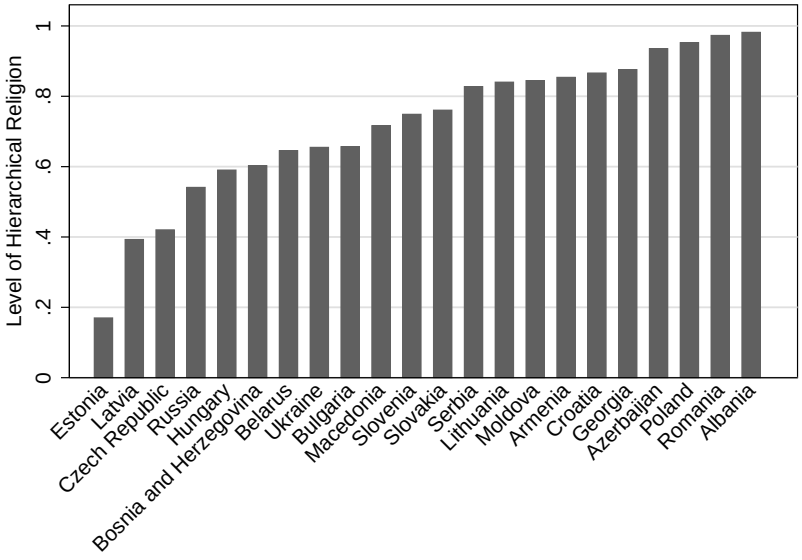
Notes: The level of contract enforcement is as a mean of ranking between one (important) and five (not important) factors affecting contract enforcement; these factors include the risk of profit transfer, exchange rate volatility, expropriation, changes in taxes resp. tariffs, property rights, macro-economic instability, political turnaround, corruption, crime and mafia, and banking sector collapse. "Other former Soviet Union" refers to Armenia, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Tajikistan, Turkmenistan and Uzbekistan. The aggregation achieves at least eight observations per bar.

Figure 3.6: Level of Trust in Host Countries



Notes: The level of trust is the proportion of people that answer "Most people can be trusted" to the question: "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?"

Figure 3.7: Level of Hierarchical Religion in Host Countries



Notes: The level of hierarchical religion is the proportion of people that list a hierarchical religion (Roman Catholic, Greek Catholic, Orthodox, Islam, Gregorian or Armenian Apostolic Church) to the question: "Do you belong to a religious denomination? If yes: Which one?"

Table 3.16: Market Environment: the Czech Republic and Hungary

ISIC Rev. 3 Classification		Czech Republic				Hungary			
ISIC	Code and Name of Product[1]	Import	Export	Tariffs	Lerner	Import	Export	Tariffs	Lerner
A	**Agriculture, hunting and forestry**								
1	Agriculture, hunting and related service activities	0.16	0.06	4.26	101.34	0.06	0.11	20.15	96.55
2	Forestry, logging and related service activities	0.01	0.03	1.02	100.62	0.10	0.26	8.36	98.14
B	**Fishing**								
5	Fishing, operation of fish hatcheries and fish farms	0.00	0.02	0.71	98.42	0.06	0.29	13.24	99.38
C	**Mining**								
10	Mining of coal and lignite; extraction of peat	0.04	0.24	0.85	99.63	0.80	0.01	3.89	98.11
11	Extraction of crude petroleum and natural gas	1.10	0.01	0.00	93.07	14.76	0.00	0.69	95.12
12	Mining of uranium and thorium ores	0.00	.	.	108.21	.	.	.	.
13	Mining of metal ores	.	.	.	.	0.91	0.02	0.05	99.03
14	Other mining and quarrying	23.74	25.17	0.37	96.63	0.42	0.07	2.43	88.03
D	**Manufacturing**								
15	Manufacture of food products and beverages	0.14	0.10	11.14	100.11	0.11	0.26	37.99	96.67
16	Manufacture of tobacco products	0.01	0.01	40.88	92.77	0.04	0.19	76.50	93.23
17	Manufacture of textiles	0.40	0.44	5.27	102.39	1.20	0.55	7.26	96.86
18	Manufacture of wearing apparel; dressing and dyeing of fur	0.19	0.31	5.14	100.28	0.26	0.80	10.05	90.23
19	Tanning and dressing of leather	0.43	0.37	5.00	102.93	0.88	0.84	6.96	92.28
20	Manufacture of wood and of products of wood and cork, except furniture	0.53	1.30	4.56	100.02	0.33	0.42	4.78	95.62
21	Manufacture of paper and paper products	0.27	0.21	6.70	102.45	1.02	0.43	5.11	94.97
22	Publishing, printing and reproduction of recorded media	0.28	0.26	4.06	99.05	0.14	0.06	4.76	93.84
23	Manufacture of coke, refined petroleum products and nuclear fuel	0.04	0.03	2.43	97.62	0.14	0.16	1.89	95.16
24	Manufacture of chemicals and chemical products	2.07	1.21	3.57	98.77	0.97	0.51	4.50	93.50
25	Manufacture of rubber and plastics products	3.29	2.58	5.18	98.10	0.71	0.40	9.69	93.40
26	Manufacture of other non-metallic mineral products	0.25	0.58	6.24	98.51	0.36	0.31	5.39	95.42
27	Manufacture of basic metals	0.20	0.20	3.66	101.77	0.79	0.50	3.73	94.38
28	Manufacture of fabricated metal products, except machinery and equipment			4.38	99.74	0.44	0.31	6.76	92.37
29	Manufacture of machinery and equipment n.e.c.	0.28	0.29	3.92	99.86	1.30	0.65	6.37	93.20
30	Manufacture of office, accounting and computing machinery	0.17	0.06	3.64	97.56	0.63	0.98	5.07	92.60
31	Manufacture of electrical machinery and apparatus n.e.c.	4.12	4.21	5.32	98.39	0.61	0.77	7.52	91.58
32	Manufacture of radio, television and communication equipment and apparatus	0.52	0.28	4.44	95.86	0.99	0.74	8.04	92.54
33	Manufacture of medical, precision and optical instruments, watches and clocks	0.63	0.27	4.66	97.58	1.03	0.49	6.42	92.37
34	Manufacture of motor vehicles, trailers and semi-trailers	0.37	0.58	6.86	99.71	0.56	0.70	9.60	91.71
35	Manufacture of other transport equipment	0.10	0.11	5.47	103.48	0.51	0.40	5.77	96.09
36	Manufacture of furniture; manufacturing n.e.c.	0.25	0.53	7.09	97.94	0.73	0.95	6.61	95.81
E	**Electricity, gas and water supply**								
40	Electricity, gas, steam and hot water supply	0.01	0.02	0.28	99.66	0.03	0.03	0.00	98.37

Notes: Import, Export and Lerner stand for *import share*, *export share*, and *subsidiary market Lerner*, respectively. See Table 3.12 in 3.A.1 for the definition of variables.
[1] For the exact name of product see http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=2.

Table 3.17: Market Environment: Poland and Slovakia

ISIC Rev. 3 Classification		Poland				Slovak Republic		
ISIC Code	Name of Product[1]	Import	Export	Tariffs	Lerner	Import	Export	Lerner
A	**Agriculture, hunting and forestry**							
1	Agriculture, hunting and related service activities	0.08	0.02	23.83	99.90	0.12	0.06	100.26
2	Forestry, logging and related service activities	0.04	0.04	32.85	93.47	0.04	0.15	97.57
B	**Fishing**							
5	Fishing, operation of fish hatcheries and fish farms	0.13	0.09	9.20	94.35	1.40	0.51	.
C	**Mining**							
10	Mining of coal and lignite; extraction of peat	0.02	0.19	2.61	105.58	2.49	0.00	101.09
11	Extraction of crude petroleum and natural gas	56.82	0.14	0.09	92.73	9.90	0.02	.
12	Mining of uranium and thorium ores	.	.	.	.	.	.	.
13	Mining of metal ores	.	.	0.53	92.04	5.00	0.25	.
14	Other mining and quarrying	.	.	0.76	95.20	0.43	0.60	93.99
D	**Manufacturing**							
15	Manufacture of food products and beverages	0.09	0.10	42.90	98.96	0.23	0.12	99.05
16	Manufacture of tobacco products	0.01	0.04	246.07	99.61	0.59	0.28	.
17	Manufacture of textiles	1.03	0.36	6.82	98.59	1.53	0.65	97.42
18	Manufacture of wearing apparel; dressing and dyeing of fur	0.15	0.75	15.30	95.96	0.27	1.09	101.34
19	Tanning and dressing of leather	0.49	0.39	8.98	95.19	0.57	0.78	102.03
20	Manufacture of wood and of products of wood and cork, except furniture	0.09	0.27	4.53	96.46	0.19	0.49	100.60
21	Manufacture of paper and paper products	0.63	0.30	3.22	99.91	0.39	0.64	96.64
22	Publishing, printing and reproduction of recorded media	0.09	0.04	2.98	92.62	0.23	0.23	97.63
23	Manufacture of coke, refined petroleum products and nuclear fuel	0.07	0.07	4.36	103.88	0.08	0.16	94.52
24	Manufacture of chemicals and chemical products	0.83	0.27	4.60	93.38	1.06	0.81	102.16
25	Manufacture of rubber and plastics products	0.45	0.20	4.49	94.78	0.73	0.63	99.21
26	Manufacture of other non-metallic mineral products	0.21	0.15	4.05	94.82	0.26	0.45	96.67
27	Manufacture of basic metals	0.34	0.40	6.75	101.71	0.25	0.58	101.67
28	Manufacture of fabricated metal products, except machinery and equipment	0.30	0.29	5.59	95.97	0.42	0.38	99.37
29	Manufacture of machinery and equipment n.e.c.	0.98	0.29	3.66	98.03	1.15	0.71	101.24
30	Manufacture of office, accounting and computing machinery	3.72	0.20	4.30	93.60	4.01	1.16	105.89
31	Manufacture of electrical machinery and apparatus n.e.c.	0.56	0.46	3.78	95.73	0.82	0.70	102.48
32	Manufacture of radio, television and communication equipment and apparatus	1.12	0.45	7.56	98.07	1.73	0.83	100.72
33	Manufacture of medical, precision and optical instruments, watches and clocks	0.75	0.12	4.92	94.26	1.07	0.31	96.43
34	Manufacture of motor vehicles, trailers and semi-trailers	0.68	0.36	8.41	97.50	0.85	1.16	96.45
35	Manufacture of other transport equipment	0.22	0.49	4.55	102.62	0.56	0.75	97.81
36	Manufacture of furniture; manufacturing n.e.c.	0.19	0.49	6.84	97.33	0.47	0.56	99.61
E	**Electricity, gas and water supply**							
40	Electricity, gas, steam and hot water supply	0.00	0.01	2.27	97.99	0.02	0.01	97.65

Notes: Import, Export and Lerner stand for *import share*, *export share*, and *subsidiary market Lerner*, respectively. See Table 3.12 in 3.A.1 for the definition of variables.
[1] For the exact name of product see http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=2.
[2] Tariff data for Slovakia are missing and therefore not reported.

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Eidesstattliche Versicherung

Ich versichere hiermit eidesstattlich, dass ich die vorliegende Arbeit selbständig und ohne fremde Hilfe verfasst habe. Die aus fremden Quellen direkt oder indirekt übernommenen Gedanken sowie mir gegebene Anregungen sind als solche kenntlich gemacht.

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