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Faculty of Social Sciences
Institute of Economic Studies

MASTER THESIS

Cross-Border Contagion: An Empirical Analysis of the 2007-09 Financial Crisis in Central and Eastern Europe

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Declaration of Authorship

The author hereby declares that he compiled this thesis independently, using only the listed resources and literature.

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Prague, January 13, 2011

Signature

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Abstract

The objective of this thesis is to examine cross-border contagion effects during the 2007-09 crisis in Central and Eastern Europe (CEE) and from all the possible propagation channels, it chooses to focus on cross-border bank loans. It tries to discover which global and local factors had significant influence on the changes in bank loans from banks in source (lending) countries to banks, as well as households, corporations and government in host (borrowing) countries. The main research method is a panel data regression model.

The empirical results suggest that both local and global factors had influence on the changes in cross-border loans, i.e. helped to spread the 2007-09 crisis to CEE. The significant local factors were macroeconomic and financial characteristics of both source and host countries, such as their GDP growth differential, interest rate differential, FDI, or profitability and health of the banking sector. The significant global factors were the expected market volatility and investors' risk appetite/aversion which was an indicator of "pure" contagion. The main contribution of this thesis lies in its focus on CEE and the analysis of investors' behavior based on their changing risk appetite.

JEL Classification	F34, G11, G14, G15, G21
Keywords	contagion, financial crisis, Central and Eastern Europe, bank loans

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Abstrakt

Cílem této diplomové práce je prozkoumat efekt přeshraniční finanční nákazy během krize 2007-09 ve střední a východní Evropě (SVE) a ze všech mechanismů šíření se zaměřuje na mezinárodní bankovní půjčky. Pokouší se zjistit, jaké globální a lokální faktory měly významný vliv na změny ve velikosti bankovních půjček ze zdrojových (věřitelských) zemí bankám, domácnostem, podnikům a vládám v přijímajících (dlužných) zemích. Jako hlavní výzkumná metoda je použitá panelová regrese.

Empirické výsledky naznačují, že jak lokální, tak globální faktory měly vliv na změny v toku mezinárodních bankovních půjček, a tedy napomohly k rozšíření krize 2007-09 do SVE. Významné lokální faktory byly makroekonomické a finanční charakteristiky věřitelských i dlužných zemí, jako například rozdíl v růstu jejich HDP, rozdíl v úrokových mírách, přímé zahraniční investice, či ziskovost a zdraví bankovního sektoru. Významné globální faktory byly očkávaná tržní volatilita a averze/apetit k riziku světových investorů, který sloužil jako ukazatel "čisté" nákazy. Hlavní přínos této práce spočívá v jejím zaměření na SVE a v analýze chování investorů v závislosti na jejich měnící se averzi k riziku.

Klasifikace JEL	F34, G11, G14, G15, G21
Klíčová slova	nákaza, finanční krize, střední a východní Evropa, bankovní půjčky

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Acronyms

AIG	American International Group
BIS	Bank for International Settlements
CAPM	Capital Asset Pricing Model
CEE	Central and Eastern Europe
CDO	Collateralized Debt Obligation
ECB	European Central Bank
EU	European Union
FDI	Foreign Direct Investment
FED	Federal Reserve System
FHLMC	Federal Home Loan Mortgage Corporation
FNMA	Fannie Mae
GDP	Gross Domestic Product
GLS	Generalized Least Squares
IMF	International Monetary Fund
OLS	Ordinary Least Squares
SIV	Structured Investment Vehicle
US	United States

Master Thesis Proposal

Author	Bc. Kristýna Žáková
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Proposed topic	Cross-Border Contagion: An Empirical Analysis of the 2007-09 Financial Crisis in Central and Eastern Europe

Topic characteristics The financial markets all around the world have become significantly interconnected during the past few decades and this fact has with certainty an important effect on the global transmission mechanisms of economic shocks. A financial crisis that originates in one country can be spread very fast to other countries through international stock exchanges, trading of various financial instruments or international bank loans. This process is called cross-border contagion and my thesis is going to analyze its role in the current financial crisis, focusing on the CEE countries.

The share of foreign owned banks and thus foreign loans in all CEE countries has increased significantly since the fall of communism, causing the integration of the region into the world financial markets. This process, together with the fact that one of the main symptoms of the current financial crisis has been the so-called "credit crunch" (reduction in the general availability of loans), makes us believe that the foreign bank loans have been the most important transmission mechanism of the current financial crisis into the CEE region. The home economies can be completely healthy but if the foreign banks decide to cut their loans, the investors cannot get money for their projects and the whole economy slows down significantly. Therefore we are going to examine the cuts in foreign bank loans in order to analyze the current financial crisis.

There are various reasons that can make the banks cut their loans to other countries and one of them might be the "pure" financial contagion which is, according to Kumar & Persaud (2002), the change in investor "risk appetite". This behavior is unrelated to the domestic fundamentals and is usually caused

by the herding effect of international investors, not necessarily based on rational decisions. In their Report on financial stability for 2008/2009, the Czech National Bank claims that this behavior also influenced the cut of foreign loans in the Czech Republic - it was put together with all the "risky" CEE countries without any deeper analysis and suddenly the inflow of foreign resources shrank.

This work is going to examine whether the cut in foreign loans was really caused by pure financial contagion (a global shift in risk appetite) or by the "country specific factors", i.e. the economic situation of both the borrowing (host) and lending (source) countries. The biggest foreign banks in the CEE region come from Austria, Germany, France, Italy and Belgium so the cross-border lending from these countries will be examined for each of the CEE countries.

The data on the foreign bank loans will be taken from The Bank of International Settlements statistics which is a commonly used source of data for the empirical literature about cross-border contagion. The exchange rates for the calculation of the Risk Appetite Index and the data for the country specific factors will be taken from various other databases, such as Eurostat etc.

Hypotheses

1. Pure contagion effect is economically and statistically significant.
2. Global factors are more significant than local factors for changes in foreign bank loans.
3. The results of the regression will not vary significantly across the pairs of analyzed host and source countries.

Methodology The most important part of the empirical research will be a panel data regression for each pair of the CEE and banking countries (i.e. host and source countries). The dependent variable will be the cross-border bank loans and the explanatory variables will be the risk appetite index and then groups of variables representing macroeconomic fundamentals, financial indicators and institutional characteristics of both host and source countries. We will start with a parsimonious model with a high number of variables from which we step by step exclude the less significant ones. In the end we get a narrower model with good statistical characteristics. The risk appetite index, i.e. the measure of pure contagion, will be calculated according to Kumar & Persaud (2002). The country specific variables will be for instance acsGDP, inflation, acsFDI, non-performing loans, loans in foreign currency and many others.

Outline

1. Introduction
2. Cross-Border Contagion Literature Review
3. Hypotheses
4. Outline of Methodology and Data
5. Empirical Testing of Cross-Border Contagion
6. Conclusions: Global vs. Local Factors
7. Resources

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Chapter 1

Introduction

The financial markets all around the world have become significantly interconnected during the past few decades and this fact has had an important effect on the global transmission mechanisms of economic shocks. A financial crisis that originates in one country can be spread very fast to other countries through various channels, such as international stock exchanges, trading of financial instruments or international bank loans.

The principle which helps a financial crisis spread across borders, the so-called cross-border or financial contagion, has awoken interest of many economists during the last two decades. One of the first to have noticed the contagion phenomenon was Eichengreen *et al.* (1996) who examined clusters of currency crises, such as the ERM or Mexican crises of the early 1990s. Since then, more evidence of cross-border contagion has appeared - starting with the Asian or Russian crises and finishing with the latest 2007-09 financial crisis.

Cross-border contagion plays an important role in analyzing the global economy in times of financial turmoils, however there are various opinions on the mechanisms through which it works. Masson (1998) or Kumar & Persaud (2002) define two main categories of contagion: pure contagion and spillovers. Pure contagion refers to the transmission of crises that cannot be explained by changes of fundamentals or by any direct linkages and spillovers between the affected countries. Others divide the spillovers further to spillovers via trade (Eichengreen *et al.* 1996; Glick & Rose 1999) and via financial linkages (Van Rijckeghem & Weder 2001). Herrmann & Mihaljek (2010) divide the factors causing contagion in two main groups - local and global, depending on whether they are linked to a specific country or are common to the whole world's economy.

The objective of this thesis is to examine the contagion effects during the 2007-09 crisis in CEE and from all the possible propagation channels, it chooses to focus on cross-border bank loans. The integration to international financial markets caused by a massive inflow of foreign capital is quite a new experience for the CEE countries. The share of foreign owned banks has increased significantly since the fall of communism, people and legal entities can take credit from foreign banks or their local subsidiaries and non-residents hold significant amounts of government and corporate bonds and shares of local companies. This of course brings many advantages, such as easier access to financing, but on the other hand makes the countries much more vulnerable to financial turbulences in the rest of the world. Therefore we have chosen CEE as a good example of a region affected by the cross-border contagion effects.

The financial integration process together with the fact that one of the main symptoms of the 2007-09 financial crisis was the so-called "credit crunch" (reduction in the general availability of loans) make us believe that cross-border loans were one of the most important transmission mechanisms of the 2007-09 financial crisis to CEE (see e.g. Nikolov (2010)). International lending to all sectors in CEE decreased substantially in the third quarter of 2008 and continued to drop until the end of 2009. The lack of funding then caused a significant contraction of the real economy and helped to spread the 2007-09 crisis in the region.

The main question to be answered in this thesis is what global and local factors influenced the cuts in cross-border bank loans in the CEE countries, i.e. helped to spread the 2007-09 financial crisis. The empirical research is based on a panel data reregression model. The data sample covers the Czech Republic, Slovakia, Poland, Hungary, Slovenia, Croatia, Bulgaria and Romania, which are examined as the "host" (borrowing) countries. Some literature on the CEE region, such as Geršl (2007), focuses also on the Baltic states - Latvia, Lithuania and Estonia. However, these countries are known for a high share of banking sector owned by the Scandinavian countries and thus do not fit to our group of 5 "source" (lending) countries which is Austria, Germany, France, Italy and Belgium. These countries were chosen mainly for the presence of big banking groups across the CEE region, such as Austrian Erste Bank and Raiffeisen, French Societe Generale, Belgian KBC, Italian UniCredit or German Deutsche Bank and Commerzbank.

The local factors examined by our model are domestic macroeconomic fundamentals and banking sector characteristics of both source and host countries.

The global factors are the expected short-term volatility on global financial markets and, more importantly, investors' risk aversion which controls for the pure contagion effect. The change in investors' "risk appetite" is calculated according to Kumar & Persaud (2002) and is usually caused by the herding effect of international investors, not necessarily based on rational decisions. We believe that many CEE countries (especially the ones with relatively sound economies such as the Czech Republic or Poland) have suffered severe losses because they were put together with all the "risky" CEE countries without any deeper analysis of their specific characteristics."Risky" in this case means mainly the high amount of debts in foreign currency which can through devaluation threaten the domestic economy (people are unable to roll over their debts that have suddenly increased in value) and was for instance one of the main causes of the crisis in Hungary.

The thesis is structured as follows: Chapter 2 provides an overview of the existing literature on cross-border contagion and explains all necessary terms and theories. Chapter 3 describes the causes and consequences of the 2007-09 financial crisis globally, as well as with focus on the CEE region which is put into both European and developed countries' context. Chapter 4 provides an empirical analysis of the cross-border contagion in CEE during the 2007-09 crisis. It is based on a panel regression model with change of cross-border loans as dependent variable and various global and local factors of source and host countries as explanatory variables. The chapter describes the model choice and its methodology, the examined data, hypotheses and assumptions, interprets the estimation results and in the end shows some robustness checks. Chapter 5 summarizes our findings.

Chapter 2

Theoretical Background

The principle of cross-border contagion and spillovers of a financial crisis from one country to another has awakened the interest of economists due to the events on financial markets in 1990s. The debates started because of the ERM crisis in 1992-93 and intensified during the Mexican "Tequilla crisis" in 1994-95 and the Asian, Russian and LTCM crises of 1997-98 (Kumar & Persaud 2002). A key text in this case was the analysis by Eichengreen *et al.* (1996) which discovered that according to a widely accepted definition of a currency crisis, 48 out of 58 analyzed crises have occurred in a cluster of two or more. That led the authors to a definition of contagion as a case where attacks on other currencies (i.e. currency crises) increase the probability of a home currency crisis, which is an effect beyond the domestic fundamentals. However, this is only one unique definition of cross-border contagion and there is no universal one in the existing literature.

2.1 Pure Contagion vs. Spillovers

Masson (1998) or Kumar & Persaud (2002) define two main categories of contagion: pure contagion and spillovers. Pure contagion refers to the transmission of crises that cannot be explained by changes of fundamentals or by any direct linkages and spillovers between the affected countries. It is not easily measured nor well defined and in the existing empirical literature often remains as residual when all other fundamental variables are accounted for. Kumar & Persaud (2002) define it as a change in investors' appetite for, or aversion to, risk. An example of this form of contagion could be when a shock in one country leads investors to change their perception of risks in countries with similar

macroeconomic fundamentals (such as the CEE region), not caring too much about whether the similarities are real or just apparent. The literature on this category of cross-border contagion could embody also the works that look at co-movements of asset prices in different countries and use various econometric techniques to find out whether there is any causality between them (Baig & Goldfajn 1999; Bae *et al.* 2003).

The other category of contagion, spillovers, is caused by "real" inter-linkages between the affected economies - often also called fundamentals-based contagion. This category of contagion can be explained solely by the fact that the affected country is linked to others via trade (e.g. import or export) or finance (e.g. bank lending). It is important to say that the pure contagion as defined by Kumar & Persaud (2002) serves as an additional or underlying factor to the fundamental-based contagion and these two transmission channels do not exclude each other.

2.1.1 Pure Contagion

According to Kumar & Persaud (2002), investors under pure contagion share a common but changing risk appetite. It is changing in the way that the investors are either risk-averse or risk-loving. When their appetite for risk decreases, they restrict their exposure to risky assets whose prices consequently fall down. On the other hand, when the investors' appetite for risk increases, their demand for risky assets increases as well and the assets' value rises. Proof of this can be seen in the fact that "strong" and "weak" periods have been similar for perceived risky assets such as Brazilian bonds, Thai baht, South African rand or United States (US) junk bonds even though Brazil, Thailand, South Africa and US do not show many similarities in macroeconomic fundamentals. In their work, Kumar & Persaud (2002) have developed an index which measures the investor risk aversion and this index is going to be used as one of the variables in our empirical model.

It is not always possible to say what was or will be the "wake-up call" to cause the change in investors' risk appetite. What makes the investors loose interest in assets that they have until then considered suitable for their risk profile? If we do not believe in the efficient markets theory, we can say that the investors' behavior can be influenced by their "bounded rationality". They can often have quite simple patterns that lead their investment decisions and an unusual event or a series of events can put this pattern in question and make

them change their perception of all assets' riskiness. A world financial crisis can be for sure accounted one of them.

The investors' behavior considering pure contagion and change in risk appetite is also sometimes referred to as the "herding behavior". There are more ways how to approach this phenomenon, described for instance in Kaminski *et al.* (2003). One possible explanation of the herding behavior is through an "information cascade" when an individual decides to follow the actions of those ahead of them without considering his or her own information. Their logic goes often so that if they join the crowd, they induce others to do the same and in that case they are safe. It often happens that if the first few individuals join the crowd, it triggers the whole process for the rest of investors.

Another theory concerning the herding behavior suggests that it can arise even when investors are rational. The assumption for that is the presence of information asymmetries, such as information costs. In cases where marginal cost of gathering information exceeds marginal gain from the information, it is rational for the investors to copy market portfolios and follow the crowd.

2.1.2 Spillovers: via Finance or Trade?

There are many works that discuss which is the most important transmission channel for contagion - is it finance or trade? The earlier works such as Eichengreen *et al.* (1996) or Glick & Rose (1999) assign a bigger importance to trade. However, the sharp rise in cross-border capital flows versus cross-border trade flows by the end of the 20th century suggests that the financial links could play a bigger role in the transmission mechanisms of a crisis. Van Rijckeghem & Weder (2001) present evidence that linkages through bank lending (i.e. financial links) can help explain contagion better than trade linkages (namely import and export) or country characteristics. They conduct their empirical analysis on a dataset from the Mexican, Asian and Russian crises.

Eichengreen *et al.* (1996) or Glick & Rose (1999) describe the most direct form of trade transmission channel which is through bilateral trade. If there is a currency crisis in one country, the demand falls accordingly and the trading partners with high levels of bilateral trade are affected. Another form of trade links spillovers is more indirect and happens through competition in third markets. In this case, a currency crisis in one country that causes depreciation of its exchange rate can negatively affect the countries that export to the same markets.

The spillovers through bank lending can be very often described by the "common lender effect" and competition for funds that is also analyzed in Van Rijckeghem & Weder (1999). It basically says that countries which are exposed to the major lender of the primary crisis country are vulnerable to contagion. Van Rijckeghem & Weder (1999) describe several mechanisms (possibly simultaneous) how "banking centers" can cause cross-border spillovers. If the banks suffer losses in the "ground zero" country (where the currency crisis has originated), it could lead them to sell off their assets in other countries in order to restore their capital-adequacy ratio. Another mechanism is if investors receive a margin call based on the decline in price in one asset and subsequently decide to sell their assets in other countries. Considering the risk management of most banks, if they face substantial losses or a rise in non-performing loans in one country, they are likely to try to reduce their overall value at risk. The usual procedure is to reduce the exposure in the riskiest markets or in credit lines in historically correlated markets (Folkerts-Landau & Garber 1998).

The common creditor propagation mechanism of contagion is further described also in Kaminski *et al.* (2003) or in Calvo *et al.* (2008). Kaminski *et al.* (2003) focuses mainly on the "fast and furious contagion" examples, which were for instance the Asian or Mexican crises. During these periods, the leveraged common creditor played a major role. The data about cross-border lending to the affected countries before and after the crises are self-explanatory. For instance before the Asian crisis, European and Japanese banks' lending to the region peaked at USD 165 and USD 124 billion respectively and after the devaluation reversed to outflows of about USD 47 billion.

Besides the bank common creditors, Kaminski *et al.* (2003) also draw attention to non-bank common creditors. Equity and bond flows also declined sharply during the 1990s crises periods. This phenomenon helps to explain among others the difficulties of Brazil, or Argentina during the Mexican crisis. US-based mutual funds specialized in Latin America withdrew massively from the region during the crisis which only worsened the situation, considering that Brazil, Mexico and Argentina accounted all together for 77% of the Latin American portfolio.

2.2 When Does Contagion Occur?

The Mexican, Asian and Russian crises were all characterized by very fast propagation which Kaminski *et al.* (2003) call "fast and furious contagion".

The affected countries had to tackle declines in equity prices, value of their currencies and national output and on the other hand sharp increases in cost of borrowing associated with lower availability of international capital. However, there are numerous examples of countries affected by a financial crisis which never spread across their borders. For instance the devaluation of Brazilian real in January 1999, or the default of the Convertibility Plan in Argentina in December 2001. The question therefore is why cross-border financial contagion occurs in some cases but not in others. What is so special about the shocks or about the countries where they happen that it makes them spread across borders?

Kaminski *et al.* (2003) come with an explanation called "the unholy trinity of financial contagion". They say that the cases where contagion occurs and where it does not can be distinguished by three key elements - a sudden cut of capital inflows, surprise announcements, and a leveraged common creditor. The role of the first element is rather straightforward, as capital investment is essential for good functioning and growth of any economy. It is further examined for instance by Herrmann & Mihaljek (2010) who look at the cuts of cross-border bank flows to emerging markets during the 2007-09 crisis or by Hernandez *et al.* (2001) who look at the determinants of private capital flows during the 1970s and 1990s.

The way of announcing the situation that triggers the whole crisis chain is crucial for its further development. An unanticipated change does not allow investors pre-adjust their portfolios and their handling space shrinks to minimum when the real crisis comes, leading to much more severe consequences. This element is quite often connected to the herding behavior or pure contagion described e.g. by Kumar & Persaud (2002). The third key element - a leveraged common creditor - was present in all the crises with immediate international influence and helped to propagate it across borders. It is quite often examined by the economists in relation to cross-border contagion and it has already been covered in a previous section of this work.

2.3 Lending to Emerging Markets

Despite the fact that most of the CEE countries examined in this work are members of the Eurpean Union and their economic situation and standard of life are often similar to average developed countries, they are still considered to belong to the emerging markets. These markets have in general a big growth

potential as the gap between their level and the level of the developed markets is rather high. But they are also much more vulnerable to any shocks that happen around the world because of their fragile institutional and economic structure, set up in a shorter time than in the developed countries. Therefore the contagion effect is highly relevant for them and many academic works analyze the changes in international bank lending to these countries in times of crisis, this work being no exception.

A rather recent example of such paper is written by McGuire & Tarashev (2008) who examine the link between lending to emerging markets and health of the global banking sector. They look at a period from early 1990s to 2007 and, similarly to our work, use the Bank for International Settlements (BIS) international banking statistics for their empirical research. One of their most important findings was that the deterioration in banks' health and the situation of developed interbank markets during the examined period consistently led to slower growth in international credit to emerging markets. On the other hand, locally extended credit did not show any signs of sensitivity to changes in creditor banks' health.

McGuire & Tarashev (2008) also examined the crisis period of mid-2007 to mid-2008 and according to their findings, the lending to emerging markets held up relatively well - on higher than expected level from the historical data analysis. However, the fall of Lehman Brothers in September 2008 was a breaking point in the latest financial crisis which made the banks change their credit policy from day to day. Therefore we expect that our work will bring some more pessimistic findings about the lending to emerging markets during the later stage of the crisis.

During the two big crisis episodes during 1990s (Mexican crisis in 1994-95 and Asian and Russian crisis in 1997-99), lending to emerging markets shrank significantly and the international banks lost their confidence in the less developed countries. The Asian and Russian crises affected also emerging Asia and Latin America. Especially Latin America was strongly hit by the contagion effect from the Russian domestic debt default. After the beginning of the new millennium, the emerging markets started to regain their good reputation and cross-border lending to this region kept rising every year. First emerging Europe and Asia started to gather their breath and then Latin America caught up in 2006. This phenomenon happened due to many different reasons, for instance the global financial liberalization, new sophisticated financial products or the eager of investors for higher yields that were not possible to gain any

more in their home countries. Therefore more and more banks expanded their activities to the emerging markets. The absolute peak of cross-border bank lending was reached between mid-2007 and mid-2008.

2.3.1 Global and Local Factors

The spillover effects in cross-border lending from developed to emerging economies can be triggered by various factors. Herrmann & Mihaljek (2010) divide these factors in two main groups which will also serve as a base for our empirical research - global and local. The first are basically any factors that are not linked to a specific country but are common to the whole world's economy and have as well a global impact. It might be for instance the pure contagion, i.e. the shift in investors' risk appetite, or the expected market volatility. By local factors it is meant the macroeconomic fundamentals, financial indicators and institutional characteristics of both the borrowing (host) and lending (source) countries.

The main question to be examined is to what extent the banks from developed economies manage their lending based on the situation in their countries and the countries to which they lend - and to what extent they let themselves get influenced by the global situation and the attitude towards risk on the world markets. Herrmann & Mihaljek (2010) find out in their recent empirical study on cross-border bank flows to emerging markets that the global factors played a major role in spreading the 2007-09 financial crisis. To be more specific, "in the latest financial crisis, the most important channel for spillovers in cross-border lending between advanced and emerging markets occurred were greater expected volatility of global financial markets and reassessment of global risk" (Herrmann & Mihaljek 2010, pg. 23). A similar finding is expected in our analysis of a smaller sample of observed countries - the CEE region and their lenders.

2.3.2 Push and Pull Factors

One line of the literature on interbank lending flows to emerging market countries, such as Jeanneau & Micu (2002) or Goldberg (2001), focuses on the so-called push and pull factors (i.e. external and internal factors). In the framework of this thesis, we might look at these factors as a further division of the local factors, connected either to the source country (push factors) or to the host country (pull factors). Our approach is inspired by Hernandez *et al.*

(2001) who tests for the presence of pure cross-border contagion (the global factors) after controlling for the push and pull factors (local factors). On the contrary, Jeanneau & Micu (2002) take the risk appetite / aversion as one of the possible push factors because it is an external factor that the host country cannot influence.

External (push) factors include for instance structural and cyclical impulses leading investors in the source countries to internationally diversify their portfolios. A common explanation of these processes in the earlier literature on this topic, e.g. Calvo *et al.* (1993), suggests that the impulses for cross border investment are usually triggered by a temporary reduction in the attractiveness of assets in the lending countries. These may result from lower returns on investments or lower economic growth, implying a countercyclical nature of the most important push factors - real interest rate and real Gross Domestic Product (GDP) in lending countries (to be further discussed). Another push factor suggested by Jeanneau & Micu (2002) is of a regulatory character, concretely the implicit or explicit guarantees by lending country governments or international financial institutions which may cause an underpricing of the risk of liabilities issued by borrowers in emerging market economies.

Internal (pull) factors are generally related to the borrowing countries - more specifically to their economic policies and performance - and work through expectations of stable improvements in the risk-return trade-off of the domestic investment projects. That means that the capital flows from developed countries are triggered either by an increase in rate of return or by reduced risk. Some examples of such factors include significant improvements in macroeconomic policies (e.g. fiscal adjustment, inflation stabilization), reduction of external debt, exchange rate stability and many others.

Jeanneau & Micu (2002) find empirical evidence that both push and pull factors of lending flows influence international bank lending. Their paper, among others, discusses whether the factors behave procyclically or countercyclically. According to their research, real GDP growth and real interest rate in lending countries (the most frequent push factors) exhibit a procyclical influence on aggregate international bank lending - the higher the variables are, the more funds flow from international banks across borders. Their finding however contradicts most of the academic literature of that time. Pull factors are by all parties considered to behave procyclically.

In general, macroeconomic conditions of host countries (Garcia-Herrero & Martinez-Peria 2007; Hernandez *et al.* 2001) and source countries (Goldberg

2001) are considered to be the major factors from the group of push and pull factors influencing bank lending to emerging countries. After controlling for the push and pull factors (in their case it means the macro fundamentals and other variables which may have influenced the co-movement of capital flows among the observed countries), Hernandez *et al.* (2001) arrive at the finding that "the availability of funds to all developing countries was an important determinant of the flows received by each of the almost 30 recipients in the sample" (Hernandez *et al.* 2001, pg. 14). This result supports the presence of contagion in the way that capital starts flowing to the emerging economies because it is fashionable and because the investors do not assess the riskiness of each individual country but of the whole region. It also confirms that the push and pull factors cannot serve as the only explanation for international capital flows.

Hernandez *et al.* (2001) apply their research both on times of financial distress and on peak times with increased investment. Their approach is rather unique because most of the literature on contagion focuses only on the times of crisis. It is not illogical considering that the periods of distress usually attract much more attention and their analysis should prevent any similar events in the future. However, it might be equally useful to examine the successful times and realize that the same factors which trigger cross-border contagion in economic decline periods work the opposite way in the times of recovery.

Goldberg (2001) focuses on the performance of US banks' international lending activities and examines whether they transmit US business cycle fluctuations to their foreign borrowers (i.e. capital flows influenced by home country macroeconomic fundamentals). Similar research was made by Peek & Rosengreen (1997) who found out that Japanese banks transmit shocks from Japan to the US. According to Goldberg (2001), there is no general rule that could be applied to all US banks. However, there is still some pattern which explains the behavior of US banks depending on the countries to which they lend. For instance the US GDP growth and bank claims on industrialized countries showed signs of negative correlation, as well as claims on emerging Asia. In contrast to that, positive correlation appeared for US GDP growth and claims on Latin American countries, suggesting that lending to these countries grows along with US economy growth. Of course it must be taken into account that this research was made about a decade ago and its findings may not be valid any more, considering the fast changes of the world financial markets.

2.3.3 Level of Financial Integration

Another aspect of the cross-border bank lending during crisis periods that is often examined is the impact of financial integration between source and host countries. Herrmann & Mihaljek (2010) find out that stronger financial integration between the emerging and advanced economies helped stabilize cross-border lending in the times of financial crises. They call these linkages "soft determinants" (e.g. tight relations between parent banks and their subsidiaries in emerging Europe) and assign them more relevance than to the "hard determinants", such as interest rate differentials. In contrast to that, IMF (2009) claims that financial interconnections within Europe increase the risk of adverse feedback loops - a mechanism during which negative events cause a reinforcing cycle of other negative events. Similarly, Hernandez *et al.* (2001) argue that the cross-border contagion effect was stronger during the 1990s than in the earlier crises and that it had increased partly because of tighter financial integration.

Calvo *et al.* (2008) analyze the empirical characteristics of systemic sudden stops in capital flows, and within this framework, also focus on the level of financial integration among the examined countries. The systemic sudden stop in this case means a large and highly unexpected capital account contraction that appears in a period of systemic turmoil. Based on their empirical research, Calvo *et al.* (2008) describe a rather interesting correlation between the probability of sudden stops and the level of financial integration.

Starting from low levels, there is a positive correlation between the two variables but from a certain level of financial integration, the probability of a sudden stop begins to decrease and is virtually nil at high levels of integration. The financial integration of the emerging markets unfortunately oscillates around the level with the highest probability of sudden systemic stops - in between developed and other developing countries. This fact suggests that financial integration might be rather risky if it is not accompanied by development of stable and trustworthy institutions that would support the use of modern financial instruments.

2.3.4 Gravity Model

For empirical research of cross-border lending to emerging markets is often used a so-called "gravity model". It matches the size of bilateral linkages with host and source country macroeconomic variables, as well as geographic, historical and institutional factors (McGuire & Tarashev 2008). The model was first

used by Tinbergen (1962) who linked the trade volume between two countries to their economic size and the economic distance between them. Nowadays it often appears in empirical works on cross-border bank lending because it creates an ideal environment for analyzing bilateral relationships between the examined countries. A rather sophisticated version of this model is used for instance in Herrmann & Mihaljek (2010).

An alternative to the gravity model used in works on cross-border bank claims might be focusing on total borrowing by emerging market countries and explaining the mix of local and cross-border lending by foreign banks. This approach was used for instance by Garcia-Herrero & Martinez-Peria (2007) who analyzed the influence of local macroeconomic variables or by Goldberg (2001) who focused on borrowings from US banks.

2.3.5 Central and Eastern Europe

The amount of literature that tackles the role of banking system and international banks in transmitting financial crises across borders has been growing recently and some of them, like this thesis, also focus on the CEE. From the earlier works, it is for instance Weller & Morzuch (2000) who handle the topic of economic transition of these countries, considering the banking sector. A general overview of the role of foreign banks in CEE countries and its possible implication for financial stability can be found in De Haas & Van Lelyveld (2003), De Haas & Naaborg (2005) or in Clarke *et al.* (2001).

A more recent paper is by Geršl (2007) who analyzes the pattern of foreign banks involvement and the risk of cross-border contagion in the CEE countries, regarding financial stability. His work focuses on three topics: the maturity of cross-border exposures, the concentration of foreign creditors and the existence of common creditors (using the framework of Van Rijckeghem & Weder (1999)). It examines the "fundamental-based" contagion (in this case through the cross-border claims channel) and does not focus on the pure contagion. The work concludes that any contagion through the foreign bank lending would have to be generated by a large shock in the source country with a major impact on creditor countries to CEE. In 2007, Geršl concluded that the risk of cross-border contagion was relatively low, also considering the stability of the creditor countries in that time. It will be up to our work to find out whether the 2007-09 financial crisis was a sufficiently "large shock" to trigger the cross-border contagion through cross-border claims in the CEE region.

2.4 Multinational Banks and Their Subsidiaries

Most of the literature on cross-border contagion examines the international funds flows from an aggregate point of view, i.e. from country to country by using the BIS data. However, there are some works that focus on the relationship and transmission mechanisms between multinational banks and their subsidiaries through the so-called internal capital market. This market serves as a mean to re-allocate resources between the banks and their subsidiaries in order to keep balance among the whole international banking group. Houston *et al.* (1997) examine this phenomenon across the United States whereas De Haas & Van Lelyveld (2009) look at it from the European perspective.

De Haas & Van Lelyveld (2009) divide the potential shocks that influence the internal capital market into two categories: financial shocks and real-economy shocks. Both of these shocks might of course happen in the source country (parent bank's country), as well as in the host country (subsidiary's country). A financial shock originates in a bank itself and causes a substantial decrease in its capital (for instance a fraud). In case of a host country financial shock, the parent bank helps its subsidiary by allocating additional capital and in case of a source country shock, the parent bank draws off the funds from its subsidiaries in order to restore its financial health. A real-economy shock, on the other hand, originates outside the banking system and causes overall changes in the investment opportunities in the affected country. This shock has a more adverse effect on the cross-border capital flows than the financial one.

De Haas & Van Lelyveld (2009) call the effect of a real-economy shock substitution effect and their findings about it are also important for our research. They have empirically proven that multinational banks can sharpen the business cycle in a host country through always shifting the funds to the most profitable countries - which means accelerating the growth if the country is growing but also deepening the recession if the country is affected by one. In the framework of this thesis and the 2007-09 crisis, the substitution effect might be considered as the influence of local factors on multinational banks. Hence there still remains the question whether this effect outweighs the pure contagion, i.e. the influence of global factors such as world markets' volatility. The answer to this question should be the same in case of an aggregate dataset (e.g. BIS data) as in the case of individual banks' data.

Hoggarth *et al.* (2010) examine the difference between intergroup and intragroup bank lending during the recent financial crisis on the BIS financial data. Through a simple regression they come to the conclusion that international banks have tended to reduce lending by more if it has been made to banks outside of their banking group, i.e. not to their subsidiaries. They suggest that the cut in international lending has not been so severe in a number of CEE countries where foreign banks have a large local presence.

2.5 Former World Financial Crises

At the end of the literature review, it might be useful to get some deeper understanding of the most important former financial crises (both primarily currency-driven) that are often subject to the empirical studies - Mexican "Tequilla crisis" in 1994-95 and the Asian crisis of 1997-98.

The Mexican financial crisis arose from a sudden devaluation of the Mexican peso in December 1994 and afterwards spread to Brazil and the Southern countries of South America. The economic situation in Mexico had been alarming long before the outburst of the crisis - the country went through a period of hyperinflation, low oil prices, low interest rates and political instability. The fixed exchange rate to USD was no longer maintainable and despite previous promises to the investors, the government had suddenly decided to devaluate their currency. This step only scared more investors away and further increased Mexico's risk profile which originated the financial crisis (Frankel & Schmukler 1996).

The Asian financial crisis originated in Thailand in July 1997 when the Thai baht collapsed after the Thai government had decided to cut its peg to the USD. The currency collapse was only the last drop leading to Thailand's bankruptcy, preceded by a severe financial distress period (partly real estate driven) and acquiring a burden of foreign debt. The crisis then spread rather fast to the surrounding countries through devaluating currencies, stock markets and other asset prices. The financial crisis caused after Thailand the most harm in Indonesia, South Korea, Malaysia, Hong Kong, Laos and the Philippines (Kaufman *et al.* 1999).

Even if the scenarios of these two crises might seem quite similar, Herrmann & Mihaljek (2010) find out that from the cross-border contagion and withdrawal of funds point of view, they differ rather substantially. According to them, during the Asian crisis global risk factors made the largest contribution to the

reduction in cross-border bank flows. The other two important factors that contributed to the reduction were the reduction of emerging markets growth rates and the deterioration of financial indicators in borrower countries (i.e. higher public deficits or worsening health of the banking sector).

On the contrary, the deteriorating global financial conditions did not play a major role during the Mexican crisis. The main reason for that is the origination of the crisis from financial distress in only one emerging market economy. Therefore the withdrawal of cross-border capital flows was mainly caused by the borrower-specific risk factors. The good financial health of the lending countries and rather tight monetary linkages between the source and host countries enabled a relatively fast stabilization of the whole situation, in contrast to the latest world financial crisis.

Chapter 3

2007-09 Financial Crisis

3.1 How It All Began

In order to examine properly the behavior of international banks during the 2007-09 financial crisis, it is necessary to have a deeper understanding of the whole crisis and its origins. Therefore this chapter will describe the whole story since the housing prices bubble and US subprime mortgage crisis until the transmission to European and basically all world economies. It will mention all important milestones and try to reveal the reasons behind the unexpectedly fast and extensive spreading of the crisis.

It might seem that the 2007-09 crisis started by the subprime mortgage crisis in 2007 but in fact its roots reach further back to the past. One of the indisputable causes, described for instance by Ivashina & Scharfstein (2010) or Lin (2008), is the expansionary US monetary policy after the bursting of tech-stock bubble in 2000-01. This recession was eased by Federal Reserve System (FED) lowering the interest rate which fell from 6.5% in January 2001 to 1% in June 2003. The low costs of funds stimulated a boom on the housing market and the higher housing prices led to a consumption boom that together with FED's continued expansionary monetary policy kept the US economy in excess liquidity. It was possible to keep such a low US and also global real interest rate because of the developing countries accumulating large volumes of US assets and keeping the huge US current account deficit by their current account surpluses, without any significant changes in real interest or exchange rates.

As a result of the continuously low interest rates, the banks and other financial institutions had to search for higher yields by more sophisticated (and

therefore also risky) financial instruments. This is where most of the financial innovation came from and unfortunately most of the new instruments were carried out by unregulated financial institutions or were too complex to be effectively regulated. The whole financial system could be described by the phrase "originate and distribute". Most of the loans or mortgages did not stay in the original institution until their maturity but were put in different tranches of some "structured" investment products often referred to as Collateralized Debt Obligation (CDO) and sold to other financial institutions - often even more than just once. So in the end, no one really knew what collateral the particular security was backed by, and all the instruments seemed almost risk-free as they claimed to be based on a risk-diversified portfolio. A significant role in this whole process of inflating the housing bubble was played by the two quasi-federal agencies Fannie Mae (FNMA) and Federal Home Loan Mortgage Corporation (FHLMC) that were for a long time encouraged to buy subprime mortgages but their risk rating was highly underestimated by most of the analysts. And then in mid 2007, the housing bubble suddenly burst and the wave of contagion started to spread through the global financial system to the real economy.

What followed after the housing market collapse can be described as a typical liquidity spiral that started with steep falls of the prices of assets on the financial institutions' balance sheets as everyone had realized their true value. It was not only the prices of real estate falling down but the value decrease struck basically all assets - the US stock market alone lost USD 8 trillion of its wealth between October 2007 when it reached an all-time peak and October 2008 (Brunnermeier 2009). The propagation mechanism of falling prices was amplified through the off-balance-sheet investment vehicles that were created by most commercial banks to finance their mortgages and other long-term assets. Such an off-balance-sheet investment vehicle is often called a Structured Investment Vehicle (SIV). These SIVs were dangerous for two reasons - first, they were not subject to such a strong regulation and capital requirements as their parent banks and second, there was a maturity mismatch between their assets and liabilities.

While mortgages which were on the asset side usually had maturities measured in years or even decades, the asset-backed securities used by the SIVs for raising funds had much shorter maturities - in average 90 days for short-term instruments and just over one year for medium-term notes (Brunnermeier 2009). The reason behind is that most investors prefer assets with short maturities so

that they can withdraw them more flexibly to fulfill their own funding needs. After the housing market bubble had burst and investors had realized the true value of the CDOs' collateral, they suddenly stopped buying them and the SIVs were exposed to a dry up in funding liquidity because they could not roll over their short-term debt. The sponsoring banks were affected by the dry-up almost instantly through a so-called liquidity backstop which was a credit line granted to the SIV to ensure its funding liquidity. Therefore the liquidity risk arising from the maturity mismatch transferred from the "shadow" banking system to the real one.

The meltdown of subprime mortgages and all types of securitized products questioned the solvency and liquidity of all financial institutions. After the fall of Lehman Brothers and Washington Mutual in September 2008 and subsequent government takeovers of FNMA, FHLMC and American International Group (AIG), it developed into such a banking panic that the world had probably never seen before. Banks almost suddenly reacted by cutting their lending which substantially increased the costs of funds, prices of all assets and commodities fell dramatically and the omnipresent insecurity about future developments increased market volatility to critical levels. Notwithstanding the fact that the governments reacted almost instantly by cutting the central banks' interest rates, the banks were just too cautious and created large cushions of excess reserves against unexpected future losses. This so-called "credit crunch" despite the anti-crisis monetary policies proves the procyclical behavior of large international banks and helps to spread the recession into real economy through lack of sources of funding.

3.2 Transmission to Developing Countries

The propagation mechanism of the 2007-09 crisis from the US to the rest of the world is a rather complex topic which can be viewed and examined from various angles. Our work handles the crisis transmission to CEE countries and as these are considered to be part of the developing world, it might be useful to examine how the crisis had spread to the developing economies and whether it was any different from the rest of the world. This topic is handled for instance by Lin (2008) or Herrmann & Mihaljek (2010).

It has already been mentioned that the US entered into a phase of fast economic growth at the beginning of the third millennium and this has been a positive turn for the developing world too. There is evidence that these coun-

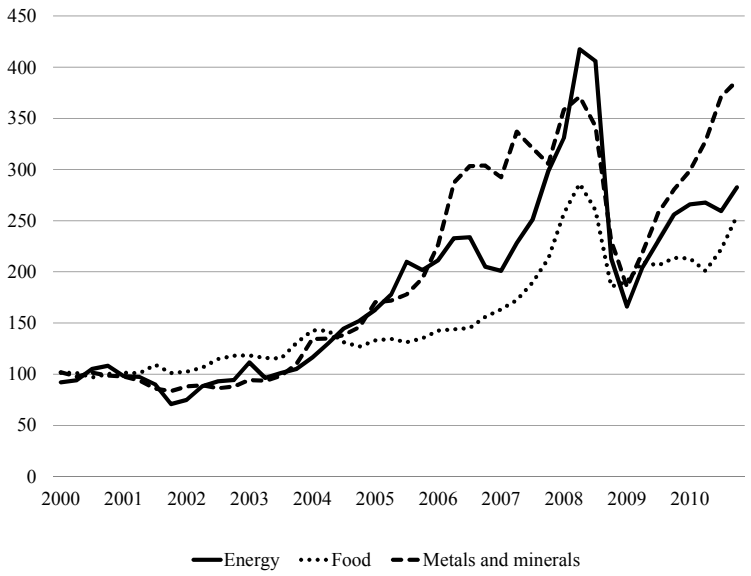
tries had begun the period in much better shape than before, considering the macroeconomic fundamentals, as well as the political and institutional situation. Most of the countries managed to reach lower inflation, more sustainable fiscal situation and regarding the CEE countries, they had just concluded the first decade of democracy after the communist regime which helped to settle the most turbulent transitional issues. Altogether it was a good basis for a period of fast economic growth.

The favorable conditions in the developing countries would probably be enough for a moderate growth but this has been further accelerated by the economic boom of the developed countries, especially the US. The most important factors that helped to transmit the growth were, according to Lin (2008) the increased export, higher commodity prices, bigger Foreign Direct Investment (FDI) and increased remittances from abroad. Put into numbers, the developing countries increased their exports by an average of 10.3% per year during the first 8 years of this decade while keeping their imports on just 4.4% per year. Taken as a share of GDP, their exports increased from 29% in 2000 to 39% in 2007. Another important factor, the commodity prices, increased sharply during the respective years which can be seen in Figure 3.1. Net private capital flows to developing countries increased only in 2007 by USD 269 billion to unprecedented USD 1 trillion. Bond flows and net bank lending increased from virtually nil in 2002 to 3% of developed countries' GDP in 2007 and in the same year another important source of capital, the remittances from workers in foreign countries, also increased sharply to approx. USD 240 billion (Lin 2008).

All the above mentioned sources of financing led to an investment boom in many developing countries (India, China, Russia etc.) which further stimulated economic growth in the developed world through demand for their capital goods. This growth caused additional capital inflow to the developing economies and resulted in a self-reinforcing cycle that brought the highest GDP growth rates in the developing world's history - in average 5% per year between 2003 and 2007.

Another important factor for the successful cooperation of the developed and developing economies were the low costs of production in the latter ones which offset the rising commodity prices and overall inflation pressure. However, in 2007 many developing countries started to hit their capacity constraints and signaled that the euphoric period of overall world growth was soon to come to an end. The cost of resources increased sharply and the US twin deficits -

Figure 3.1: Commodity Price Indices (2000-10), 2000=100



Source: World Bank.

fiscal and current-account - caused the dollar to depreciate and led to greater volatility in commodity prices (a sharp decrease between 2008 and 2009 can be seen in Figure 3.1). If we had depicted the developing countries' conditions at the beginning of this decade as an indicator of economic growth, then the conditions at the end of this decade should be seen as an indicator of economic downturn.

The two possible propagation mechanisms of a crisis - finance and trade - have already been discussed in Chapter 2 and it is believed that the 2007-09 crisis has mostly been spread through the financial contagion (Lin 2008; Griffith-Jones & Ocampo 2009). Or at least the financial contagion in most countries came before the real economy effects, including the developing countries. The interest rate spreads soared, many currencies depreciated because the traders shifted their positions towards the "more stable ones" and the stock markets collapsed due to slumping commodity prices. In general, the key channel for transmission of the crisis from developed to developing countries happened via private capital flows - both through volumes and costs of such flows. That goes hand in hand with the credit crunch and cut of foreign bank lending that is the main topic of this work. The increased foreign ownership of developing countries' banks which is quite common for the CEE region turned

out to be more a source of vulnerability than stability. Many of these banks cut lending to their subsidiaries in developing countries in order to strengthen their weak home positions. Other factors which influenced the flow of cross-border bank loans are examined in detail in Chapter 4.

In general, countries with large balance-of-payments and fiscal deficits were much more vulnerable to the crisis propagation mechanisms. When the capital inflow dried up and current account shifted from deficit to balance, it was much more problematic for them to find additional sources of financing due to the already large fiscal deficit. According to Griffith-Jones & Ocampo (2009), the hardest hit by the crisis were the CEE transition economies because of their current account deficits and high vulnerability of the domestic financial system which led to rapid withdrawals of private capital flows.

3.3 The 2007-09 Crisis in CEE

3.3.1 European Context

To understand fully the situation of CEE countries during the 2007-09 crisis, it is necessary to examine them not only in the developing world context but also in the European context. One of the most significant differences between the European and US crises were the pre-crisis conditions. In general, Europe did not suffer from the macroeconomic imbalances that had caused the overseas crisis and most European banks did not hold any subprime mortgages or US mortgage backed securities. However, they relied on the same short-term wholesale financing from the same liquidity pool as the SIVs. For instance, this happened to be fatal for British Northern Rock which after facing a run on bank had to be taken into public ownership in 2008. Basically all European banks had to face substantial liquidity shortages and write off significant amounts of assets because of the global credit crunch. As a consequence, most of the European governments had to intervene and bail them out, following the US example.

This thesis is built on an assumption that the 2007-09 crisis in Europe was imported through the financial system and afterwards transmitted to the real economy through a substantial cut in loans to non-financial corporations and households. It has been empirically proven by several economists, such as Nikolov (2010), who also claims the financial sector to have procyclical effects on the economy, boosting the yields during good times and deepening the losses

during bad times. Further on in his research, he finds evidence for positive correlation between capital in the banking system and economic growth. Countries with better capitalized banks experience smaller declines during times of crisis because they have a bigger reserve cushion which can absorb shocks to the system and limit deleveraging - the 2007-09 crisis being no exception.

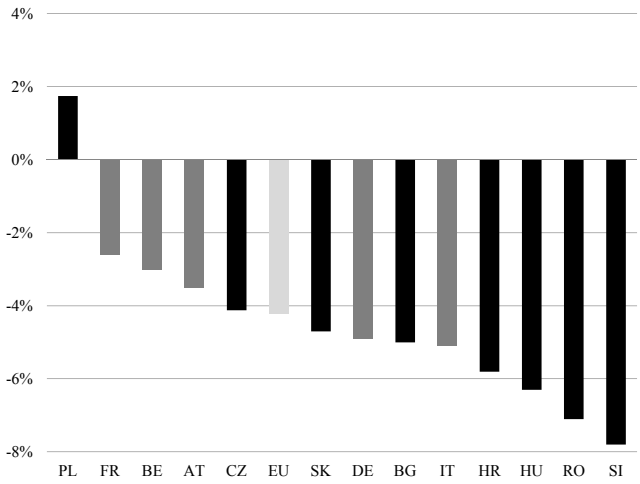
3.3.2 Crisis Impact on CEE

It is important to note right at the beginning that the 2007-09 crisis has not hit the CEE countries (or the whole Europe) evenly and that its consequences were different throughout the region. The extent of the crisis varied across the countries, depending on such factors as the capitalization of the banking sector, the size of government deficit, the dependence on exports, the amount of loans in foreign currency, or the exchange rate regime. The beginning of the crisis also varied across the region, depending on the type of "wake-up call" in each country and the local conditions.

Out of all the CEE countries and the source countries examined in this thesis, Poland was the only one that managed to keep its GDP growth from 2008 to 2009 above zero. The values for all the countries are presented in Figure 3.2. The European Union (EU) average is -4.2% and it can be seen quite clearly that most CEE countries besides the Czech Republic are below this level. When comparing the source and host countries, the first group is deffinitely better off - with France, Belgium and Austria above the EU average and Germany and Italy slightly below it. Slovenia experienced the sharpest GDP drop out of all examined countries and also out of the whole Eurozone (-7.8%), led by a 21.6% y-o-y drop in gross fixed capital expenditure. Also Slovenia's inflation was the highest out of the Eurozone in 2009 (6.6%).

In general, the Viszegrad countries (Czech Republic, Slovakia, Poland and Hungary) overcame the crisis easier than the Balkan countries (Croatia, Slovenia, Bulgaria, Romania), with the exception of Hungary. Hungary was one of the countries to be hardest hit initially by the crisis, mainly due to a high share of loans in foreign currency (euros and Swiss francs). Figure 3.5 shows that Hungary had the highest share of FX loans from all the CEE countries - almost 60% of total loans to both corporates and households. The loans' conditions were more favourable compared to the ones in Hungarian forints, however when the financial crisis started, they became poison pills to the Hungarian economy. Forint depreciation which would otherwise bring the economy

Figure 3.2: Real GDP Growth by Country (2008-09)



Source: Eurostat.

competitive advantage in exports, caused it much more trouble by increasing the value of loans that households, corporations and the government had to roll over. Many debtors thus started to default on their liabilities, the conditions in the country worsened, and the subsequent depreciation closed an imaginary viscious circle. This viscious circle has only been broken by substantial balance of payments support from the International Monetary Fund (IMF) and the EU.

The newest EU member states, Bulgaria and Romania, have had the lowest living standards from the whole Union even before the 2007-09 crisis. Unfortunately, the crisis did not spare them and because of belonging to the hardest hit countries, their situation got even worse. The unemployment rate over 8% (Figure 3.3) and an extensive government deficit (Figure 3.4) are only further indicators of the deteriorated economic conditions. The damages might have been less severe if the countries had been included in the EU's 2007-13 budget which would have given them access to the large EU funds (e.g. the European Structural Funds).

Out of Bulgaria and Romania, the latter one was affected harder by the recession. Its GDP drop was the second biggest out of all examined source and host countries and its public debt was the biggest one in both 2008 and 2009 (5.4% and 8.3% of GDP respectively). A high government deficit is on one hand a consequence of a crisis but on the other hand it also allows for a more severe impact of the crisis. As already explained in Section 3.2, large fiscal deficits make countries more vulnerable to crisis propagation mechanisms

because they have difficulties finding additional sources of financing. However, we should keep in mind that it is only one of many possible factors influencing the crisis expansion. It is more relevant for developing countries than for the developed ones (such as our source countries) which have more stable financial systems and better financing options.

Figure 3.3: Unemployment Rate (2009)

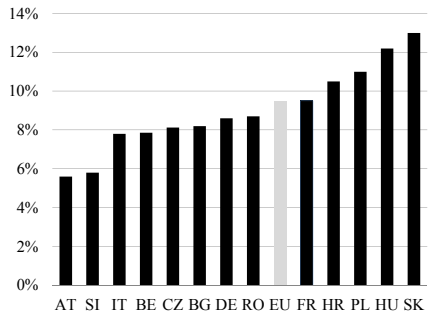


Figure 3.4: Public Debt (% GDP)

Source: Eurostat.

Figure 3.5: FX Loans (2008)

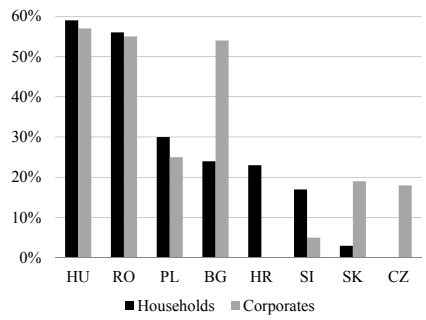
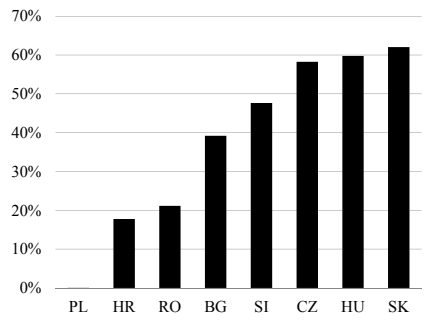


Figure 3.6: Goods Exports (2008; % GDP)



Source: Czech National Bank. Croatian National Bank. Eurostat.
Note Figure 3.5: Loans in foreign currency are calculated as percentage of total loans. HR - data for households and corporations together.

Another disadvantage of Romania during the crisis was its high share of loans in foreign currency - the second highest from the CEE in 2008 concerning both households and corporates (Figure 3.5). Hungary and Romania are rather outstanding examples in terms of loans in foreign currency and all the other countries except Bulgaria in corporate loans reach no more than a half of their values. The least dependent country on loans in foreign currency is the Czech Republic whose households basically do not borrow in any other currency than the Czech crown and corporations borrow less than 20% of their total loans.

These characteristics of the Czech Republic definitely had a positive influence on its ability to cope with the crisis. As a small open economy dependent on exports (see Figure 3.6), it could depreciate its currency to gain more competitiveness without any negative effects through the foreign loans mechanism seen e.g. in Hungary. Of course it was not spared from the adverse affects caused by the demand slump on its core exporting markets (Germany, Poland, France, UK etc.). However, it still belongs together with Poland to the CEE countries which were least affected by the 2007-09 crisis. Poland is a rather specific case in the region because of its lower dependency on exports and foreign trade in general. But when looking at its unemployment rate of 11% (the third highest from the examined countries) and fiscal deficit of 7% (also the third highest), we might see some other problems arising in the future.

Slovakia and Slovenia also have very low amount of loans in foreign currency but the interpretation differs for them as they are members of the Eurozone. Taken into account that most foreign currency loans in Europe are contracted in euros, it is not so surprising that Slovenia only had very little of them. Slovakia did not join the Eurozone until 1 January 2009 so its foreign currency loans in 2008 included the ones in euros, however their low amount did not bring much advantage to Slovakian economy. Neither Slovakia, nor Slovenia could deflate their currency in 2008 - in case of Slovakia because of the Maastricht convergence criteria - and thus they could not gain competitive advantage on their export markets. As they are both strongly dependent on exports (see Figure 3.6) this monetary policy limitation has caused some serious damage to their economies.

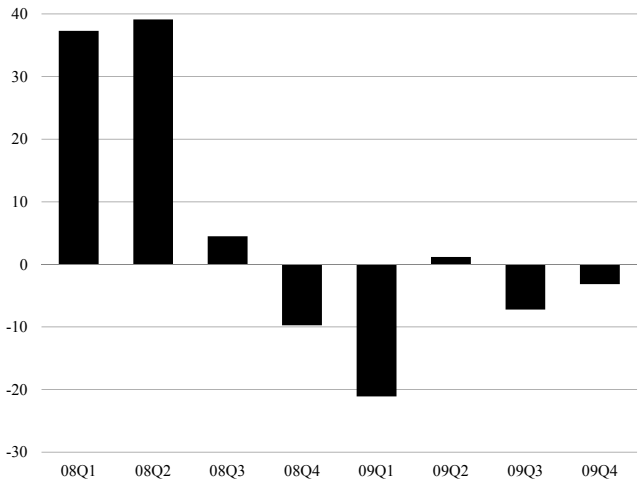
3.3.3 Cross-Border Lending to CEE

Section 3.3.2 describes the situation of the CEE region during the 2007-09 crisis and which factors had positive or negative impact on the way each country has coped with it. One of these factors which also belongs to the major topics of this thesis are the cross-border bank loans. According to the Bank for International Settlements (BIS) statistics, international banks started to withdraw funding from some emerging markets in the third quarter of 2008 (08Q3) and CEE has been no exception in this regard. Figure 3.7 shows exchange rate adjusted changes of external liabilities of all BIS reporting banks[1] towards all sectors

[1]Australia, Austria, Bahamas, Bahrain, Belgium, Bermuda, Brazil, Canada, Cayman Islands, Chile, Chinese Taipei, Cyprus, Denmark, Finland, France, Germany, Greece, Guernsey, Hong Kong SAR, India, Ireland, Isle of Man, Italy, Japan, Jersey, Korea, Luxem-

in CEE from 08Q1 until the end of 2009. The funding drop in 08Q3 was rather sharp as the cross-border liabilities increased only by about USD 5 bn, compared to almost USD 40 bn during the previous two quarters. 08Q4 was the first quarter when the total amount of liabilities decreased and with a slight exception of 09Q2, it kept decreasing throughout the whole year 2009.

Figure 3.7: Cross-border Liabilities towards CEE (2008-09; USD bn)



Source: BIS locational statistics.
Note: Exchange rate adjusted changes in external liabilities of BIS reporting banks towards all sectors in CEE.

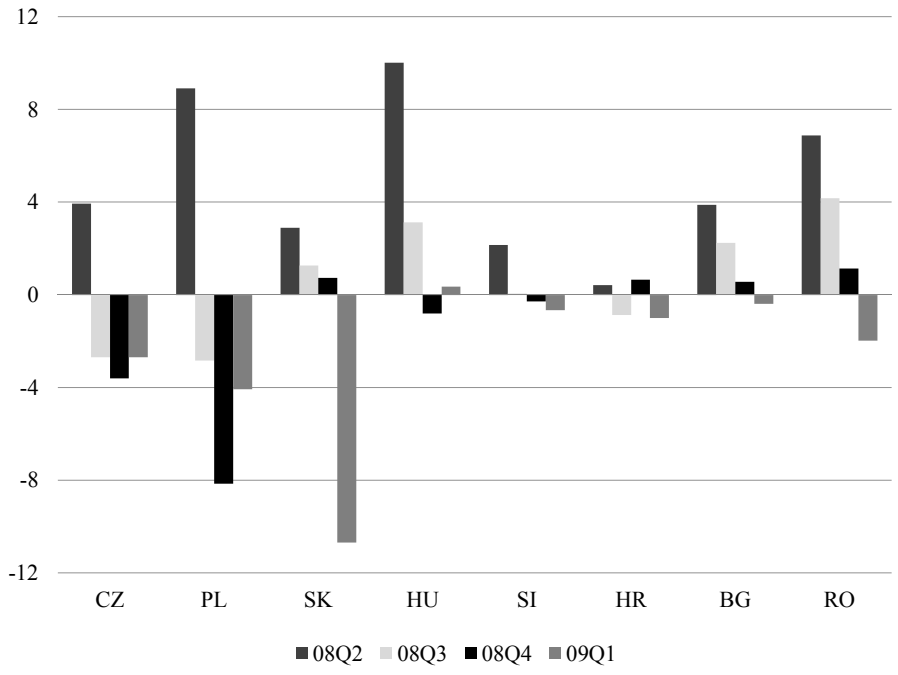
According to BIS (2009), countries with sound and relatively liquid banking systems were affected first from all emerging markets. It is believed that it was caused by some international banks who wanted to reduce liquidity shortages in their home markets. The reasons behind cross-border loans cuts in CEE will be examined in the empirical Chapter 4 - whether it was the distress of banks in source countries, worsening conditions of host countries, pure financial contagion in the form of increased investors' riks aversion or any other local or global factor. However, we should now have a look at the intensity of cuts in each host country and some economic and banking sector characteristics that might have influenced the funding drop consequences. Figure 3.8 presents exchange rate adjusted changes of external liabilities of BIS reporting banks towards all sectors in each CEE country.

We can see that the Czech Republic and Poland which probably have the soundest banking systems were the first ones to get into negative changes which

bourg, Macao SAR, Malaysia, Mexico, Netherlands, Netherlands Antilles, Norway, Panama, Portugal, Singapore, South Africa, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States

supports the BIS (2009) hypothesis. The largest drop of USD 11 bn happened in Slovakia in 09Q1. This could partly be caused by the country's conversion to euro and investors' skepticism towards such step in the middle of a financial crisis. Another Viszegrad country, Hungary, was also affected by a rather steep fall of cross-border loans but in this case a more severe drop was probably prevented by the IMF and EU financial support. The Balkan countries have not been subject to such big changes as the Viszegrad countries in total amounts, however relative to the size of their GDP, the effects are quite comparable. The biggest drop among them happened in Romania in 09Q1 and it amounted to USD 2 bn.

Figure 3.8: Cross-border Loans by Country (08Q2-09Q1; USD bn)

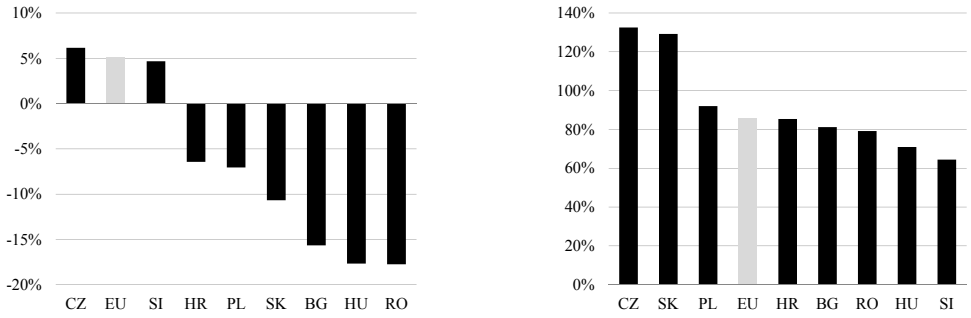


Source: BIS locational statistics.
Note: Exchange rate adjusted changes in external liabilities of BIS reporting banks towards all sectors in each CEE country.

The size of cross-border loans cuts is for sure a relevant piece of information, however it needs to be accompanied by some characteristics of the borrowing countries and their banking sectors. One factor that plays a major role in the dependence of a certain country on external financing are its net external assets (foreign financial assets - foreign financial liabilities) presented in Figure 3.9 as percentage of GDP. According to this figure, the Czech Republic and Slovenia are the only two countries out of the whole CEE region which are net lenders

and not net borrowers to the world banking system. Therefore the cut of external financing of their credit expansion might not have had such a crucial impact on the spreading of the 2007-09 to their economies. The three most dependent countries on external financing are Romania, Hungary and Bulgaria - with their net external assets ranging between -15% and -20% of GDP. All these countries have been hit by the crisis rather severely.

Figure 3.9: Net External Assets (2008) Figure 3.10: Deposit-Loan Ratio (2008)



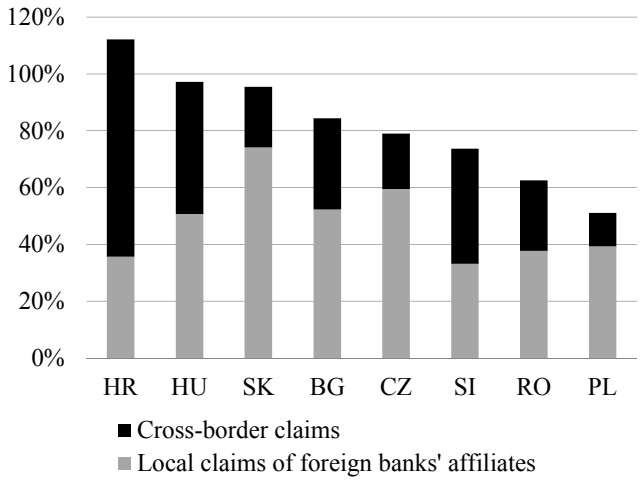
Source: Czech National Bank. Croatian National Bank.
Note Figure 3.9: Net external assets are calculated as percentage of GDP.

Another important factor that captures the dependence on external financing is banks' deposit-to-loan ratio. This ratio is computed by dividing the amount of bank's deposits by its loans and it tells us how much the bank is relying on borrowed funds. If the ratio is high, the bank finances most of its loans from deposits, and if it is low, the bank needs to seek for other sources of financing, such as external loans. The values for the CEE countries are presented in Figure 3.10. The EU average is 86% and three CEE countries range above this level - the Czech Republic, Slovakia and Poland. The first two are even more special because their ratio is higher than 100% which means that their banks receive more deposits than give loans - quite a rare example to be found in Europe. These countries should, ceteris paribus, be less sensitive to changes in cross-border bank flows. The opposite side of the scale is occupied by Slovenia and Hungary, from which the latter one has been for sure more affected by the low deposit-to-loan ratio because of its combination with low net external assets ratio.

One of the last issues to be mentioned regarding the cross-border bank flows to CEE is the difference between "foreign" and "international" claims in the BIS terminology. Mosts analysts were using the BIS data for an assessment of the roll-over risk of the CEE countries during the 2007-09 crisis. Out of these data they usually picked the "foreign" claims statistics which does not

only cover direct cross-border exposure of BIS reporting banks towards the CEE countries ("international" claims) but also local claims of reporting banks' affiliates in CEE in local currency. Considering the fact that many local affiliates are predominantly financed by local deposits (such as in the Czech Republic or Slovakia) or may have other sources of financing than loans from their foreign mother banks, the "foreign" claims create a false picture of the CEE dependency on external financing. Figure 3.11 shows the difference between "foreign" and "international" claims for each country as percentage of GDP. The biggest share of local claims of foreign affiliates on total "foreign" claims is characteristic for the Czech Republic, Slovakia and Poland who were thus most affected by the analysts' data misinterpretation.

Figure 3.11: Foreign Claims (2008; % GDP)



Source: BIS locational statistics. Czech National Bank.
Note Figure 3.11: HR - data for 2010.

Chapter 4

Empirical Testing

4.1 Choosing the Right Model

The purpose of our empirical research is to discover what global and local factors influenced the cuts in cross-border bank loans in the CEE countries, i.e. helped to spread the 2007-09 financial crisis. The methodology builds on the existing empirical literature, especially on Herrmann & Mihaljek (2010) who examine the cross-border bank flows to world emerging markets, McGuire & Tarashev (2008) who look at banks' health and its influence on lending to emerging markets, Jeanneau & Micu (2002) who focus on push and pull factors and bank lending, and De Haas & Van Lelyveld (2009) who examine linkages between parent banks and their foreign subsidiaries.

Our data sample covers 8 CEE countries, namely the Czech Republic, Slovakia, Poland, Hungary, Slovenia, Croatia, Bulgaria and Romania, which are examined as the borrowing "host" countries. Some literature on the CEE region, such as Geršl (2007), focuses also on the Baltic states - Latvia, Lithuania and Estonia. However, these countries are known for a high share of banking sector owned by the Scandinavian countries and thus do not fit to our group of 5 "source" (lending) countries which is Austria, Germany, France, Italy and Belgium. These countries were chosen mainly for the presence of big banking groups across the CEE region, such as Austrian Erste Bank and Raiffeisen, French Societe Generale, Belgian KBC, Italian UniCredit or German Deutsche Bank or Commerzbank.

The examied time period stretches from 2001 to 2009 using quarterly values, as the dependent variable (the cross-border loans) is recorded quarterly. The beginning of the observation has been set for 2001 mainly due to data

availability reasons. The calcualtion of the risk appetite index is based on the exchange rates of several world currencies towards euro and uses also forward rates going more than one year backwards, so 2001 was the first year for which the index could be calculated properly. Another reason behind the time period choice is that the 1990s were a transformation period for the CEE region which is often characterized by very chaotic and unreasonable data samples - if they are available at all. Compared to that, the observations after 2001 should be more stable and show better relations amongst the examined variables.

All variables in our model have been either taken as a logarithm or, where it was a percentage, smoothed by the moving average method. In that case, the value at time t is calculated as the average over the period $\langle t-2, t+2\rangle$. When using the logarithm of a certain variable, we had to deal with negative values - for instance by the dependent variable. For that purpose we use the same method as Herrmann & Mihaljek (2010): for negative value we take the logarithm of the absolute value and assign it a negative sign.

The data are analyzed as panel data that pool together time series of cross-sections. Each section represents one pair of host and source countries which makes 40 sections in total, observed over time $t\,(t = 1, \ldots, 36)$. The poolability of the data, i.e. the stability of coefficients across sections, has been tested using the Chow test and the results supported the panel data approach. More detailed description of the test outcomes will be presented in Section 4.4.

In order to capture all different kinds of effects that might have influenced the cross-border bank flows in CEE during the 2007-09 crisis, we have created a basic model and three other extension models. Each of them is trying to explain different aspects of cross-border bank lending, looking at it from a different point of view. Our *Basic model* comprises the following variables:

$$l\_LOANS_{ijt} = \beta_0 + \beta_1\, GROWTH_{ijt} + \beta_2\, MM\_INT_{ijt} + \varepsilon_{ijt} \tag{4.1}$$

where

- l_LOANS_{ijt} is the logarithm of an exchange rate adjusted change in the claims of BIS reporting banks in source country $i\,(i = 1, \ldots, 5)$ vis-à-vis all sectors in CEE host country $j\,(j = 1, \ldots, 8)$ at time $t\,(t = 1, \ldots, 36)$ (source: BIS),

- $GROWTH_{ijt}$ is the GDP growth of host country j minus GDP growth of source country i in percentages at time t (source: Eurostat),
- MM_INT_{ijt} is the money market interest rate (rate on short-term lending between financial institutions) of host country j minus money market interest rate of source country i in percentages at time t (source: IMF, European Central Bank (ECB))
- and ε_{ijt} are the error terms.

The *Basic model* specifications are the following:

1. *Global Model*

$$\begin{aligned} l\_LOANS_{ijt} &= \beta_0 + \beta_1 GROWTH_{ijt} + \beta_2 MM\_INT_{ijt} + \\ &\quad + \beta_3 KP\_INDEX_t + \beta_4 l\_VOLATILITY_t + \varepsilon_{ijt} \end{aligned} \tag{4.2}$$

where

- KP_INDEX_t is the investors' risk appetite index at time t, calculated according to Kumar & Persaud (2002) (the calculation details will be described in Section 4.3.3),
- and $l\_VOLATILITY_t$ is the logarithm of The Chicago Board Options Exchange S&P 100 Volatility Index at time t (source: Bloomberg).

The *Global model* corresponds to the idea that cross-border bank loans are mostly influenced by variables determined on a global basis, with supposedly global effects (the "global factors"). Therefore the *Basic model* is extended by two more variables - the risk aversion index and volatility. The former is used as an overall indicator of the willingness of market participants to take on risk and the latter as an indicator of the expected short-term volatility of the global financial market (i.e. the level of risk), based on the weighted average of implied volatilities for a wide range of strikes.

2. *Lender Model*

$$l\_LOANS_{ijt} = \beta_0 + \beta_1 GROWTH_{ijt} + \beta_2 MM\_INT_{ijt} + \beta_3 LLP\_S_{it} + \\ + \beta_4 NIM\_S_{it} + \varepsilon_{ijt} \quad (4.3)$$

where

- LLP_S_{it} is the average ratio of loan loss provisions to net interest revenue in banks in source country i at time t in percentages (source: Bankscope database),
- and NIM_S_{it} is the average net interest margin in banks in source country i at time t in percentages (source: Bankscope database).

The *Lender model* corresponds to the idea that "local factors" in source countries have major influence on the loans coming from these countries to the CEE region. The loan loss provsions ratio is a proxy for the general financial condition of a bank and therefore its country average might be a proxy for the soundness of the local banking sector ("bank health"). It is the relationship between provisions in the profit and loss account and the interest income over the same period. In a well run bank, these ratios should be as low as possible and if the lending book is higher risk, it should be compensated by higher interest margins. If the ratio deteriorates, it means that risk is not being properly remunerated by margins. The net interest margin is a bank performance indicator, calculated as a ratio of net interest income to earning assets. Higher margins and profitability are desirable as long as the asset quality is being maintained.

3. *Borrower Model*

$$l\_LOANS_{ijt} = \beta_0 + \beta_1 GROWTH_{ijt} + \beta_2 MM\_INT_{ijt} + \beta_3 LLP\_H_{jt} + \\ + \beta_4 GBAL\_H_{jt} + \beta_5 FDI\_H_{jt} + \varepsilon_{ijt} \quad (4.4)$$

where

- LLP_H_{jt} is the average ratio of loan loss provisions to net interest revenue in banks in host country j at time t in percentages (source: Bankscope database),

- $GBAL\_H_{jt}$ is the government balance as a percentage of GDP in host country j at time t (source: Eurostat, Croatian Bureau of Statistics),
- and FDI_H_{jt} is the foreign investment to the host country j as a percentage of GDP at time t (source: IMF).

The *Borrower model* corresponds to the idea that factors which make a host country most vulnerable to cuts in foreign lending are its own characteristics, especially the ones indicating its potentional riskiness. These are represented by the loan loss provisions ratio (i.e. the soundness of the bankig sector used also in the *Lender model*) and the government balance which is the net lending (+) or net borrowing (-) by the country's government. Higher fiscal deficit is believed to indicate higher probability of future default on government debt and thus a higher risk profile of the host country. The foreign direct investment is taken as a proxy for the openness of the host country's economy which besides bank investment covers also other sources of capital inflow.

A big part of the literature that was described in Chapter 2 analyzes the financial contagion through a "common lender effect", assuming the existence of a "ground zero" country where the crisis has originated. The models are based on the exposure (e.g. foreign loans) of the examined region towards the ground zero country. This framework however cannot be used for our analysis because there is basically no direct exposure of the CEE countries towards the US. We could use the exposure of the source countries but there are no data on international loans between our source countries and the US. Therefore we restrict our analysis to the global factors, such as investors' attitude toward risk, which were certainly influenced by the situation in the US.

Another model that we have considered was a gravity model, used e.g. by Herrmann & Mihaljek (2010). The model builds on an assumption that the geographical proximity of the source and host countries has a significant influence on the flows of funds between them. A distance between the countries' capitals is therefore taken as one of the explanatory variables. This approach usually works for large data samples covering the whole world and with large variety of distances. However, it did not work for our data sample with all the examined countries concentrated on a very small area. As the distance between capitals is a time-independent variable, it requires the use of a random effects estimator because the fixed one would wipe out all the variable's effects due

to a near-singular matrix. However, the intercepts differ significantly across the examined sections (for details see Section 4.4) so the random effects model would have to be extended by dummies for the different sections that would cover the fixed effects. When testing this model, the distance variable did not show any signs of signifiance so we have decided to abandon the gravity model.

4.2 Hypotheses and Assumptions

Our main hypothesis is that both local and global factors have a significant influence on the cross-border loans from BIS reporting banks in our chosen source countries to the banking and non-banking sectors in our chosen CEE host countries. The model specification goes even further by dividing the local factors to the ones related to a source country (*Lender model*) and the ones related to a host country (*Borrower model*). We presume that all the variables included in our model in Section 4.1 will be significant and our expected signs of their coefficients are stated in Table 4.1. It has to be noted, though, that our hypothesis is already based on some previous testing of a larger data sample. The variables that had throughout our preparatory phase appeared non-significant or highly correlated with some others have been excluded from the model and are stated in Section 4.3, Table 4.2.

One of our hypotheses is that pure contagion, i.e. the change in investors' risk appetite/aversion has helped to spread the 2007-09 financial crisis to the CEE countries through a significant influence on the cut of cross-border bank loans. However, we have to keep in mind that our risk appetite index is a global index of pure contagion and as such does not tell us about the risk appetite/aversion only towards the CEE region. The general idea behind this index is that if investors' risk aversion rises, they tend to reduce their exposure to risky assets and shift their portfolios towards seemingly safer ones. Another part of our hypothesis therefore needs to state that the CEE countries are considered relatively risky compared to the rest of the source countries' portfolios. An increase in investors's risk aversion thus reduces the amount of loans to the host countries which induces a positive sign of the KP_INDEX coefficient. A negative sign of the KP_INDEX coefficient would, on the other hand, contradict our hypothesis and induce that the CEE countries are no longer considered a risky region.

There are several hypotheses to be tested in this thesis and they will either be confirmed or rejected, according to the results of our empirical research.

Table 4.1: Expected Signs of Coefficients

Variable	***Sign***	***Description***
Basic model		
$GROWTH$	$\oplus$	A higher GDP growth of host country j relative to source country i should, *ceteris paribus*, increase the amount of cross-border loans from banks in country i to all sectors in country j.
MM_INT	$\oplus$	A higher interest rate in country j relative to country i should, *ceteris paribus*, motivate the banks in country i by higher yields to increase the cross-border loans to country j.
Global model		
KP_INDEX	$\oplus$	A higher investors' risk appetite should, ceteris paribus, increase loans to "risky" countries which, we believe, is still the perception of the CEE region.
$l\_VOLATILITY$	$\ominus$	A higher volatility of the global financial markets should, *ceteris paribus*, decrease the amount of investments in general and therefore also loans from country i to country j.
Lender model		
LLP_S	$\ominus$	The amount of loan loss provisions as an indicator of health of the banking sector in country i should, *ceteris paribus*, have a negative effect on the amount of loans flowing from country i to country j or anywhere else.
NIM_S	$\oplus$	The net interest margin as an indicator of performance and profitability of the banking sector in country i should, *ceteris paribus*, have a positive effect on the amount of loans flowing from country i to country j or anywhere else.
Borrower model		
LLP_H	$\ominus$	Higher loan loss provisions in country j should, *ceteris paribus*, reduce the amount of loans from country i as it indicates poor health of the banking sector in country j.
$GBAL\_H$	$\oplus$	A higher government fiscal deficit in country j (i.e. lower government balance) increases the country's riks profile and therefore it should, *ceteris paribus*, decrease the amount of loans from country i to country j.
FDI_H	$\oplus$	A higher FDI to country j as an indicator of the openness of its economy should, *ceteris paribus*, increase the amount of loans flowing to country j from country i.

However, there is also one assumption which has been adopted from other empirical works, such as Nikolov (2010), and will not be tested by any of our models. It is the assumption that the changes in cross-border bank loans were one of the mechanisms that helped to spread the 2007-09 crisis across the CEE region. It was certainly not the only propagation mechanism, as the CEE banks in general are not so much dependent on external financing compared to the EU average. The main reason for that, especially in the Czech Republic, Slovakia or Poland, is a rather low loan-to-deposit ratio which provides the banks with enough internal funds so that they are not so much dependent on financing from abroad. However, the cross-border loans still represent a substantial source of funds for the CEE economies (especially in Hungary and the Balkan countries) and their reduction may cause liquidity troubles to the local banks and subsequently to the borrowers from non-financial sector. This is the main reason why we have chosen to examine the cross-border bank loans and their determinants in connection with the 2007-09 financial crisis. More details on the banking sector characteristics of the CEE countries can be found in Section 3.3.1.

4.3 Data Description

4.3.1 Cross-border Bank Loans

The data for the foreign bank loans have been taken from the BIS statistics. It is a commonly used source of data for the empirical literature about cross-border contagion, used for instance by Geršl (2007) or Van Rijckeghem & Weder (2001). The BIS data are issued quarterly and include both stocks ("amounts outstanding") and flows ("changes"). Our explanatory variable is based on the flow data, adjusted for exchange rate changes.

The BIS dataset is a consolidated banking statistics, in which creditor data are reported on both the nationality (i.e. home country) and the residence (i.e. host country) basis. In the first case, they are called *consolidated statistics* and in their framework all bank loans from let us say Germany are consolidated on a worldwide basis and reported as loans from German banks. In the second case, in the *locational statistics*, all cross-border loans made by banks based in Germany (including e.g. the Austrian banks) are reported as "German", while the loans from the Austrian banks' subsidiaries in London are reported as the UK loans. The main purpose of both data sets is to enable an analysis of the

cross-border capital flows intermediated by the internationally active banks. The locational data are more relevant for countries receiving external loans (rather than giving the loans) because they measure lending flows in a given period, consistent with the balance of payments data ("external positions" correspond to the "other investment" category of capital flows).

It this thesis, we use the external loans of BIS reporting banks from source countries vis-à-vis individual host countries from the locational statistics. It comprises data on gross international financial claims and liabilities of banks resident in a given country, on banks and the non-bank sector in other countries. One of the main reasons for picking the locational statistics, besides the consistency with the balance of payments data, is the focus on the CEE region. We believe that distance-wise, it is more relevant to examine loans from all international banks based in our source countries than to look at for instance subsidiaries of French banks in South America. There, the probability of lending to the CEE region would be rather limited.

4.3.2 Local Factors

The local factors in our empirical model are various macroeconomic, financial and banking indicators and characteristics of both the borrowing (host) and lending (source) countries. We started to build our model with a broad dataset including about 20 variables and then step by step began to exclude the variables that were not significant or that were highly correlated with some others (in that case we chose the more significant one).

The variables that were in the end chosen for our model are described in Section 4.1. The other variables that we, for various reasons, excluded are described in Table 4.2. The variables which were specific for source and host countries were tested in both alternatives and if one of them was included in our model, the excluded alternative is not stated in Table 4.2.

All the local factors which are supposed to describe the situation of banks in host or source countries were taken from a database called Bankscope, released by a business intelligence company Bureau van Dijk. It is a comprehensive global database of banks' financial statements, ratings and intelligence, covering about 30,000 banks up to 16 years backwards. We requested the examined ratios for all banks in our source and host countries and used a median for each country as a variable in our model.

Another database which we used besides the commonly known Eurostat is

Table 4.2: Excluded Variables

Variable	*Source*	*Description*
CB_INT	Eurostat, ECB	central bank interest rate of host country j minus central bank interest rate of source country i (%) - highly correlated with MM_INT
$INFL$	IMF	inflation of country j minus inflation of country i (%)
FIN_OPEN	BIS, Eurostat	ratio of external assets and liabilities of BIS reporting banks in country j vis-à-vis country i relative to country j's GDP
$BP\_S(\_H)$	Eurostat	balance of payments of country i or j which is net current + capital account (credit - debit) as a percentage of GDP - correlated with $FDI\_S(\_H)$
$UNEM\_S(\_H)$	Eurostat, IMF	unemployment rate of country i or j (%)
$ROAE\_S(\_H)$	Bankscope	return on average equity of banks in country i or j which is a measure of profitability / return on shareholder funds (%)
$SOLV\_S(\_H)$	Bankscope	ratio of equity to assets of banks in country i or j which is a measure of solvency (the amount of protection afforded to the bank by the equity they invested in)
$LIQ\_S(\_H)$	Bankscope	deposit run off ratio of banks in country i or j which is a measure of what percentage of customer and short term funds could be met if they were withdrawn suddenly

the International Financial Statistics of the IMF. The database covers most IMF members, as well as some non-members up to 1948. It shows major economic aggregates used in the analysis of economic developments which together makes approx. 32,000 time series for more than 200 countries. The data are available in three freqencies: annual, quarterly, and monthly - from which we chose the quarterly time series corresponding to our dependent variable.

Unfortunately, not all data used in our model are available in quarterly frequency. In those cases we had to use yearly data and apply the same value for all four periods in a year. Concretely, it is the case of the following variables: $GBAL\_S(\_H)$, $FDI\_S(\_H)$, $LLP\_S(\_H)$, $NIM\_S(\_H)$, $ROAE\_S(\_H)$, $SOLV\_S(\_H)$, $LIQ\_S(\_H)$. This approach should not have any disturbing effect on the logic of our model besides a different variability of the dependent and some explanatory variables.

4.3.3 Risk Appetite Index

One of the global factors used in our empirical research is the KP_INDEX, named after Kumar & Persaud (2002) whose calculation methods we use. The index serves as a measure of investors' risk appetite and indicates the level of "pure" financial contagion which cannot be explained by changes of fundamentals or by any direct linkages and spillovers between the affected countries. It is important to note that the shift in investors' risk appetite can be caused by two different events:

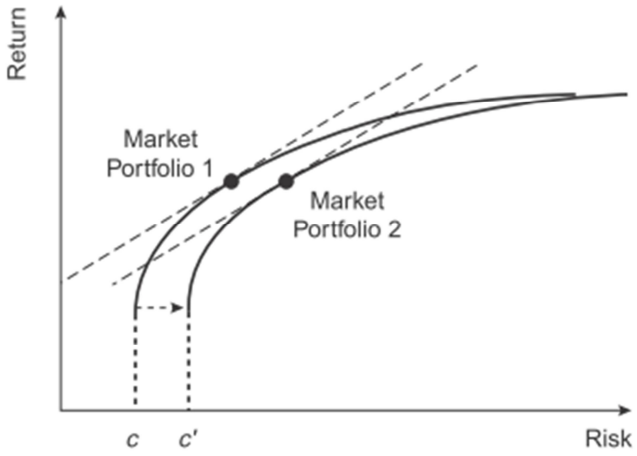
- a shift in the overall degree of investors' aversion or appetite to risk,
- a shift in the relative weight of different types of investors with different risk appetites.

The first factor is rather intuitive to understand and can be caused for instance by a series of negative returns on the financial markets. The second factor could reflect for example the changing popularity of some risky instruments or funds - hedge funds, emerging markets mutual funds etc.

The logic behind KP index calculation is based on the Capital Asset Pricing Model (CAPM) where the assumption of a single risk-free rate rate at which all investors can infinitely borrow and lend is removed and the assumption that all investors have the same changing risk appetite is added. Then the composition of the equilibrium market portfolio can change with altering risk aversion.

The two basic concepts that need to be distinguished in the CAPM model are the level of risk and the real risk appetite. If the level of risk changes (Figure 4.1), the whole efficiency frontier shifts but the slope of the capital market line stays the same. Therefore the market portfolio's composition remains static and there is no systematic relationship between price impact (where price is the expected rate of return) and asset risk (volatility). On the other hand, if the risk appetite changes (Figure 4.2), the efficiency frontier stays the same but the capital market line changes its slope as the investors change the weights of risky and safe assets. Therefore there is a systematic relationship between price impact and asset risk.

Figure 4.1: CAPM: Shift of Level of Risk

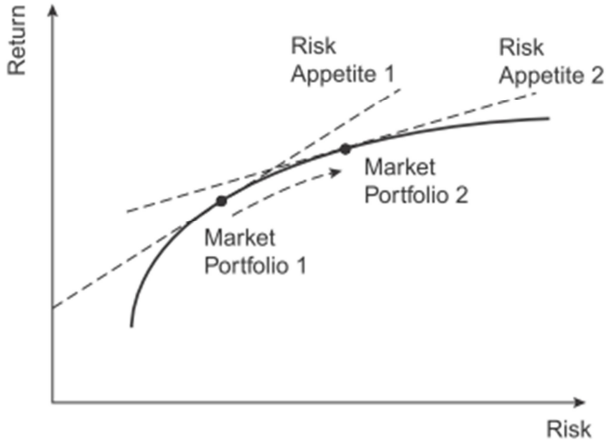


Source: Kumar & Persaud (2002), pg. 411.

To be able to distinguish between the changes in risk appetite and level of risk when observing asset price changes, it is necessary to look at the *order* of returns for any given asset. When risk changes at period t, the order of price movements is the order of the impact of the current change in risk. Therefore there should be weak correlation between price movements at t and a measure of riskiness at t - k. Contrary to that, when appetite for risk changes, the order of price changes follows the order of past riskiness. Therefore there should be strong correlation between price movements at$t$ and a measure of riskiness at t - k.

For the purposes of this thesis, the calculations are based on daily spot and three-month forward exchange rates against euro of 11 currencies which

Figure 4.2: CAPM: Shift of Risk Appetite



Source: Kumar & Persaud (2002), pg. 410.

are realatively liquid, and where the forward exchange rate is not impeded by capital controls (all data have been downloaded from Bloomberg):

- Australian dollar
- Canadian dollar
- Czech koruna
- Hong Kong dollar
- Japanese yen
- New Zealand dollar
- Norwegian crown
- Singaporean dollar
- South African rand
- Swedish crown
- British pound

The index calculation can be divided into 3 basic steps:

1. Calculating the *current rank of excess returns* (asset prices) by taking the log difference of the spot rate and the three-month forward rate determined three months ago (65 business days). If the spot rate has outperformed the forward rate, there is an excess return.

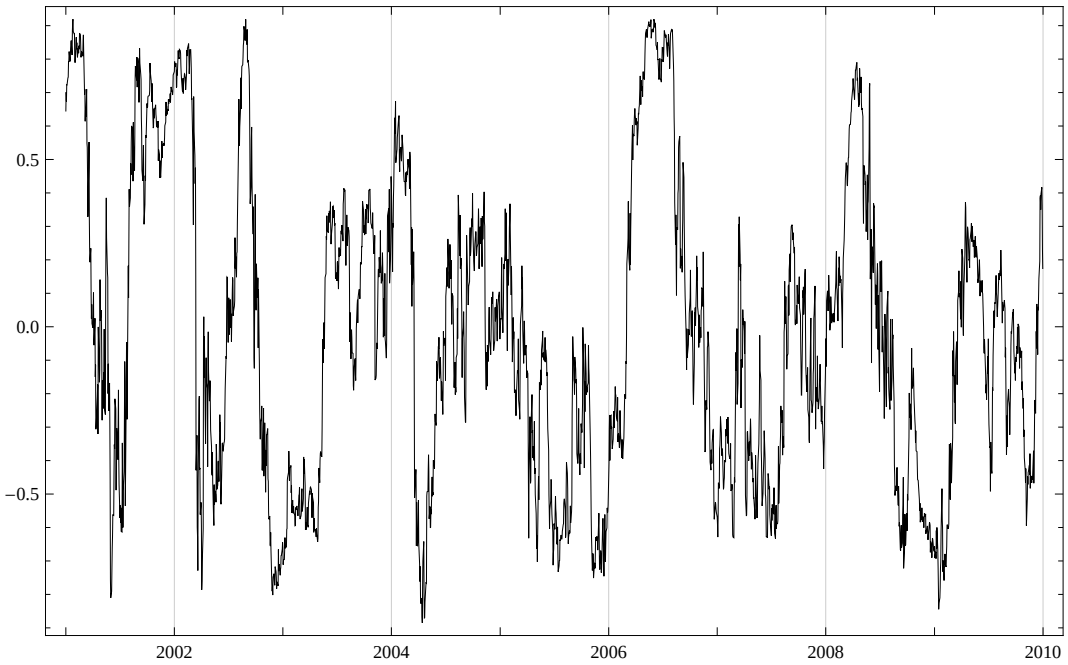
2. Calculating the *past rank of risk* by taking the average volatility of quarterly excess returns over a one year period (260 business days). The period over which the volatility of returns is measured and over which the returns are measured must not overlap. Therefore the 260 business days over which the volatility is calculated have to finish 66 business days before the date of the spot rate.

3. Obtaining the KP index by calculating the *Pearson's correlation* of the current rank of excess returns and the past rank of risk. If the correlation is positive, the investors increase their risk appetite. If the correlation is negative, the investors become more risk averse. The more significant the correlation (approaching 1 or -1), the stronger the change of investors' risk appetite.

The outcome of the above described calculations are daily measures of investors' risk appetite from 1 January 2001 to 31 December 2009. In order to match the frequency of our dependent variable, we have calcualted quarterly averages of the index.

The results of our calculations are presented in Figure 4.3. We can see that the index is very volatile as it is calculated on a daily basis. When trying to analyze investors' risk appetite/aversion during the 2007-09 crisis, attention needs to be paid to some visible peaks and bottoms. There is a very long period of risk appetite during most of the year 2006 before the crisis had started. After that in 2007, the values oscillate mostly below 0, indicating prevailing investors' risk aversion due to the burst of the housing bubble in the US. Then at the beginning of 2008, investors start to gain confidence in the markets again but the mid-2008 and the fall of Lehman Brothers bring their risk appetite to an almost historical minimum. The situation gets better during 2009 but there are still more negative than positive values of the risk appetite index.

Figure 4.3: Risk Appetite Index (2001-09)



Source: author's computations.

4.3.4 Volatility

The second global factor in our model is a variable called $VOLATILITY$. It is the Chicago Board Options Exchange S&P 100 Volatility Index and its use is inspired by Herrmann & Mihaljek (2010). It serves as an indicator of the expected short-term volatility of the global financial market, based on the weighted average of implied volatilities for a wide range of strikes. For our purposes it approximates the level of risk on the global market which supplements very well the KP_INDEX. In this way we have both the level of risk and the risk appetite as factors that may influence the flow of cross-border bank loans. The $VOLATILITY$ index has been downloaded from Bloomberg.

4.4 Estimation Results

The basic parameters of our model are described in Section 4.1. The data are analyzed as panel data that pool together time series of cross-sections. Each section represents one pair of host and source countries which makes 40 sections

in total, observed over time $t\,(t = 1, \ldots, 36)$. All estimations and tests of our data sample have been conducted in the econometrics software Gretl 1.9.3.

In a general matrix form, our panel data model (in any of its specifications) can be described by Equation 4.5:

$$y = \alpha\iota_{NT} + X\beta + Z_\mu\mu + \nu = Z\delta + Z_\mu\mu + \nu \tag{4.5}$$

where y is of dimension $NT \times 1$, ι_{NT} is a vector of ones of dimension NT, Z is $NT \times (K+1)$ and Z_μ is $NT \times N$. Z_μ is a selector matrix of ones and zeros, or simply the matrix of individual dummies that one may include in the regression to estimate the μ_i's (time-invariant cross-section specific components) if they are assumed to be fixed parameters. N is the number of cross-sections, T is the number of time periods, and K is the number of explanatory variables.

4.4.1 Chow Test of Poolability

At first, it is necessary to find out whether our assumption of the data poolability is correct because otherwise each section (a pair of host and source countries) would have to be examined separately. For this purpose we use the Chow test of poolability which tests the stability of coefficients across sections. The Chow test has two main versions based on Equation 4.5:

1. $H_0 : \delta_i = \delta$ for all i against $H_A : \delta_i \neq \delta$ at least for some i where $i = 1, \ldots, N$.

   Test statistics is an F-test which is $F_{(N-1)(K+1),N(T-K-1)}$ distributed.

2. $H_0 : \beta_i = \beta$ for all i against $H_A : \beta_i \neq \beta$ at least for some i.

   Test statistics is an F-test which is $F_{K(N-1),N(T-K-1)}$ distributed.

When we test the first version on our *Basic model*, we get the result that p-value $= 3.65682e - 008$. The null hypothesis is strongly rejected which tells us that all three coefficients (including intercept) are not stable across sections. However, this does not mean that the data cannot be pooled together - in case the weaker version of Chow test does not reject the null hypothesis.

The results of the second Chow test version on all model specifications are summarized in Table 4.3 and the null hypothesis cannot be rejected on 10% significance level for any of the cases. This tells us that all coefficients except

the intercept are stable across sections and we can therefore use the panel data approach - if controlled for section-specific fixed effects.

Table 4.3: Chow Test Results

Model	*p-value*	H_0
Basic model	0.220635	confirmed
Global model	0.673328	confirmed
Lender model	0.148259	confirmed
Borrower model	0.213310	confirmed

Source: author's computations.

4.4.2 Choosing the Right Estimator

The Chow test results might suggest that a fixed efects estimator would be the best solution for our model, however we are going to examine all possibilities as there are more factors that need to be considered. The estimation methods that can be applied on panel data are

1. Pooled OLS estimator
2. Fixed effects estimator (within estimator)
3. Between estimator
4. Random effects estimator (GLS)

For the decision about wich one of these methods to use, we run the estimations on our *Basic model*.

The **pooled OLS estimator** does not consider the μ_i's to be fixed parameters and thus $Z_\mu \mu + \nu$ may be simply rewritten as u where $u_{it} \sim IID(0, \sigma_\nu^2)$. In other words, there are no cross-section specific μ_i's that would add up with the "universal" intercept and create cross-section specific intercepts. The pooled OLS estimation results can be found in Table 4.4. $GROWTH$ is significant on 1% significance level and MM_INT turns out to be insignificant even on 10% level. In order to judge the suitability of this estimation method, we need to know the results of a test for fixed effects which is part of Gretl outcome for the fixed effects estimator.

Table 4.4: Pooled OLS Estimator

Pooled OLS, using 1440 observations
Included 40 cross-sectional units
Time-series length = 36
Dependent variable: l_LOANS

	Coefficient	Std. Error	t-ratio	p-value
const	0.561677	0.108134	5.1943	0.0000
GROWTH	0.0671632	0.0195443	3.4365	0.0006
MM_INT	−0.0147783	0.00994534	−1.4860	0.1375

Mean dependent var	0.655001	S.D. dependent var	1.843261
Sum squared resid	4829.708	S.E. of regression	1.833294
R^2	0.012161	Adjusted R^2	0.010786
$F(2, 1437)$	8.844919	P-value(F)	0.000152
Log-likelihood	−2914.574	Akaike criterion	5835.149
Schwarz criterion	5850.966	Hannan–Quinn	5841.053
$\hat{\rho}$	0.049746	Durbin–Watson	1.845816

Source: author's computations.

The **fixed effects (within) estimator** considers the μ_i's to be fixed parameters which implies that the intercept is specific for each section. The model can be rewritten as

$$y_{it} = \alpha + X'_{it}\beta + \sum_{i=1}^{N} \mu_i D_i + \nu_{it} \tag{4.6}$$

where D_i is a dummy variable for the i-th section, $\sum_{i=1}^{N} \mu_i = 0$ and $u_{it} \sim IID(0, \sigma_\nu^2)$. The fixed effects estimation results are presented in Table 4.5. Both $GROWTH$ and MM_INT are significant on 1% significance level.

The **test for fixed effects** has the following null hypothesis

$$H_0 : \mu_1 = \mu_2 = \ldots = \mu_{N-1} = 0.$$

Test statistics is an F-test which is $F_{(N-1),N(T-1)-K}$ distributed. Its result for the *Basic model* can be found in Table 4.5 where it is called "test for differing group intercepts". The p-value = 2.36421e-012 so the null hypothesis can be rejected on 1% significance level and it confirms that the intercept is not the same for each section.

The within estimator builds on the information that is reflected in the time series changes within the subjects/sections - the so-called "within variation". On the other hand, the **between estimator** builds on the information that is reflected in the changes between subjects in a specific time period - the so-called "between variation". The between estimator can be obtained by running OLS on the model in (4.5), premultiplied by P. P is a matrix which averages the observation across time for each section and can be described as $P = Z_\mu(Z'_\mu Z_\mu)^{-1}Z'_\mu$, the projection matrix on Z_μ. The between estimation results are presented in Table 4.6. $GROWTH$ is not significant and MM_INT is significant only on 10% significance level.

Table 4.5: Fixed Effects (Within) Estimator

Fixed-effects, using 1440 observations
Included 40 cross-sectional units
Time-series length = 36
Dependent variable: l_LOANS

	Coefficient	Std. Error	t-ratio	p-value
const	0.649038	0.0573322	11.3207	0.0000
GROWTH	0.0664261	0.0178934	3.7123	0.0002
MM_INT	−0.0396325	0.0115318	−3.4368	0.0006

Mean dependent var	0.655001	S.D. dependent var	1.843261
Sum squared resid	4393.608	S.E. of regression	1.772789
R^2	0.101358	Adjusted R^2	0.075003
$F(41, 1398)$	3.845866	P-value(F)	1.41e–14
Log-likelihood	−2846.437	Akaike criterion	5776.874
Schwarz criterion	5998.315	Hannan–Quinn	5859.537
$\hat{\rho}$	−0.052933	Durbin–Watson	2.029193

Test for differing group intercepts –
Null hypothesis: The groups have a common intercept
Test statistic: $F(39, 1398) = 3.55801$
with p-value = $P(F(39, 1398) > 3.55801) = 2.36421\text{e-}012$

Source: author's computations.

The **random effects estimator** is a matrix-weighted average of the within and between estimators, weighting each estimate by the inverse of its corresponding variance. Compared to that, the pooled OLS estimator gives equal weight to the between and within variations. In the random effects model, the μ_i's are assumed random and thus $\mu_i \sim IID(0, \sigma^2_\mu)$, $\nu_{it} \sim IID(0, \sigma^2_\nu)$ and the

Table 4.6: Between Estimator

Between-groups, using 40 observations
Dependent variable: l_LOANS

	Coefficient	Std. Error	t-ratio	p-value
const	0.723165	0.158469	4.5635	0.0001
GROWTH	−0.130267	0.0973305	−1.3384	0.1889
MM_INT	0.0613601	0.0338831	1.8109	0.0783

Mean dependent var	0.655001	S.D. dependent var	0.536779
Sum squared resid	10.31260	S.E. of regression	0.527938
R^2	0.082276	Adjusted R^2	0.032669
$F(2, 37)$	1.658564	P-value(F)	0.204256
Log-likelihood	−29.64727	Akaike criterion	65.29455
Schwarz criterion	70.36118	Hannan–Quinn	67.12648

Source: author's computations.

μ_i's are independent of the ν_{it}'s. In addition, the X_{it}'s are independent of the μ_i's and ν_{it}'s for all i and t. The random effects estimator is a Generalized Least Squares (GLS) estimator of the regression coefficients and its results can be found in Table 4.7. Gretl uses the Swamy-Arora method to estimate the Ω matrix. $GROWTH$ is significant on 1% significance level and MM_INT is significant on 5% significance level.

The Gretl outcome for the random effects estimators (Table 4.7) includes also two complementary tests - a Breusch-Pagan test and a Hausman test. The **Breusch-Pagan test** basically compares the GLS and pooled OLS estimators with a null hypothesis that the unit-specific error equals to zero

$$H_0 : \sigma_\mu^2 = 0.$$

It is a Lagrange Multiplier test which is distributed as χ_1^2. The p-value = 1.42083e-022 so the null hypothesis is strongly rejected. This result implies that the random effects estimator (GLS) is not better than the pooled OLS one.

The **Hausman test** has a null hypothesis

$$H_0 : E(u_{it}/X_{it}) = 0$$

and the test statistics is distributed as χ_K^2. If the null hypothesis is rejected, the GLS estimator will be biased and inconsistent while the within estimator

stays unbiased and consistent. The test p-value = 0.019800 so the null hypothesis cannot be rejected even on 10% significance level. Therefore the GLS estimator is at least as good as the within estimator.

Table 4.7: Random Effects Estimator

Random-effects (GLS), using 1440 observations
Included 40 cross-sectional units
Time-series length = 36
Dependent variable: l_LOANS

	Coefficient	Std. Error	t-ratio	p-value
const	0.597076	0.0989893	6.0317	0.0000
GROWTH	0.0704776	0.0172045	4.0965	0.0000
MM_INT	−0.0270989	0.0105271	−2.5742	0.0101

Mean dependent var	0.655001	S.D. dependent var	1.843261
Sum squared resid	4836.419	S.E. of regression	1.833929
Log-likelihood	−2915.574	Akaike criterion	5837.148
Schwarz criterion	5852.965	Hannan–Quinn	5843.053

$$\hat{\sigma}_\varepsilon^2 = 3.14278$$
$$\hat{\sigma}_u^2 = 0.278719$$
$$\theta = 0.440342$$

Breusch-Pagan test –
Null hypothesis: Variance of the unit-specific error = 0
Asymptotic test statistic: $\chi^2(1) = 95.5793$
with p-value = 1.42083e-022

Hausman test –
Null hypothesis: GLS estimates are consistent
Asymptotic test statistic: $\chi^2(2) = 7.84408$
with p-value = 0.0198006

Source: author's computations.

In order to decide which estimator is the best one to use, it is necessary to summarize the results of the four possible models and the complementary tests. Both the Chow test and the test for fixed effects suggest that there are different intercepts across sections. Together with the fact that the pooled OLS and the between estimators assign a rather low significance to our explanatory variables, the results so far speak in favour of the within estimator. The Breusch-Pagan test suggests that the random effects estimator is not better than the pooled OLS, however the Hausman test does not reject the consis-

tency and unbiasedness of the GLS estimator. Considering all these results and the fact that not only the statistics, but also pure logic speak in favour of the fixed effects across countries (a small set of examined units), we decided to use the fixed effects (within) estimator.

The fixed effects model assumes homoscedasticity within each section and across sections and Gretl calculates error terms robust to this assumption. The relatively low R^2 is not unusual for larger panel data sets and is also given by the fact that we are trying to explain quarterly data which are extremely volatile and often switch the sign or equal to zero. Neither of the estimation methods lead to normally distributed residuals and therefore this characteristics did not play any role in our estimation method decision. However, it should be taken into account when interpreting the results of the final model because it worsens its reliability. Additional robustness checks can be found in Section 4.5.

4.4.3 Results Interpretation

After choosing the right estimator for our model, this section iterprets the estimation results for the *Basic model* and its three specifications. But before going into more details, there is one general characteristic of the model worth noting - the cross-section specific fixed effects. This information tells us that even if our dataset reacts identically to changes of explanatory variables, each pair of source and host countries is unique in their intercept. In this case, the intercept might be interpreted as the average level of cross-border bank loans from the source to the host country. The CEE is a rather homogenous region but there are for sure differences in the amounts of cross-border loans flowing within each pair of countries, depending on their size, institutional relations, size of banking sectors etc.

1. *Basic model*

   The *Basic model* results are presented in Table 4.5 and both explanatory variables are significant on 1% significance level. The $GROWTH$ coefficient equals to 0.066 which confirms our hypothesis that a higher GDP growth of host country j relative to source country i increases the amount of cross-border loans from banks in country i to all sectors in country j. On the other hand, the MM_INT coefficient has a negative sign (-0.040) which implies that a higher money market interest rate in country j relative to country i reduces the amount of cross-border bank loans between them.

This finding is rather surprising and goes against our original hypothesis. We expected that the banks in source countries would be motivated by higher interest rates in host countries which generally reflect in higher relative yields from the loans provided. But it seems that this motivation has been offset by some other factors. A high interest rate is often characteristic for less mature financial markets and this interpretation might play its role also in the decision of the banks in our source countries. Considering the remaining perception of the CEE countries as a relatively risky region, the higher interest rates might be taken as a sign of certain underdevelopments on their financial markets and discourage the foreign banks from lending to them. Therefore the reverse relationship between the interest rate differential and cross-border loans.

2. *Global model*

Table 4.8: Global Model

	Coefficient	Std. Error	t-ratio	p-value
const	1.95372	0.350788	5.5695	0.0000
GROWTH	0.0561885	0.0176749	3.1790	0.0015
MM_INT	−0.0266712	0.0120764	−2.2085	0.0274
l_VOLATILITY	−1.02908	0.264581	−3.8895	0.0001
KP_INDEX	0.615255	0.251918	2.4423	0.0147

Mean dependent var	0.655001	S.D. dependent var	1.843261
Sum squared resid	4342.279	S.E. of regression	1.763665
R^2	0.111856	Adjusted R^2	0.084500
$F(43, 1396)$	4.088788	P-value(F)	1.10e–16
Log-likelihood	−2837.976	Akaike criterion	5763.952
Schwarz criterion	5995.937	Hannan–Quinn	5850.552
$\hat{\rho}$	−0.061235	Durbin–Watson	2.047046

Test for differing group intercepts –
Null hypothesis: The groups have a common intercept
Test statistic: $F(39, 1396) = 3.47887$
with p-value = $P(F(39, 1396) > 3.47887) = 6.66517\text{e-}012$

Source: author's computations.

The *Global model* is supposed to find out to what extent are cross-border loans influenced by global factors - in our case global risk aversion

(KP_INDEX) and expected volatility ($l\_VOLATILITY$). Its estimation results are presented in Table 4.8. The $l\_VOLATILITY$ coefficient equals to -1.029 and is significant on 1% level. The negative sign confirms our hypothesis that higher expected volatility on the global financial markets signals a higher level of overall risk and reduces the amount of cross-border loans from country i to country j.

The KP_INDEX coefficient equals to 0.615 and is significant on 5% level. Its positive sign confirms our hypothesis that the CEE countries are still considered a relatively risky region and that the global changes in investors' risk appetite influence the amount of bank loans flowing to them from more developed countries. When investors' risk appetite increases ($KP\_INDEX > 0$), they shift their portfolios towards more risky assets, including claims on banking and non-banking sector in the CEE countries. On the contrary, if investors' risk aversion increases ($KP\_INDEX < 0$), they shift their portfolios towards safer assets and reduce their exposure towards the CEE region.

3. *Lender model*

The *Lender model* corresponds to the idea that local factors in source countries have major influence on the loans coming from these countries to the CEE region. Out of many tested macroeconomic fundamentals, characteristics of the banking sector and other factors, two variables showed the most influence - loan loss provisions (LLP_S) and net interest margin (NIM_S). The estimation results are presented in Table 4.9.

The LLP_S coefficient equals to -0.028 and is significant on 5% level. Its negative sign confirms our hypothesis that the average ratio of loan loss provisions to net interest revenue of banks in source countries has a negative influence on loans to host countries. If the banks are in bad shape and coping with liquidity troubles, they do not have enough means to lend money to other foreign banks. And during the 2007-09 crisis, the banks in Western Europe were hit by the credit crunch and increasing amount of defaulting loans which reduced the cross-border loans to CEE countries.

The NIM_S coefficient equals to 0.728 and is significant on 1% level which gives it a higher importance than to the loan loss provisions ratio. Its sign corresponds to our hypothesis that higher profitability of banks

in source countries leads to higher loans to host countries. The relationship, however, also works vice-versa so when the profitability of most banks during the 2007-09 crisis decreased, they had to cut their lending including the loans to CEE countries.

Table 4.9: Lender Model

	Coefficient	Std. Error	t-ratio	p-value
const	−0.522259	0.504705	−1.0348	0.3010
GROWTH	0.0478612	0.0175147	2.7326	0.0064
MM_INT	−0.0302982	0.0111940	−2.7067	0.0069
LLP_S	−0.0278516	0.0126533	−2.2011	0.0279
NIM_S	0.728035	0.204487	3.5603	0.0004

Mean dependent var	0.655001	S.D. dependent var	1.843261
Sum squared resid	4295.275	S.E. of regression	1.754094
R^2	0.121470	Adjusted R^2	0.094410
$F(43, 1396)$	4.488806	P-value(F)	2.92e–19
Log-likelihood	−2830.140	Akaike criterion	5748.279
Schwarz criterion	5980.265	Hannan–Quinn	5834.879
$\hat{\rho}$	−0.073123	Durbin–Watson	2.072346

Test for differing group intercepts –
Null hypothesis: The groups have a common intercept
Test statistic: $F(39, 1396) = 4.20155$
with p-value = $P(F(39, 1396) > 4.20155) = 4.37069\text{e-}016$

Source: author's computations.

4. *Borrower model*

The *Borrower model* examines to what extent the local factors in host countries influence cross-border loans they receive from source countries. The factors that in the end turned out significant are incoming foreign direct investment (FDI_H), loan loss provisions of the banking sector (LLP_H), and government balance ($GBAL\_H$). The estimation results are presented in Table 4.10.

The FDI_H coefficient equals to 0.017 and is significant on 5% level. It confirms our hypothesis that a greater openness of the host economy increases the amount of cross-border loans flowing to the country. On the other hand, it is quite a common effect in periods of crisis that countries

tend to close up and cut the linkages to other economies. In that case the relationship works at a disadvantage for the host countries and as the amount of their FDI decreases, the cross-border loans from source countries are cut correspondingly.

Table 4.10: Borrower Model

	Coefficient	Std. Error	t-ratio	p-value
const	1.23062	0.138669	8.8746	0.0000
GROWTH	0.0372643	0.0177287	2.1019	0.0357
MM_INT	−0.0354144	0.0124086	−2.8540	0.0044
FDI_H	0.0172770	0.00703901	2.4545	0.0142
LLP_H	−0.0163966	0.00574287	−2.8551	0.0044
GBAL_H	0.131258	0.0310373	4.2290	0.0000

Mean dependent var	0.655001	S.D. dependent var	1.843261
Sum squared resid	4238.313	S.E. of regression	1.743048
R^2	0.133121	Adjusted R^2	0.105779
$F(44, 1395)$	4.868664	P-value(F)	3.78e–22
Log-likelihood	−2820.527	Akaike criterion	5731.055
Schwarz criterion	5968.313	Hannan–Quinn	5819.623
$\hat{\rho}$	−0.087799	Durbin–Watson	2.102410

Test for differing group intercepts –
Null hypothesis: The groups have a common intercept
Test statistic: $F(39, 1395) = 4.49401$
with p-value = $P(F(39, 1395) > 4.49401) = 8.07653\text{e-}018$

Source: author's computations.

The LLP_H coefficient equals to -0.016 and is significant on 1% level. Similarly to the *Lender model*, a deteriorating banking health in a source country reduces the amount of cross-border loans it receives. It increases the country's risk profile and the international investors rather invest in other countries with a lower default probability.

The $GBAL\_H$ coefficient equals to 0.131 and according to its p-value, it turns out to be the most significant coefficient in the *Borrower model*. Its sign confirms that a larger fiscal deficit of a host country reduces the amount of received cross-border loans. This is due to a deteriorated risk profile of the country arising from a larger probability of future default on public debt. During the 2007-09 crisis, most European governments had to boost their econ-

omies or bail out some troubled enterprises that were too big to fail. These actions of course costed a lot of money and significantly increased public debt which negatively influenced the willingness of foreign banks to lend money to these countries. In general, countries with the largest fiscal deficits were the most hit by cuts in cross-border loans.

4.5 Robustness Checks

In order to analyze the data set in more detail, several robustness checks have been carried out. The estimation results are examined under changing characteristics of the model. To be more specific, two main areas are being paid attention to - (1) the geographical location of the host countries and from that arising regional characteristics and (2) the specifics of cross-border lending during the 2007-09 crisis. The estimation results are presented in Sections 4.5.1 and 4.5.2. However, it has to be taken into account that the data sample is not very extensive in its original form and when divided in smaller groups for the robustness checks, the smaller size can have negative influence on the characteristics of the model and information capability of the estimation results. Therefore main focus should be placed on the overall test results and this section should be taken only as additional information. We use the same fixed effects model with error terms robust to homoscedasticity as for the original model.

Besides the regional and time robustness checks, we have also tried the dependence on lagged variables. Dependent and explanatory variables up until three periods backwards were involved in the model with all its specifications. However, the lagged variables did not show any significance compared to the current ones which speaks in favour of the original model.

4.5.1 Regional Characteristics

The idea behind this robustness check is the diversity of the CEE region. It reaches from the Central European countries which are very close to their Western European neighbours to the Balkan countries further in the East. Each of these countries certainly has its special characteristics (which has been also confirmed by the main estimation results), however we think that the CEE region can be divided in two main sub-regions of countries with very similar local particularities. It is (1) the Viszegrad countries, namely the Czech

Republic, Slovakia, Poland and Hungary, and (2) the Balkan states, namely Slovenia, Croatia, Bulgaria and Romania. The countries in one sub-region share similar history, cultural background and other characteristics which all form investors' opinion about it and which may lead to similar investment decisions regarding all the members.

1. *Viszegrad countries*

   The Viszegrad countries all lie in the heart of Europe and as such have been probably more influenced by the Western Europe throughout the history than the Balkan countries. They all joined the EU in 2004 and Slovakia adopted euro on 1 January 2009. When considering some basic macroeconomic fundamentals and institutional characteristics (more details on that can be found in Chapter 3), they are perceived as more developed compared to the other sub-region. The results of the estimation of all the four models for the Viszegrad countries are presented in Table 4.11.

   Signs of all estimation coefficients remain the same as in the main model so the economic logic holds. However, the significance of some variables has changed and some of them are not significant even on 10% level. The most significant in all model specifications is the interest rate differential (MM_INT), always on 1% significance level. On the contrary, $GROWTH$ loses its significance and in the *Lender model* it is not significant at all. The reason behind these changes might be the relatively fast development of the Viszegrad countries during the 1990s so that their economic and social level is now not so far from the source countries. Therefore the lending countries probably do not pay so much attention to the GDP growth differential as a sign of development when deciding whether to invest in them or not.

   Also the significance of the global factors decreased substantially and they would both be significant only on 15% level. The explanation might be that when the source and host countries are so close as the Viszegrad and the surrounding countries, the source countries pay much less attention to the global factors. They have very good local knowledge of the host countries and thus their investment decisions cannot be so easily influenced by the volatility on global financial markets or change in their risk aversion.

In the *Lender model*, LLP_S has the same significance as in the main model (5%) but NIM_S does not turn out significant. This suggests that cross-border loans to Viszegrad countries are sensitive to changes in bank health in the source countries but changes in the the banks' profitability are balanced through some other channels. In the *Borrower model*, the only significant additional factor is FDI_H which suggests that the source banks probably do not pay that much attention to the risk factors of the host countries.

2. *Balkan countries*

The Balkan countries are not such a homogenous region as the Viszegrad countries. Slovenia, the most developed country of the region, has been a member of the EU since 2004 and adopted euro in 2007. Romania and Bulgaria joined the EU in 2007 during the last enlargement and Croatia has been negotiating its acceptance since 2003. However, Croatia's GDP per capita is approx. double the GDP per capita of Bulgaria or Romania which are the poorest countries of the EU. The results of the estimation of all the four models for the Balkan states are presented in Table 4.12.

The significance of the estimation coefficients has, similarly to the other region specification, changed. In terms of the *Basic model*, $GROWTH$ turns out to be more significant than MM_INT which is in contrast to the Viszegrad countries. The overall economic growth of the Balkan countries, less developed than the Viszegrad region, seems to be more important for cross-border loans than the maturity of their financial sector.

$l\_VOLATILITY$ is highly significant which suggests that the flow of cross-border loans to the Balkan countries is more influenced by the global factors, probably due to their larger distance from the source countries. The distance might have influenced also the significance of factors connected to the potential riskiness of the host countries - LLP_H and $GBAL\_H$ in the *Borrower model*. They take over all the significance of FDI_H which is exactly the opposite situation then by the Viszegrad countries. The estimation results are converse also in the *Lender model* with NIM_S highly significant and LLP_S not significant at all. The logic behind this might be that the higher distance and potential riskiness of the Balkan countries make them candidates for cross-border loans only if the banks' profitability rises substantially and if the source banks' profitability decreases, their loans are the first to be cut.

Table 4.11: Viszegrad Countries

Fixed-effects, using 720 observations
Included 20 cross-sectional units
Time-series length = 36
Dependent variable: l_LOANS

Basic model

	Coefficient	Std. Error	t-ratio	p-value
const	0.869249	0.102108	8.5131	0.0000
GROWTH	0.0569726	0.0329119	1.7311	0.0839
MM_INT	−0.121982	0.0311119	−3.9208	0.0001

Global model

	Coefficient	Std. Error	t-ratio	p-value
const	1.29063	0.311221	4.1470	0.0000
GROWTH	0.0592943	0.0284840	2.0817	0.0377
MM_INT	−0.0966560	0.0321123	−3.0099	0.0027
l_VOLATILITY	−0.388945	0.265743	−1.4636	0.1438
KP_INDEX	0.616802	0.419665	1.4697	0.1421

Lender model

	Coefficient	Std. Error	t-ratio	p-value
const	0.937324	0.599354	1.5639	0.1183
GROWTH	0.0354943	0.0313859	1.1309	0.2585
MM_INT	−0.102459	0.0279301	−3.6684	0.0003
LLP_S	−0.0446999	0.0192252	−2.3251	0.0204
NIM_S	0.234674	0.243544	0.9636	0.3356

Borrower model

	Coefficient	Std. Error	t-ratio	p-value
const	0.605278	0.213832	2.8306	0.0048
GROWTH	0.0549451	0.0316600	1.7355	0.0831
MM_INT	−0.101380	0.0286806	−3.5348	0.0004
FDI_H	0.0159155	0.00742586	2.1433	0.0324
BP_H	−0.0377994	0.0364931	−1.0358	0.3007
LLP_H	−0.00615233	0.00720562	−0.8538	0.3935

Source: author's computations.

Table 4.12: Balkan Countries

Fixed-effects, using 720 observations
Included 20 cross-sectional units
Time-series length = 36
Dependent variable: l_LOANS

Basic model

	Coefficient	Std. Error	t-ratio	p-value
const	0.599831	0.0803591	7.4644	0.0000
GROWTH	0.0727637	0.0214630	3.3902	0.0007
MM_INT	−0.0259384	0.0116883	−2.2192	0.0268

Global model

	Coefficient	Std. Error	t-ratio	p-value
const	2.64745	0.580114	4.5637	0.0000
GROWTH	0.0560231	0.0231363	2.4214	0.0157
MM_INT	−0.0155876	0.0124474	−1.2523	0.2109
l_VOLATILITY	−1.57936	0.422052	−3.7421	0.0002
KP_INDEX	0.348800	0.294686	1.1836	0.2370

Lender model

	Coefficient	Std. Error	t-ratio	p-value
const	−1.73573	0.641194	−2.7070	0.0070
GROWTH	0.0551158	0.0216975	2.5402	0.0113
MM_INT	−0.0178994	0.0109260	−1.6382	0.1018
LLP_S	−0.00949461	0.0145881	−0.6508	0.5154
NIM_S	1.16691	0.268920	4.3392	0.0000

Borrower model

	Coefficient	Std. Error	t-ratio	p-value
const	1.12555	0.231308	4.8660	0.0000
GROWTH	0.0407130	0.0234806	1.7339	0.0834
MM_INT	−0.0323292	0.0149091	−2.1684	0.0305
FDI_H	0.0165205	0.0183219	0.9017	0.3675
LLP_H	−0.0127602	0.00659570	−1.9346	0.0534
GBAL_H	0.169437	0.0598030	2.8333	0.0047

Source: author's computations.

4.5.2 Crisis Period

The crisis period robustness check tests the original model with all its specifications only for the years 2007, 2008 and 2009 ($t = 25, \ldots, 36$) and it tries to find out whether the relationships between the dependent and explanatory variables hold. The estimation results are preseted in Table 4.13, however they should be interpreted with caution as the crisis period is rather short and all variables are more volatile than in normal times.

Starting with the *Basic model*, MM_INT is much more significant in all model specifications than $GROWTH$. This might be due to the fact that during a financial crisis, financial market characteristics of host countries are more important for the lending banks than the overall situation of the borrowing economies. The interest rate also gives more specific information which is easily accessible and changes more frequently according to the current situation on the financial markets.

The *Global* and *Lender model* specification coefficients do not show much signs of significance but the results get better with the *Borrower model*. This suggests that during the crisis period, the host country local factors are the most important factors which influence the amount of cross-border bank loans. To be more specific, it is the openness of the host economy (FDI_H signifcant on 5% level) and the potential riskiness arising from the size of public debt ($GBAL\_H$ significant on 1% level).

Table 4.13: Crisis Period

Fixed-effects, using 480 observations
Included 40 cross-sectional units
Time-series length = 12
Dependent variable: l_LOANS

Basic model

	Coefficient	Std. Error	t-ratio	p-value
const	0.720620	0.133634	5.3925	0.0000
GROWTH	0.0928430	0.0392414	2.3659	0.0184
MM_INT	−0.111639	0.0378899	−2.9464	0.0034

Global model

	Coefficient	Std. Error	t-ratio	p-value
const	2.13798	0.874514	2.4448	0.0149
GROWTH	0.0770442	0.0408010	1.8883	0.0597
MM_INT	−0.104101	0.0376292	−2.7665	0.0059
l_VOLATILITY	−0.993268	0.616777	−1.6104	0.1080
KP_INDEX	−0.165517	1.07495	−0.1540	0.8777

Lender model

	Coefficient	Std. Error	t-ratio	p-value
const	−1.91404	2.05996	−0.9292	0.3533
GROWTH	0.0493652	0.0396325	1.2456	0.2136
MM_INT	−0.0226538	0.0372380	−0.6084	0.5433
LLP_S	−0.0380271	0.0359761	−1.0570	0.2911
NIM_S	1.51627	0.818236	1.8531	0.0645

Borrower model

	Coefficient	Std. Error	t-ratio	p-value
const	1.64752	0.350447	4.7012	0.0000
GROWTH	0.0158182	0.0381381	0.4148	0.6785
MM_INT	0.105585	0.0407172	2.5931	0.0098
FDI_H	0.0412966	0.0199792	2.0670	0.0393
LLP_H	−0.0163208	0.0153558	−1.0628	0.2884
GBAL_H	0.405880	0.0940006	4.3178	0.0000

Source: author's computations.

Chapter 5

Conclusion

This thesis deals with the topic of cross-border contagion in times of financial crises. The globalization of financial markets across the world which has happend during the past few decades has made it much easier for a financial crisis to spread from one country to another. In order to control or at least be able to predict the contagion effects, it is important to examine the times of financial turmoil and focus on the propagation mechanisms and factors which make a crisis expand across borders.

The main focus of this thesis was cross-border bank loans to CEE countries - one of the contagion channels through which the 2007-09 crisis had affected the region. We tried to discover which global and local factors had significant influence on the changes in bank loans from banks in source countries to banks, as well as households, corporations and government in host countries. The data were analyzed as panel data that pool together time series of cross-sections, each section representing one pair of host and source countries. The examined time period was from 2001 to 2009 with quarterly frequency.

Out of all considered estimators, we have chosen the fixed effects (within) estimator which considers the intercept to be specific for each section, i.e. for each pair of source and host countries. This information tells us that even if our dataset reacts identically to changes of explanatory variables, the average amount of funds flowing between each source and host country differs. It is consistent with a commmon sense assumption that the level of changes in cross-border loans should differ for instance in Poland and Croatia, even if the changes depend on the same factors.

In order to capture all different kinds of effects that might have influenced the cross-border bank flows in CEE during the 2007-09 crisis, we have created

a basic model and three other extension models. Each of them tries to explain different aspects of cross-border bank lending, looking at it from a different point of view. The outcomes of the sub-models are summarized in the following four paragraphs.

The *Basic model* revealed that a higher GDP growth of a host country relative to a source country increases the amount of cross-border loans. On the other hand, a higher money market interest rate in a host country relative to a source country reduces the amount of cross-border loans. This finding was rather surprising and contradicted our original hypothesis. However, if we consider the remaining perception of the CEE countries as a relatively risky region, the higher interest rates might be taken as a sign of certain underdevelopments in their financial markets and discourage the foreign banks from lending to them. An important finding based on the omitted variables was that the distance between a source and a host country has no influence on the changes of loans between them and thus an application of a gravity model would not make any sense in this case.

The *Global model* showed evidence of global factors' influence on international bank lending to CEE countries. More concretely, higher expected short-term volatility in the global financial markets which signals a higher level of overall risk reduces the amount of cross-border loans to CEE. The same but less significant effect is caused by increased investors' risk aversion. This variable controls for the pure contagion phenomenon and thus confirms that CEE is still considered a relatively risky region from which funds should be withdrawn in times of crises.

The *Lender model* examined effects of various source country specific factors and found two of them significant. The average ratio of loan loss provisions to net interest revenue of banks in source countries which is an estimator for banks' health (the higher, the less healthy) reduces loans to host countries. On the other hand, source country's banks' profitability (the net interest margin) raises the amount of cross-border loans. This relationship, however, also works vice-versa so when the profitability of most banks during the 2007-09 crisis decreased, they cut their lending including the loans to CEE.

Similarly to the *Lender model*, health of the banking sector was proven to reduce cross-border loans also in the *Borrower model* - just regarding the host country's banks. Another host country specific factor that appeared significant was the incoming FDI which was an estimate for the openness of the host country's economy and had a positive effect on cross-border loans. The most

significant variable in this model specification was government balance which proved that a large fiscal deficit of a host country reduces the amount of received cross-border loans due to a deteriorated country's risk profile.

A couple of robustness checks were conducted in order to see the model's behaviour in different time periods and for different regions within our data sample. An interesting finding was that the GDP growth differential appeared much less significant than the interest rate differential for the Viszegrad countries. The reason behind it might be the relatively fast development of the Viszegrad countries during the 1990s so that their economic and social level is now not so far from the source countries. Therefore the lending countries probably do not pay so much attention to the GDP growth differential as a sign of development when deciding whether to invest in them or not. The situation was exactly the opposite for the less developed Balkan countries (GDP growth differential was more significant) which supports our explanation.

Another interesting finding was that the global factors were much less significant for the Viszegrad countries than for the Balkan countries. This suggests that the closer the host countries are to the source countries, the better knowledge there is about the borrower and the less attention the lending banks pay to the global factors. The crisis period robustness check assigned most significance to the realtive interest rate differential and the host county specific factors. This suggests that in times of crises, investors assign the most importance to the soundness of the financial market characteristics and risk profile indicators of host countries.

This thesis proved that cross-border bank loans to CEE countries were influenced by both global and local factors and out of the local factors by both source and host country specific ones. The confirmation of pure contagion effect implies that even if the policy makers take measures against spillovers via local factors, they can never control the whole contagion process. The policy measures which could possibly influence cross-border spillovers of a financial crisis via country specific factors might be the subject of some further research.

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