Charles University in Prague

Faculty of Social Sciences
Institute of Economic Studies

MASTER THESIS

Foreign and Domestic Currency Loans in Central Europe: An Empirical Analysis

Author: **Bc. Nikola Burešová**

Supervisor: **Doc. Roman Horváth Ph.D.**

Academic Year: **2012/2013**

Declaration of Authorship

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

The author hereby declares that this thesis has not been used to obtain another university degree.

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Prague, July 25, 2013

Nikola Burešová

Acknowledgments

I am obliged to the supervisor of my thesis, Roman Horváth, for his guidance and helpful advices.

I thank to my family and friends, especially thank to Stepan and Theresa, for positive expectations and support.

Abstract

This thesis describes the history and present situation of dollarization process and analyzes the situation in three new EU member states. It describes the development of the official and unofficial dollarization of credits and deposits, and concludes the results of previous studies. Furthermore, it provides a detailed analysis of situation concerning borrowing denominated in foreign currencies in the Czech, Hungarian and Polish household sector, for the period of last eleven years.

The empirical analysis investigates the determinants of foreign currency loans in a household sector. Using three different panel data regressions, we found that share of foreign currency denominated loans in examined countries are positively influenced by dollarization of deposits, banks' net foreign assets and loan to deposit ratio. Other tested variables, such as EU membership, interest rate differential or exchange rate volatility, changes their significance and impact according to the model or the method used. Their impact on a dependent variable is insignificant and not stable.

Abstrakt

Práce popisuje historický a současný pohled na proces dolarizace a zkoumá situaci ve třech nových členských zemích Evropské Unie. Dále zkoumá vývoj oficiální a neoficiální dolarizace úvěrů a vkladů a shrnuje výsledky předchozích studií. Teze detailně analyzuje situaci půjček domácností denominovaných v zahraničních měnách během posledních jedenácti let v České republice, Maďarsku a Polsku.

Empirická analýza zkoumá determinanty zahraničních půjček domácností. S použitím tří různých regresí panelových dat jsme dospěli k závěru, že podíl zahraničních půjček domácností ve zkoumaných zemích je pozitivně ovlivněn vklady v zahraničních měnách, čistými zahraničními aktivy bank a podílem půjček a vkladů. Ostatní zkoumané proměnné, vstup do Evropské Unie, diferenciál úrokových měr nebo volatilita směnného kurzu se mění podle použití modelu a metod. Jejich vliv na závislou proměnnou je nevýznamný a nestabilní.

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Acronyms

BIS	Bank for International Settlements
B-P/LM	Breusch-Pagan/Lagrange Multiplier
BUBOR	Budapest Interbank Offered Rate
CESEE	Central, Eastern and Southern European Economies
CZK	Czech Crown
ČNB	Česká Národní Banka (Czech National Bank)
EBRD	European Bank for Reconstruction and Development
ECB	European Central Bank
ETF	Exchange Trade Funds
ETN	Exchange Trade Notes
EU	European Union
EUR	Euro
EURIBOR	Euro Interbank Offered Rate
FE	Fixed Effect
FX	Foreign Currency
GDP	Gross Domestic Product
HUF	Hungarian Forint
IFS	International Financial Statistics
IMF	International Monetary Fund
LM	Lagrange Multiplier
MNB	Magyar Nemzeti Bank (National Bank of Hungary)
NBP	Narodowy Bank Polski (National Bank of Poland)
OECD	Organisation for Economic Co-ordination and Development
OLS	Ordinary Least Squares
PLN	Polish Zloty

PRIBOR   Prague Interbank Offered Rate

RE   Random Effect

SE   Standard Error

UIP   Uncovered Interest Parity

WIBOR   Warsaw Interbank Offered Rate

Master Thesis Proposal

Institute of Economic Studies
Faculty of Social Sciences
Charles University in Prague

Author:	**Bc. Nikola Burešová**	Supervisor:	Doc. Roman Horváth PhD.
E-mail:	Nikola.buresova@seznam.cz	E-mail:	Roman.Horvath@gmail.com
Phone:	723075470	Phone:	222112317
Specialization:	*Finance, financial markets and banking*	Defense Planned:	June 2013

Proposed Topic:

Foreign and Domestic Currency Loans in Central Europe: An Empirical Analysis

Topic Characteristics:

My thesis will focus on the empirical estimation of the main determinants of foreign currency borrowing in the countries of Central Europe. I will look at the so called "dollarization" process as a familiar feature of catching- up process in the New Member States. I will also describe the historical development of private borrowing in each country and summarize the benefits and costs of foreign currency borrowing.

The baseline idea of my thesis will be build on the Rosenberg's and Tirpák's paper *Determinants of Foreign Currency Borrowing in the New Member States of the EU*. I will update the study and use the broader dataset including pre-crisis, crisis and after-crisis data. According to the found literature sources I will try to summarize possible motivations and benefits of foreign currency borrowing.

Base on the panel data regression model I will try to estimate the most relevant indicators of foreign loans and compare the results for individual countries. According to the results and literature studying this topic I will try to answer questions such as: Do regulatory measures, EU membership or trade openness matter in the foreign borrowings?

Hypotheses:

1) The low interest rate in relative terms influences the borrowing in home currency.

2) The exchange rate volatility in individual country influences the willingness to take foreign loans.

3) The joining EU increases the availability of foreign borrowing, which influences the change in composition of private credit.

Methodology:

Firstly I will analyze the present situation in the Central European countries. I will try to find out the most relevant historical moments which can influence the foreign currency borrowings.

Secondly I will do the empirical estimation of variables influencing foreign currency loans on the panel of private sector in the most important Central European countries. I will use the panel data regression model with independent variables such as FX deposits, bank's foreign assets, exchange rate volatility or interest rate differential. I will add different variables to the initial model and test their significance. As additional variables I assume to take regulatory policies, trade openness or EU membership.

I will use data from the Eurostat, IMF, BIS, EBRD and national statistical databases. I assume different results for each country according to the historical development and other specific relevant factors. The results can be biased with respect to the recent financial crisis.

Outline:

1. Historical background
   a. The catching-up process – so called "dollarization"
   b. Development of FX loans
   c. Present situation in the countries of Central Europe
2. Financial dollarization
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   b. Pros and cons of dollarization
   c. Literature review
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Core Bibliography:

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Author   Supervisor

1. Introduction

The rapid credit growth and the change in currency composition of private loans have been a hallmark of the convergence process in the European Union. Although the phenomenon of foreign currency borrowing started on the corporate level, it was quickly spread to the household level.[1] The credit growth has been often seen as a sign of a healthy and well functioning banking and financial sector. However, we have to keep in mind that the credit growth is not always beneficial for the economy. In this paper, we look at the historical development of the credit growth and changes in the currency denomination of private loans over time in three Central European countries.

The hardest hit of the recent financial crisis was mostly seen in the emerging economies in Central and Eastern Europe.[2] Generally, we believe that the main reasons for the financial troubles were consumption and lending boom, especially triggered by foreign currency denomination. In this paper, we focus only on the situation in the countries of Central Europe, and we study the recent historical development of the credit growth in the individual regions for getting a better overview for an empirical analysis.

From the historical point of view, the rapid credit growth was in all examined countries during the pre-crisis period. The problem was that in most of the countries the internal currency sources were insufficient to cover financing linked to the rapid credit growth; thus, the banks had to look for other sources of funding. That implicated the increasing importance of the external funding sources in the early 2000s. During the period from 2003 to 2007 the increasing trend in private sector borrowing was significantly higher than in other Western European countries,[3] but the absolute value stayed at the lower rate than in the rest of the Europe. According to the Barrel, David, Fic and Orazgani (2009), the expansion of the private sector debt was affected by two

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[1] Fidrmuc, Hake and Stix (2011).
[2] Beckmann, Fidrmuc and Stix (2012).
[3] Geršl and Jašová (2012).

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driving factors, the convergence process of individual countries and the short term borrowing.[4]

The significant changes in the ratios were observed. The debt to income ratio increased relatively moderately during the catching up period in the Czech Republic, Hungary and Poland. In comparison, the growth was unsustainable in other countries, such as the Baltic States (for example Estonia or Latvia). The development of the debt to income ratio and credit growth are closely linked to the changes of determinants, such as GDP per capita, interest rate and house prices.[5] However, the favourable development of those determinants does not necessarily guarantee the smooth credit growth. The biggest threat determining the changes are the economic cycles (the excessive borrowing during boom can increase the insolvency risk during the recession) and bubbles in house prices (bubbles shift the price equilibrium in the real estate market and immediate changes in the balance sheet of householders are not possible).

The development of the private credits was affected in all countries during the recent financial crisis. In the last quarter of 2008 the credit growth changed into the credit crunch. In the most of the Central European countries, the decline of foreign borrowing in the household sector was highly significant. However, the foreign borrowing was not cancelled out totally. The share of foreign currency loans still stays at a high level in some countries, and thus the financial sector can be prone to changes leading to problems in economy.

The environment of rapid credit growth has demanded for the proper risk management and assessment of credits in banks. Some countries used various regulatory, supervisory and administrative measures to manage rapid growth of private sector borrowings denominated in foreign currencies. Important measures used in selected countries are described later in the Section 4.

The policies and measures promoting the local currency loans or limiting the foreign currency borrowing of unhedged borrowers shall improve the financial

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[4] The convergence process leads to the macroeconomic long term equilibrium, which will be reached by increase in indebtedness. Such trend can be driven by the economic business cycles or by autonomous factors, such as foreign ownership of banks or financial liberalization.
[5] Barrel, Davis, Fic and Orazgani (2009).

situation. Every innovation in the banking system can enhance the quality and increases the quantity of loans. Proper measures or monetary policies decrease the vulnerability of the financial system, and thus prevent economy from another deep financial crisis.

The credit growth analyses were popular topic before the crisis and many authors have tried to specify or determine the rapid increase in private borrowings and the possible negative or damaging impacts on the financial market. Most of them agreed on the fact that the excessive credit growth creates economic and financial imbalances and makes the banking and financial system vulnerable. Especially, the foreign currency indebtedness of householders increases a susceptibility of the country to financial crisis.

The financial crisis changed the behaviour of many borrowers and also the view of authors studying this topic. The excessive credit growth was studied in different countries by a wide range of authors. Also the currency composition and source of funding of private loans and deposits have been very common topics in recent years. Before the onset of the crisis, the researches tried to find and define a term excessive credit growth and its possible threats.

Nowadays, the orientation of foreign currency loans and deposits changed. Authors try to look for determinants triggering the financial problems in the economy. Researchers studying financial dollarization concluded that financial dollarization coexisting in the presence of large exchange rate fluctuations can cause financial instability and can be a potential source of balance sheet problems.

It is a high incentive to study deeper the problems and determinants of financial dollarization and possible consequences or solutions for varying environments in different countries. Moreover, the regulatory and supervisory measures should be based on a good understanding of the driving forces of foreign currency borrowing and lending. Every measure should work on the specific analysis for a unique environment of every country.

In this paper, we study not only before crisis development, but also the post-crisis situation. We look for possible problematic elements that can trigger the credit

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crunch and lead to a change in the currency preferences of borrowers or depositors. The main contribution of this paper is an empirical analysis investigates different determinants of foreign currency loans in the sample of three Central European countries during the last eleven years. We built on the paper written by Rosenberg and Tirpák (2009) that we update and widen. The baseline of this paper is described in detail in Section 3.

The objective of this thesis is to test following three hypotheses using various panel data regression methods. First, we assume that low interest rate in relative terms influences the borrowing in home currency. Second, we expect that the exchange rate volatility influences the willingness to take foreign currency loans. Third, we think that joining the EU increases the availability of foreign borrowing.

The remainder of the thesis is organized as follows. Section 2 describes in detail the process of financial dollarization. The following Section 3 summarizes the most important literature sources used in this paper. We compare various opinions about the determinants of foreign currency loans from different points of view. The development of loan dollarization from the pre-crisis to the post-crisis period in the individual countries is listed in Section 4. In Section 5, we firstly explain the main variables that we assume to be important determinants influencing the denomination of loans in the household sector. Then we come up with three main hypotheses that we want to test, using various modifications of three panel data regressions. We compare our results with findings of Rosenberg and Tirpák (2009). Lastly, we summarize the regression results and describe their meanings. Last part of this thesis, Section 6, concludes all findings and results.

2. Dollarization

In the recent years, the term dollarization has been commonly used as a familiar feature of the catching up process, and it has often been linked to the recent financial crisis. However, the dollarization process is not new. After the international financial crisis in several emerging countries in the late 1990s the dollarization was commonly announced as a policy tool to eliminate the exchange rate fluctuations.

The financial dollarization defined by Basso, Calvo-Gonzalez and Jurgilas (2007, p.7) is *"the holding by residents of a share of their asset and/or liabilities denominated in foreign currency."* In fact, we should talk about the euroization or swissfrancization process because the borrowing and lending in Central European countries have been denominated mostly in the euro or Swiss franc and not in the dollar.

The authors Eichengreen and Hausmann (1999) defined the term "Original sin" meaning that the least developed countries have no ability to use domestic currency for borrowing abroad or for long term loans. The countries are limited by currency composition of their portfolios. In the case they want to choose one of the stated possibilities, they have to take loans in foreign currency.

In this chapter, we look at the dollarization process throughout the history and also during the recent years. We search for the motivation of the foreign currency composition of the portfolios. Then we conclude the advantages and disadvantages of such strategies and describe the carry-trade model that can be seen as an economic base of the behaviour of borrowers.

2.1 Historical Development of Dollarization

The loans and deposits denominated in foreign currency were known already during the colonization before 1800. The colonized countries were accepting foreign currency of anchor countries to stabilize their monetary and economic systems. The end of the colonization era concluded the historically first foreign currency adoption.

The next milestone of foreign borrowing was triggered by the financial globalization in the 1990s. The intensity of the financial crisis gave new impulse to the discussions about the exchange rate regimes. As a result the model widely used in emerging economies, soft peg exchange rate regimes[6] and open capital account, became unsuitable.[7] There are two solutions: either the hard currency pegs that can be transformed into the dollarization process[8] or the flexible exchange rate regimes.

In the 20th century, the dollarization was common in many emerging countries in Asia, Latin America and few countries in Europe, for example in the Nordic countries and Italy. The foreign debt and debt to income ratio increased significantly in the new EU member states during the period from 1995 to 2007. We can use cases in Estonia, Latvia and Hungary as examples of excessive increase in the ratio of foreign currency denominated loans to the total loans. The case of the last named country is described in detail in the Section 4.

The dollarization has been existing in two forms, as an official process of taking the foreign currency instead of the local currency (for example the entrance into the EU with adopting the euro currency); or in the unofficial form, where the domestic currency is still valuable, and only some parts of the population opt to use a foreign currency. Thus, in the second case, two currencies are used in one country. In this paper, we analyze only the countries with unofficial dollarization but in this part we look throughout the history and analyze also the official cases.

According to the authors Winkler, Mazzaferro, Nerlich and Thimann (2004), the official dollarization can be found in three cases throughout history:

1. Sustained cases

   According to the United Nations published list, we can identify more than 50 cases of sustained dollarization in official form. These countries had several characteristics: a small population (less than 1 million), politically dependent status (more than half of listed countries), and an adoption of foreign currency (mostly currency of the geographically neighbouring country). Thus, the

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[6] Soft pegs implicitly guarantee the stability of exchange rate.
[7] Winkler, Mazzaferro, Nerlich and Thimann (2004).
[8] According to Bordo, Meissner and Stuckler (2009), free floating exchange rate demotivates from taking foreign currency loans, and currency mismatches can be eliminated by monetary union.

dollarization had regional dimension. These countries gained monetary and economic stability following convergence with the anchor country.

2. Abandoned cases

Throughout history, the abandoning of the dollarization was rare. For example, civil war broke out in Liberia and political turmoil led to the end of dollarization period ranging over hundred years. The change in political status was a more common reason of the abandoning foreign currency. If the colony gained the status of the independent country, it often abandoned the exchange rate regime with regionally proximate country and introduced its own currency.

3. Recent cases

The countries that have recently adopted foreign currency are much larger than those named in sustained cases. The key currencies used in those transactions were mostly euro and US dollar. The biggest incentive for dollarization is achieving monetary and economic stability. As an example, we can state Kosovo, Ecuador or Montenegro.

We should take a lesson from history. The dollarization significantly changed the balance sheets of banks, altered the exchange rate depreciations, and led to considerable financial problems. To analyze the financial dollarization process, we firstly describe the sources of motivation of borrowers and countries for foreign currency funding. Secondly, we look at cost and benefit analysis of official dollarization and also critically analyze the unofficial dollarization. Each problem is described separately in the following sections.

2.2 Motivation for Foreign Currency Borrowing

The catching up process is linked to the so called dollarization effect in the countries of Central Europe. As was defined above, dollarization is the holding of assets or liabilities denominated in a foreign currency. In European countries the loans and deposits are usually denominated in euro or Swiss franc. According to this fact, we should talk about the euroization or swissfrancization process.

We can look at the dollarization process from two different perspectives. From the stability point of view, dollarization can be seen as a tool for reaching the monetary and financial stability via the elimination of credit problems. From the integration point of view, dollarization is closely linked to the financial and economic situation in the individual country, and it also depends on the stage of integration of the issuing country.

The recent studies offer us a wide range of possibilities of foreign currency incentives. In comparison, in the past, the financial dollarization was defined only as a substitution phenomenon. One of the basic ideas of motivations of depositors and borrowers was defined by Ize (2005). He argued that householders are choosing foreign currency deposits to decrease the risk of their portfolios and foreign currency credits in order to maximize their objective function in the presence of default risk.

According to Ize and Levy-Yeyati (2003), we can find three motivations for foreign currency borrowing. The first approach is based on *the price – risk portfolio choice*, where traders try to choose the best possible composition and allocation of a currency portfolio to minimize the variance of portfolio return. The returns of both domestic and foreign currency instruments are not certain. The returns of financial instruments denominated in domestic currency depend on interest rate and exchange rate. Conversely, returns of foreign instruments are based on inflation and exchange rate volatility. In this approach we believe that the uncovered interest rate parity (UIP) condition holds.[9] In such a case, borrowers choose foreign currency loans with lower exchange rate volatility and higher price volatility, and cannot profit from different interest rates.

The second approach works with *the market failures,* such as externalities or imperfections that make the foreign currency loans cheaper than the domestic currency loans in relative terms. Foreign currency funding is more favourable if lenders are imperfectly informed about the borrower's portfolio or if the default of borrower is positively influenced by the depreciation of the real exchange rate.

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[9] The condition of uncovered interest parity states that the difference in interest rates between two foreign countries is equal to the expected changes in the exchange rates in those countries. If this condition does not hold, then there is an opportunity for arbitrage profit (arising from the difference in interest rates).

The third paradigm is based on the *financial environment and the quality of the domestic institutions*. Weak monetary policy and improperly working financial institutions can lead to a higher degree of dollarization. Other determinants, such as joining the EU or euro adoption, can lead to an increase in financial dollarization.

Looking separately at the borrowing in the private sector, we are interesting in the reasons and motivations for preference choice of currency denomination of loans in the household sector. According to the authors Pann, Seliger and Übeleis (2010), the households are motivated by two sources.

The first possibility is that people opts the foreign loans or mortgages because it seems to be less expensive. The local currency mortgages/loans may be more expensive at the beginning. However, in the case of increase in inflation, domestic currency loans become more affordable than the foreign ones. To conclude this fact, the domestic currency loan poses a higher financial burden at the outset; therefore, it is less attractive for potential borrowers, and thus, the rational behaving potential borrower, who wants to save money, chooses the foreign currency loan.

The second possibility is that the borrower has a foreign asset portfolio or is expecting to get income denominated in a foreign currency (he can yield on export, holding foreign asset or just working abroad). The householders choose foreign currency loans with respect to the opportunity of hedging their money portfolio against the currency risks. They behave as rational market players.

2.2.1 Cost and Benefit Analysis

In this section, we look at advantages and disadvantages arising from official dollarization. It is obvious that the cost and benefit analysis has two opposite perspectives. The first one is the perspective of the demand side, the side of borrowers. The second perspective is the supply side; it can be the perspective of financial institutions, intermediaries or banks. Based on the cost and benefit analysis of official dollarization, we critically analyze the unofficial dollarization. In this case, it is a question of the behaviour of individual market players not of the government. Thus, the impact on the economy and whole population is hard to measure or classify.

According to Winkler, Mazzaferro, Nerlich and Thimann (2004), there is widespread agreement on the main benefits of official dollarization. We can conclude those benefits of dollarization for the adopting country as follow:

1. Fostering macroeconomic stability[10] – stabilize the monetary and fiscal policies of the adopting country. The monetary situation is improved by the catching up process to the degree of the issuing country. We suppose that the issuing country has a higher degree of credibility, interest rate and inflation in relative terms. The fiscal discipline of the adopting country is corroborated by elimination of the possibility of financing the national debt by printing new money.

2. Lower risk premium – the adoption of foreign currency depreciates with domestic currency, and thus lowers the risk premium.

3. Domestic financial sector development – the development of financial sector in the adopting country is one of the assumptions of the dollarization process. The stable currency leads to financial development.

4. Elimination of transaction costs – one of the most visible effects of dollarization. The adopting country significantly eliminates the transaction costs (costs for the exchange currencies) by the adoption foreign currency.

5. Stronger economic and financial integration – the business cycle and the economy shocks are more synchronized after the dollarization process.

Winkler, Mazzaferro, Nerlich and Thimann (2004) listed the main costs of official dollarization as follow:

1. Loss of an adjustment mechanism – the adopting country loses the chance to react to asymmetric shocks and fluctuations of the business cycle using the monetary policy instruments.

2. Loss of the function of the lender of last resort– the financial sector loses the possibility of preventing the default on deposits. It is not possible any more to inject the unlimited liquidity into the financial sector.

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[10] The process of importing credibility from abroad.

3. Loss of seigniorage – the loss of the revenue from printing own money.

If we look separately on the case of unofficial dollarization, the advantages and disadvantages analysis will not be as extensive as for the official case. The official dollarization deals with the behaviour of government and it impacts the economy as a whole. In contradiction, the unofficial dollarization is based on the behaviour of individual market players and the resulted impact on the whole economy is hard to measure.

Thus, the positive and negative impacts are not as straightforward as in the case of official dollarization. The individual market players (borrowers and depositors) do not have any incentives or enough knowledge to predict the possible impact of their behaviour on the whole economy. The problem is, that their bad choices in conjunction with the unfavourable financial environment can lead to vulnerability and instability of the whole financial and monetary system.

The borrowers or banks are choosing the foreign currency loans and deposits as a way of minimizing the risks of their financial portfolios or to yield the maximal possible return. However, the risk savings and hedging opportunities can lead to monetary changes, and not always in a positive way. To conclude our findings, the benefits of unofficial dollarization can be seen in transaction costs saving and lowering portfolio risk by hedging.

General problem of unofficial dollarization can be seen in the information asymmetry between the banks and borrowers/depositors. According to Beckmann, Fidrmuc and Stix (2012), the information about the risk issues is not fully available. General knowledge about the macroeconomic risks for financial stability is available.[11] However, the impacts on the households or indirect credit risk effects on banks are not known.

The difficulties in data collection concerning mostly information about the financial situation of the individual householders and their behaviour are also mentioned as a disadvantage of unofficial dollarization. That leads to a lack of information and in result to biased regression results. The biggest problems of foreign

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[11] Banks are burden by the macroeconomic risks, such as the balance sheet mismatches, refinancing problems or the threat of sudden stops.

currency borrowing and lending are higher risk burden of unhedged borrowers and higher volatility of banking system. The volatility in financial sector is caused mostly by shifting risks from banks to borrowers or depositors, especially during the crisis.

2.3 Borrowers, Lenders and Their Financial Strategies

According to researchers Basso, Calvo-Gonzalez and Jurgilas (2007),[12]Hake (2011)[13] and Neanidis and Savva (2009),[14] the financial dollarization is an asymmetric process, where we have to separately examine both deposits and credits. There are authors[15] that suppose the market forces to get to the equilibrium stage despite the different motives of both sides. In equilibrium, the borrowers and depositors choose the same currency composition of their portfolios, and banks can assist only in a role of intermediary without any significant influence.

If we look at the changes in foreign funding during the catching up process, we can prove that dollarization is an asymmetric process. Private loans expanded in many countries in comparison to private deposits, which remained mostly unchanged. To explain this trend, banking institutions often fund foreign currency borrowings from external sources instead of using the domestic sources, which were insufficient in most of the cases.

We work with the fact that financial dollarization is not symmetric between private borrowings and deposits, similarly to authors named in the beginning of this section. In the next part, we describe the incentives of both market sides for preferring foreign currency denomination to domestic currency denomination. We look separately at demand side (householders or firms) and supply side (banks or financial intermediaries).

2.3.1 Demand Side and Carry Trade Strategy

We consider households and firms on the demand side in the financial market, and they can represent both, borrowers or depositors. The decision of demand side is

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[12] Their research published in 2007 showed that dollarization of deposits is not matched with the dollarization of credits.
[13] She agrees with the opinion that dollarization is asymmetric process between loans and deposits, but in the research from 2011 she studied only loan side of the market.
[14] They modelled determinants of both deposits and credits of financial dollarization.
[15] We can name Ize (2005).

mostly influenced by the changes in the interest rate and the exchange rate. In contrast, the supply side is not directly influenced. It just adapts according to the financial situation.

The incentives of the demand side for borrowings denominated in foreign currencies can be either owning foreign assets or receiving foreign income.[16] When domestic currency appreciates, the market players want to close a position in the financial market. The depositors close their market position by taking a foreign currency loans, and the unhedged borrowers close their market position by depositing foreign currency because they are exposed to enormous risk burden.

The demand side has lower risk burden resulting from foreign currency denomination than the supply side. The borrowers are mainly hit by the exchange rate and currency risks. In comparison, the banks are affected by the whole risk portfolio (the individual risks are described later). Although the borrowers bear less risk, they are in a disadvantageous position. They do not have the possibility to diversify their portfolios or shift out part of their risk exposure to someone else. The supply side has this opportunity and often uses it.

If we look on the demand side of the foreign borrowing in individual countries, the householders are behaving similarly to the exact trade-off strategy. The households choose between two alternatives: foreign currency borrowings (based on interest savings) or domestic currency debt (with potential risks of worse interest rate).[17] The choosing of the right alternative can be seen as analogous to carry trade investment strategy.

The tenet of the carry trade activity is that the trader (in our case the household or a firm) accepts the risk of his position (for us the risk on mortgage or loan) in exchange for receiving the lower level of interest rate. According to Curcuru, Vega and Hoek (2010), the most basic currency carry trade strategy can be seen as the pairs, the borrowing in low interest rate currency and the depositing in higher yielding target currency. The return of such investment depends not only on the movements of exchange rate but also on the difference between the deposit and borrowing rates.

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[16] Pann, Selinger and Übeleis (2010).
[17] McCauley (2010).

Specialized funds and notes allow borrowers to borrow at relatively low interest rates and invest in high yielding currency. The retail investors can choose exchange–traded funds (ETFs) or exchange–traded notes (ETNs) that are designed for such types of carry trade investments. It is important to check the movements of the deposited currency because the carry trade will be profitable as long as the target currency does not depreciate too much in comparison to the position of the funding currency. The main risk of carry traders is the volatility of exchange rate.

The ratio between the carry and risk can be measured by the so called Sharpe ratio. The ratio measures the trade-off between the carry (in our case the interest rate differential) and risk (in our case the unforeseeable currency movements). The Sharpe ratio is equal to the interest rate differential divided by the currency volatility. The higher the ratio is the more attractive the position of the foreign currency borrowers becomes. Furthermore, this ratio can help us to find out why carry traders from different countries are borrowing in different currencies.

The carry trade maximization problem can be solved only when the uncovered interest rate parity (UIP) does not hold. The arbitrage condition of UIP says that there does not exist any profit opportunity on the exchange of two currencies with different interest rates. If this condition holds, there are no incentives to borrow in foreign currency. Whether or not the arbitrage condition holds, it is often a point of interest. Authors such as Goswami and Shrikhande (2001) believe that the UIP holds; therefore, the interest differential does not matter.

2.3.2 Supply Side

The supply side of the financial market can be represented by banks or other financial institutions, which can provide foreign currency lending. In comparison to the earlier described demand side, the determinants of supply are not easy to classify. The banks react on the actual situation in the financial market and on the behaviour of borrowers and depositors. However, we are able to find the determinants influencing the composition of portfolio of banks that have a considerable impact on the supply of foreign currency financial instruments.

From the theoretical perspective stated in the paper by Brown and de Haas (2010), bank foreign lending is influenced by monetary conditions,[18] the function of the composition of the bank's clientele and the currency structure of the bank's liabilities.

Nowadays, many banks in transition economies tend to increase their funds by accumulation of foreign denominated liabilities. The motivation of banks is based on two aspects. First, they have easier access to foreign funds than in the past. Second, banks have support from their parent institutions in the European Union.

The supply of foreign currency loans increases with high volatility of domestic inflation and low real exchange rate. Moreover, the supply is dependent on the access of banks to foreign currency funds and on the relationship with the parent institution.[19]

The trend of increasing foreign currency liabilities in balance sheets of banks was found by Basso, Calvo-Gonzalez and Jurgilas (2007) in research on transition economies. They observed that banks can finance the domestic credit growth by foreign currency lending. Moreover, if banks lend in foreign currency, then the increase in dollarization of credit is not followed by the increase in the dollarization of deposit; that means the dollarization process is asymmetric.

Authors Pann, Selinger and Überleis (2010) think that dollarization of loans arises out of the lack of loans denominated in domestic currency combined with easy access to foreign funds and exchange rate policies. In consequence, banks often prefer to lend in foreign currency to avoid risks and currency mismatches.[20]

The financial institutions are visibly affected by the carry-trade activities of borrowers. The final impact on a balance sheet of banks differs according to the role of

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[18] By monetary conditions authors mean the increasing willingness to take foreign loan if the interest rate differentials are high and the real exchange rate volatility is low.
[19] Brown, Kirschenmann and Ongena (2010).
[20] Pann, Selinger and Übeleis (2010) defined the currency mismatches: the currency composition of loans does not match the currency composition of deposits. Banks prevent such mismatches in their balance sheet by lending in foreign currency.

the institution in the transaction and of the structure of carry-trade strategy. The role of the bank can be different:[21]

1. Bank can serve as an intermediary. Either as a provider of funding currency of foreign loans or as a depositor of the target currency used by the carry-trade investors.

2. Bank can behave as a direct carry trader.

3. Bank can work as counterparty in derivative transactions.

In comparison to the householders, the banks are much more burden by different risks.[22] The main risks of the supply side bring out problems, such as currency mismatches on the bank's balance sheet, the threat of sudden stops or aggregate refinancing problems. It can result in macroeconomic risks and disturb financial stability of the country.[23]

According to the Pann, Selinger and Überleis (2010), we can generally distinguish the risks of banks as direct and indirect risks. Indirect credit risk arises from the foreign denominated lending. In comparison, direct credit risk consists of funding and liquidity risks. The extent of both risks depends on the currency denomination of the contract, type of the borrower and the domestic currency regime.

As was mention before, the banks have to bear more risks arising from foreign currency operations than the householders. The following two specific risks represent the biggest threat for most of the banks. The *concentration risk* emerges from the underestimated diversity of borrowers. Based on the non-diversification aspect, all heterogeneous borrowers are exposed to the same level of risk. The *contagion risk* is another danger for the banking sector. With an increasing extent of the dollarization, the dependence on other international financial institutions also increases. With the problem of overall hedging against the exchange rate risks the contagion risk arises. There are other risks that banks have to bear: reputational risk, operational risk, funding risk, legal risk and socio-political risk.

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[21] Galati, Heath and McGuire (2007).
[22] Pann, Selinger and Übeleis (2010).
[23] Beckmann, Fidrmuc and Stix (2012).

Moreover, the matching of the banks and borrowers/depositors is a two way process. Not only banks are oriented on a certain group of customers, but also the householders are choosing the type of banks to deal with. Thus, it is important to examine the determinants of the portfolio of banks similarly as we analyzed the behaviour of the householders before.

The composition of portfolios of banks is an important factor of the supply side. De Haas, Ferreira and Taci (2010) showed that the characteristics of banks (such as the size or kind of ownership) and the institutional environment of the country significantly influence the final composition of the portfolios of banks. Moreover, the financial environment and bank's ownership changes were visible during the last two decades.

The foreign ownerships of banking institutions spread all over Europe and also helped to better integration of the financial system. The dominance of foreign ownership and also the wide network of the affiliates of the foreign parent institutions offer broad foreign sources of funding. In conclusion, the composition of bank's portfolio is mainly determined by three factors: ownership of the bank (we can distinguish domestic banks, foreign acquired banks or foreign greenfield banks), size of the bank and legal environment in the country.

Unpredictable changes can hit both sides of the market. Thus, it is important to summarize the advantages and disadvantages of both sides. In the case of a sudden change in financial conditions, the private sector without foreign currency income can have serious problems with the costs of the foreign loans. Ordinarily, borrowers are not hedged against the exchange rate and currency risks.[24] The extent of foreign currency borrowing is influenced individually in each country by the volatility of exchange rate and changes in interest rate.

If we compare the possibilities of both sides, the banks have an advantage in financial dollarization. Their advantage is an opportunity to diversify the risks of their financial portfolio. According to Luca and Petrova (2008), the banks facing foreign currency liabilities have two possibilities to cope with the future risks. The banks can

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[24] Pann, Selinger and Übeleis (2010): according to the research on Austrian banks, the unhedged borrowers are typically highly educated and rich people.

either absorb all currency risk, or they can shift the currency risk on the borrowers. The first possibility represents lending denominated only in domestic currency, in comparison to the second possibility which represents the foreign currency denominated borrowing. The second possibility accompanied by the unhedged borrowers can be a big threat for the whole economy. In the case that the borrowers are not sufficiently hedged, the shift out of risks can lead to financial spillovers and currency imbalances.

There are various studies examining the topic of foreign currency borrowing and lending as was mentioned in the beginning. Some authors analyzed only one side of the market while others wrote more complex studies and investigated the determinants of both market sides. The motivation for choosing only one side for the analysis can be either the belief that the financial market is in equilibrium (the demand is equal to the supply, and thus it is sufficient to examine only one of them) or the lack of valuable data.

In this paper, we investigate the different determinants influencing only the demand side of the market. We focus on foreign currency denominated borrowings in the household sector in the sample of three Central European countries. However, the knowledge about the behaviour of both market sides (given by different forces and limited by different sets of available opportunities) is helpful for us. We proceed from the Rosenberg's and Tirpák's paper (2009) that investigates the economic incentives and country-specific characteristics of foreign loans in the new EU member states.

2.4 International Credit and Policy Measures

In this section, we look deeper at the policy challenges in the case of choosing international credit. International credit is defined as a composition of foreign currency credit and cross-border credit. According to the authors Avdjiev, McCauley and McGuire (2012), the international credit consists of three components:

1. Direct cross-border credit – borrowing directly from non-resident banks.

2. Indirect cross-border credit – borrowing banks located in a particular country finance a large share of domestic credits, can be plain (Poland) or fancy (Korea).

3. Foreign currency denominated credit – does not matter if the borrowing bank is inside or outside the country.

International credit can pose three main risks to the whole economy, mostly seen in times of rapid domestic credit growth. The first problem accompanied with the international credit can be seen in economies experiencing boom of the economy. The foreign currency credit represents more extensive work for domestic authorities, which try to monitor credits and want to limit the rapid credit growth more than domestic currency loans. The tools of domestic authorities to slow down the credit growth do not work in the international framework. The controlling credits and their development are also a big problem in a cross border channel, where borrowers are obtaining loans directly from the issuing country.

The second problem represents a higher currency risk exposed on the private sector. The change in preference to the foreign currency shift out local currency liabilities, and thus the domestic monetary policy is limited.

The increasing pressure on the exchange rate is a third problem of international credits. The householders (borrowing in foreign currency) often do not have earnings or assets denominated in foreign currency, and thus represent an unhedged market players. The borrowers in the private sector are therefore burdened by exchange rate risks. Their portfolios are also highly dependent on the volatility of exchange rate.

The policy makers can introduce different measures, which should increase or decrease the credit growth, and thus influence the extent of borrowing. The rise of key rates makes the borrowing more expensive, thus it should be used only in case of excessive credit growth, which the policy makers would like to lower. The problem is that change in interest rate influences the whole economy and thus it is rarely used for changing the credit situation. Moreover, the foreign borrowing rises with the domestic rate tightening.

3. Literature Review

The topic of foreign currency borrowing has been studied and researched from different perspectives with different data by many authors. Some of them tested only one side of the market; others examined both dollarization of deposits and loans in different regions from different time perspective, and thus gained different results.

This paper builds upon and is related to previous literature. We conclude some of the literature sources, which can be valuable or useful for our empirical analysis. The sources can be divided according to the macroeconomic or the microeconomic view on the problem. We also distinguish literature sources according to different assumptions about market conditions. Some authors study only demand or supply separately, while others study the whole market.

There exist two basic reasons why authors study only one market side. The first one is that they assume that the market forces get to equilibrium, and thus the dollarization process is symmetric for loans and deposits. The second reason is that authors suppose that dollarization process is not symmetric but still they examine only one side of the market; in this case the reason is the lack of valuable information and data. More complex studies that examine both dollarization of credits and deposits are mostly done by authors assuming that the dollarization process is not symmetric.

Firstly, we conclude studies researching only one part of the market (it does not matter whether it is the borrowing or the lending side). Then, we look at the more complex studies looking for determinants of both loans and deposits in foreign currency. At the end, we briefly summarize the literature studying the problem of dollarization from the microeconomic or macroeconomic level.

3.1 Studies Analyzing Only One Side of the Market

Rosenberg and Tirpák (2009) analyzed the determinants of foreign currency borrowing during the catching up process in new EU member states using the multivariate approach. They specialized on the currency composition changes of private loans. They agreed with the finding that dollarization is asymmetric between loans and deposits. They suggested, according to the previous researches, that local

banks with a high share of foreign currency deposits are more willing to lend money in foreign currency. That implies high impact of dollarization of deposits on the dollarization of credits, which is one of their assumptions. Rosenberg's and Tirpák's main idea was to test different indirect effects of joining the EU on individual economies. They proved the fact that significant effects exist.

They stated increasing access to foreign funds, liberalization of capital funds and more hedging opportunities emerging from higher trade openness as the most important channels influencing foreign borrowing. Moreover, they obtained the result that regulatory measures aimed at a decrease in share of foreign currency borrowing are more or less ineffective.

Hake (2011) tested determinants of foreign loans using the Meta regression[25] in CESEE countries. She obtained the results that foreign currency borrowings decrease with the volatility of foreign currencies and is positively influenced by foreign currency deposits or minimum variance of the portfolio. She also agreed with the opinion that foreign currency dollarization is asymmetric between loans and deposits.

Luca and Petrova (2008) wrote an empirical analysis testing the determinants of currency composition of portfolios in 21 transition countries in Latin America. Using OLS and panel regressions, they found that the share of foreign denominated loans increases with active export trading, interest rate differentials, volatility of domestic monetary systems and dollarization of deposits. It decreases with exchange rate volatility. Another foundation is that countries with better-developed exchange markets have a lower degree of loan dollarization.

The hypothesis that foreign lending by banks is mostly determined by the macroeconomic environment[26] was stated in the paper written by Brown and de Haas (2010). The resulted determinants of their analysis were determinants of macroeconomic stability, such as interest rate differential (not positively related to FX lending), real exchange rate volatility (discouraging the FX lending) and deposits denominated in foreign currency.

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[25] The Meta analysis is quantitative method of research. She used number of determinants depicted by other authors and examined their significance.
[26] It does not matter which kind of ownership structure has the bank.

3.2 Studies Analyzing Both Market Sides

One of the first authors studying both market sides was Alain Ize (2005). He highlighted motivation of both sides; depositors are choosing foreign denomination to gain safe heaven portfolio, and borrowers want to maximize their profit. He assumed that the financial market goes to equilibrium despite the different motivations of both sides; therefore, the banks do not have any important role in foreign currency transactions.

Authors Basso, Calvo-Gonzalez and Jurgilas (2007) studied both dollarization of credit and dollarization of deposit. They found out that dollarization of deposits and credits are not always matched. Another useful conclusion is that the openness of the country contributes to higher dollarization but only on the corporate level, not on the household level. Moreover, the easier access to the foreign funds has a significant impact on both deposits and credits. The dollarization of credits increases with the access to foreign funds and conversely dollarization of deposits decreases. They also coped with the uncovered interest rate parity condition and they acquired the results that if the condition holds, the interest rate differential has no impact on the currency composition of loans and deposits.

Steiner (2011) analyzed factors on both supply and demand sides of the market. She gained the results that the supply side is mostly dependent on the difference among the interest margin,[27] on the quality of the banking sector and on the concentration of financial institutions in the banking sector. On the other hand, the demand side is dependent on the real estate prices and extent of the household's consumption. Both sides are influenced by the interest rate differential, inflation and joining the EU. She concluded that regulations and other measures should be targeted on both market sides.

The paper written by Neanidis and Savva (2009) differs from the previous comprehensive studies because they added the time perspective. Authors examined both sides of financial dollarization in transition economies from the short-term perspective. They found that the domestic currency depreciation influences the supply

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[27] Difference is calculated as lending rate minus interbank interest rate in domestic and foreign currency.

side; thus, the depositors are willing to change the currency composition of their portfolios with respect to the foreign currency. On the other hand, the monetary expansion has the contradicting effect on the behaviour of depositors. The effect of both determinants increases with the higher level of a country's dollarization. The other way around is the situation from the side of borrowers. The impact of the exchange rate decreases the foreign dollarization, and monetary expansion leads to the reductions in the share of foreign currency in loans.

3.3 Microeconomic and Macroeconomic Studies

Pellényi and Bilek (2009) analyzed the situation of the householders from the microeconomic level.[28] As a result of microeconomic research, authors found out that borrowers in Hungary choosing a foreign denomination were not yielding higher income, were not better educated or better financial literate. The higher risk aversion was not significant for foreign currency borrowers. They concluded their findings that foreign currency borrowers are not considerably different from the local currency borrowers. Moreover, they argued that the foreign borrowing is influenced by macroeconomic factors that leads to the underestimation of the currency risk.[29]

Beckmann, Fidrmuc and Stix (2012) analyzed the impact of foreign loans on the financial vulnerability of borrowers in Central and Eastern Europe. Their paper looked at the situation from the microeconomic point of view; they tested nine countries in two years and collected special data for their research. To summarize their results, the depreciation of the country has a significant impact on the borrowing regardless of the currency denomination,[30] and the stable exchange rate regime leads to the indifferent behaviour of borrowers.

One of the macroeconomic dollarization approaches is based on the currency composition of the financial portfolio. The authors Ize and Levy-Yeyati (2003) studied minimum variance portfolio allocations and obtained the result that it provides the natural benchmark to measure financial dollarization. They argued that the interaction between dollarization of loans and dollarization of deposits leads to financial

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[28] Research was done for the special case of Hungary.
[29] They highlighted two macroeconomic factors: interest rate and exchange rate of euro.
[30] That means the loan arrears are always higher for both domestic and foreign currency in depreciating country.

equilibrium. Moreover, the combination of floating exchange rate and inflation targeting can be used as a measure to decrease share of foreign currency loans. Because it leads to a relatively higher volatility of exchange rate, in comparison to the volatility of prices, and thus it reduces financial dollarization.[31]

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[31] In regard with this conclusion, it holds only in case of so called real dollarization.

4. Situation in Individual Countries

A lot of countries in Central and Eastern Europe were severely hit by the recent financial crisis. As the main problem, we can see the financial instabilities in those economies. The pre-crisis period was displayed with rapid growth in consumption and private credits often denominated in foreign currency. The majority of foreign currency debts or deposits were made via the euro or Swiss franc.[32] It implied that also the debt to income ratios increased rapidly during the catching up process of the new EU member states.

This paper does not study the most problematic countries such as Estonia or Latvia; we examine deeper the situation in the three chosen Central European countries, namely in Poland, Hungary and the Czech Republic.[33] For all of the named countries, the increase in the debt to income ratio was moderate in comparison to other new member states in the European Union.

4.1 Situation in the Czech Republic

The transition era from socialism of the Czech banking sector started in 1991. During this period, banking institutions operated with high loan to GDP ratios and their lending was mainly oriented at the corporate level. The perspective of the bank institutions changed after 10 years, when also the household sector started to be important.

During the following privatization period, when most of the state-owned banks became private-owned, the demand for the banking services significantly increased. The changing nature of the monetary policy (without rigid measures) formed the economy. The resulting economic regime was based on the fixed exchange rates and money supply targeting. In line with the new regime of loose monetary policy, the quality of the bank institutions worsened, and destabilized the economy that started

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[32] Beckmann, Fidrmuc and Stix (2012).
[33] Slovakia is a special case because it is the only country in our sample, which adopted euro.

to overheat. At the end of the 20[th]century, the contentious situation resulted in the banking sector crisis and recession of the Czech economy.[34]

Another wave of privatization and restructuralization of the banking sector came after the year 2001. More than 94 % of all banks were under direct or indirect foreign control, and only two banks remained under state control.[35] That means almost whole banking sector were controlled by the foreign parent companies from the European Union, and this structure persisted to the present. The initial orientation of the banks started to change; the banks began to lend money not only to the corporate sector but also to the household sector.[36] The following period from 2003 to 2008 is well known as the credit boom of the Czech economy.

The Czech credit growth period had some features similar to the booms in the rest of Europe, but it was not the same. Same as in other countries, the rapid growth in borrowings was caused by the increase in credits to the household sector. The biggest difference was that the source of the financing (both credits and deposits) was transacted only via domestic currency. The different feature of the credit boom and different source of financing formed the specific environment of the Czech economy and influenced the policy measures linked to the recent financial crisis.

Nowadays, the financial asset market in the Czech Republic is still relatively small in comparison to other European countries. The financial system is bank-based, similar to other examined countries, and the percentage of financial activities on GDP increases every year. The domestic banks are still the most important in the financial market, but also other non-banking financial institutions played a role. In 2004, the share of financial intermediary services was around 20 %. In the following years, the competition in the financial market and increased tax burden hardened the situation in the market, and non-banking institutions started to lose their positions. The share of financial intermediary services decreased in 2010 by 9 % to only 11 % of the market.[37]

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[34] Frait, Geršl and Seidler (2011): The deep banking crisis is date from 1997 to 1999. It was caused mainly by non-optimal macroeconomic policies and problems in the Czech financial system.

[35] Mejstřík, Pečená and Teplý (2009): The state was involved only in Česká exportní banka and Českomoravská záruční a rozvojová banka.

[36] Frait, Geršl and Seidler (2011): The share of loans to corporate sector was very high, around 90 % of all lending.

[37] Frait, Geršl and Seidler (2011).

To analyze the current situation of the foreign currency credits in the Czech Republic, we look at the components of international credit.[38] As was mentioned before, the major banks were acquired by international financial institutions and therefore the non-financial institutions may borrow directly from their foreign parent institutions. According to those reasons, only one component of the international credit, the direct cross border credit, plays a significant role in the Czech Republic.

The Czech Republic is one of a few countries in Europe where the household sector did not choose the foreign currency loans or external funding during the credit boom (from 2003 to 2008). The share of foreign denominated loans is less than 0.5 % of the total loans in the household sector. The situation of the non-financial institutions is not better, but some of them choose this possibility in order to hedge their income denominated in foreign currency (mostly caused by revenues from exports).

To summarize the differences in the Czech credit boom in comparison to other European countries, we can say that the credit boom hit mostly the household sector. The loans and deposits were predominantly denominated in the local currency, and thus the financial institutions had no incentives to lend or deposit money in foreign currency to hedge their positions or to mitigate risks.

The development of currency composition of borrowing during the last eleven years can be seen in the two following charts. In the *Chart 1*, we can see the normalized number of loans denominated in domestic currency in the household sector. During the whole examined period the share of domestic loans on the total loans of the households is very high. There is also visible increasing tendency of the number of loan during the first six years (credit boom period). From the year 2008 the trend is stable and loans denominated in domestic currency represents more than 99.7 % of total loans of the householders.

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[38] The components of international credit were described in the Section 2, Chapter 4.

Chart 1: Development of normalized domestic loans in the Czech Republic
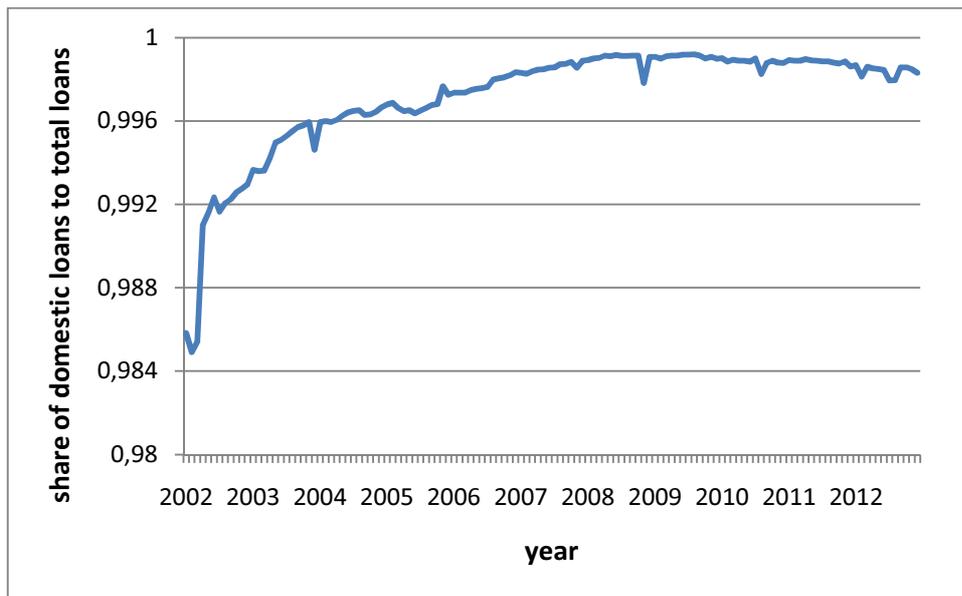
Source: ČNB – ARAD, and authors' calculations.

In the following *Chart 2*, we can see the development of the amount of normalized loans of householders denominated in foreign currencies during the whole examined period. The tendency is strongly decreasing from the beginning of the examined period to the year 2006. After the year 2006 the number of foreign loans continues a moderately decreasing trend until the end of examined period. The share of foreign household credits is very low during the whole period, ranging from a maximum of 1.5 % to a minimum around 0.1 % of total loans in the household sector.

Chart 2: Development of normalized foreign loans in the Czech Republic
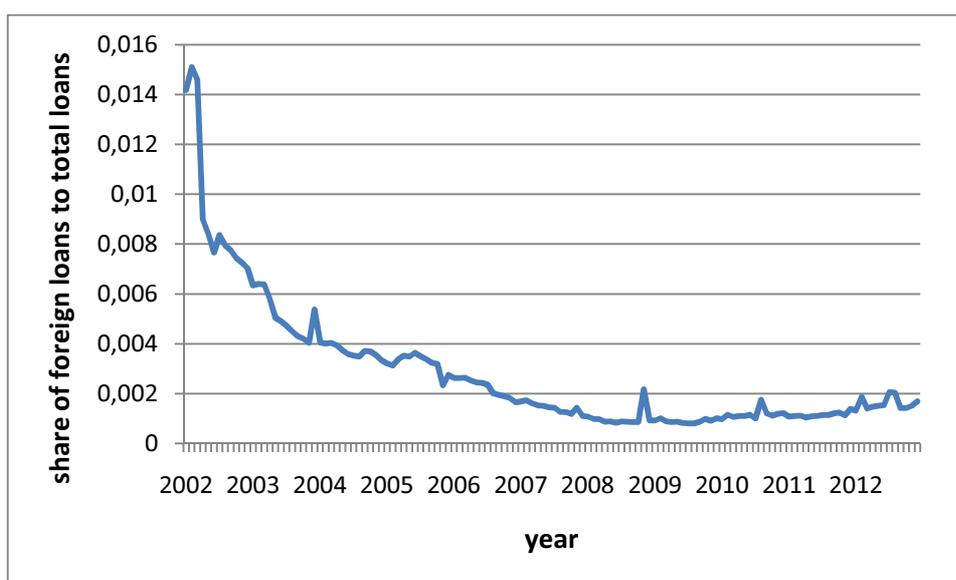
Source: ČNB – ARAD, and authors' calculations.

4.2 Situation in Hungary

The Hungarian banking sector was remarkably transformed during the second half of the 1990s. It altered from the initial money losing state-owned banking institutions, draining public financial sources, to banking institutions, generally operating on the same level as in the rest of the Western European countries. In the end of the transformation, more than 75 % of bank institutions were fully or partially owned by foreign owners.[39]

During recent years, Hungary achieved a credit boom in the borrowing in the private sector. Concretely, the share of the non-financial sector loans increased from 52.4 % of GDP in 2000 to 93.5 % of GDP at the end of 2007.[40] The household sector contributed to almost 60 % of this increase. The growth was almost entirely driven by an increase in foreign currency denominated borrowing. The change in behaviour of the households was caused by the higher availability of foreign financing, increasing competitiveness among bank institutions and also by the future prospects of better living conditions and more stable economic growth resulting from joining the EU in 2004.

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[39] Banai, Király and Nagy (2011); Akbar and McBride (2003).
[40] Pellényi and Bilek (2009).

The governmental program of housing loans announced between the years 2000 and 2003 also contributed to the rapid increase in borrowing. The government subsidized the local currency interest rate, which led to an enormous increase in the demand for housing loans.

When the government recognized the enormous costs of subsidizing, the conditions of the housing loan program were gradually tightened.[41] The banking sector reacted quickly and filled the financial market gap with a supply of relatively cheap foreign currency housing loans. Also the household sector answered to this offer, and mostly all private loans were made via foreign currency. The Swiss franc was the most commonly used currency for Hungarian borrowings and offered better interest than domestic Hungarian forint. From the economic point of view, the borrowers behaved as rational market players because they chose the loans with lower interest.

The problems arose when the re-elected government implemented the drastic austerity measures to reduce the state budget deficit in September 2006.[42] It led to a higher tax burden on the household sector and deterioration of the individual financial situation. The private sector did not want to change the living standard, which resulted in a higher level of borrowing to cover the excessive consumption.

The privatization of the Hungarian banking sector was finished during the year 2008. The foreign bank institutions dominated the market, and they provided cheap funding based on the support from their international parent institutions. This period is known as a boom in foreign currency borrowing in Hungary. People started to prefer loans denominated in Swiss franc to those denominated in a local currency. The main reasons were the increasing forint interest rate and the needs of the householders to finance their consumptions and mortgages.

The economic situation worsened in autumn 2008. The increasing trend of Hungarian borrowing slowed down because of the spillovers of the international financial crisis. The foreign currency loans represented around 60 % of total loans of householders, deposits denominated in foreign currency reached 20 % of total value of

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[41] The extent of the subsidy was linked to the yield of treasury bonds.
[42] The austerity measures primarily included tax increase and secondary stated reform programmes aiming at the state administrative, education and public services.

private deposits. The loan to deposit ratio was quite high; the share was close to 140 %.[43] To conclude the situation in Hungary during the year 2008, we have to highlight the fact that the borrowings in the household sector were highly skewed to foreign currency denomination, and also the difference between the number of loans and deposits was considerable.

The devaluation of Hungarian forint influenced the quality of banking loans and also decreased the demand for domestic loans. The National bank of Hungary reacted by increasing interest rates (by 300 basis points in October 2008).[44]

The year 2009 was important for further development of the banking sector in Hungary. Most of the measures and attempts of Hungarian government helped to quickly overcome financial crisis. The government provided guarantees and liquidity injections that supported to overcome the financial problems. During this time around 70 % of private loans were denominated in foreign currency. In the September 2009, the Hungarian government and the majority of commercial banks agreed on the special behaviour, the change was based on retail lending. Moreover, the government guaranteed the mortgage payment scheme.

The international financial market started worrying about the sustainability of the Hungarian system in the year 2010. The high amount of the foreign currency borrowings of householders and large public debt combined with a low participation rate in the labour market led to significant problems and high vulnerability of the financial system. The first half of the year 2010 is specific as a strong recovery period for the country. The new government came with new measures and statements that led to a higher volatility of forint and bond market. They also introduced lending limitations, and foreign denominated mortgages were tied to registered collateral.

During the last year 2011, the bilateral currency problems were still vivid. Around two-thirds of mortgages were still denominated in Swiss franc. The continuing appreciations of Swiss franc deeply worsened the situation of the householders. Although the foreign currency mortgages were ban to registered collateral, the situation had to be abandoned because of compliance with the European Union

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[43] Pann, Seliger and Übeleis (2010).
[44] EBRD: Transition report 2008-2011: Country assessments: Hungary.

legislation. September 2011 brought the turning point in unfavourable development. Another agreement among government and banks was signed. The authorities of both parts agreed on special discounted rates to allow borrowers to repay their debts.

To summarize the situation in Hungary, the country has been still vulnerable to external shocks during the last years. As the greatest threats, we can name loss of capital market access (caused by the risk aversion of investors) and exchange rate depreciation.[45] Nowadays, the Hungarian economy is based on the non-pegged exchange rate regime similarly to Romania and Ukraine and has a high share of lending denominated in Swiss franc.[46]

It is interesting to look back on the motivation of the Hungarian borrowers. They behaved as rational economic players when they chose foreign currency loans with respect to the macroeconomic situation in Hungary. This fact was proved by Pellényi and Bilek in their research in 2009. The households choose the possibility that minimizes their expected costs. The source of the decision of the householders is still not clear. Moreover, most of them did not realize the possible exchange rate or currency risks arising from foreign currency borrowing.

The development of the currency composition of Hungarian loans can be seen in the following charts. The first one shows us the development of the loans of households denominated in Hungarian forint during the last eleven years (values are in billions HUF). The second chart depicts the percentage distribution of the domestic and foreign currency loans.

As we can see in *Chart 3*, at the beginning of the monitored period the share of foreign currency denominated loans was less than 1 % of the total loans. During the following two years, the proportion of foreign currency in composition of loans increased moderately. The turning point in the evolution was the end of the year 2007 when the share of foreign loans equilibrated and exceeded the share of domestic loans. The increasing tendency continued until the beginning of the year 2009, when foreign loans reached a peak at nearly 70 % of the total value of loans. As was described before, the crisis and government measures influenced development, and

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[45] EBRD: Transition report 2008-2011: Country assessments: Hungary.
[46] Pann, Seliger and Übeleis (2010).

thus the amount of foreign loans started to decrease during 2009. Despite the sinking trend and other unfavourable conditions, the share of foreign currency loans is still very high at around 55 % of all household loans in the end of examined period, as can be seen in *Chart 4*.

Chart 3: Currency composition of loans in the household sector in Hungary
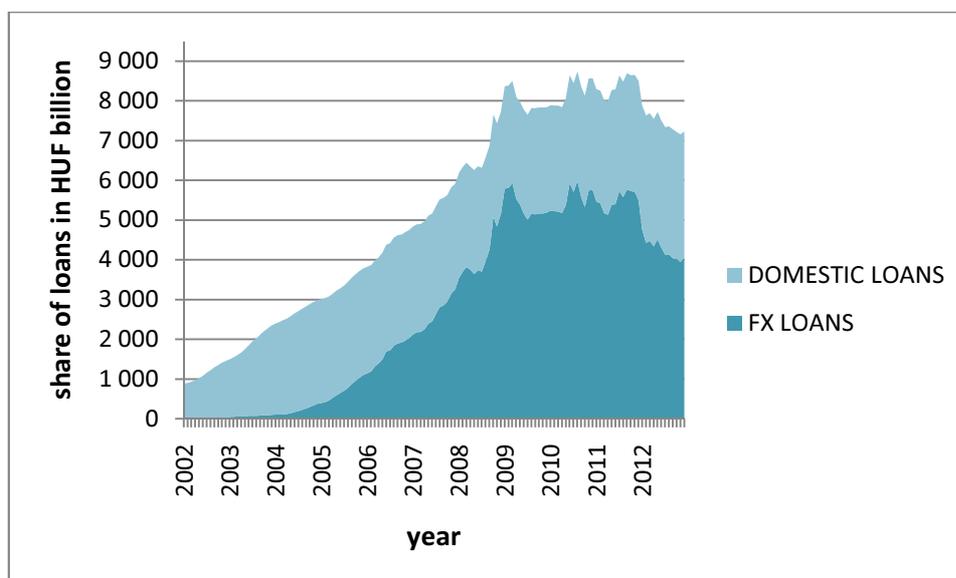
Source: MNB, and authors' calculations.

Chart 4: Share of domestic and foreign currency loans in Hungary
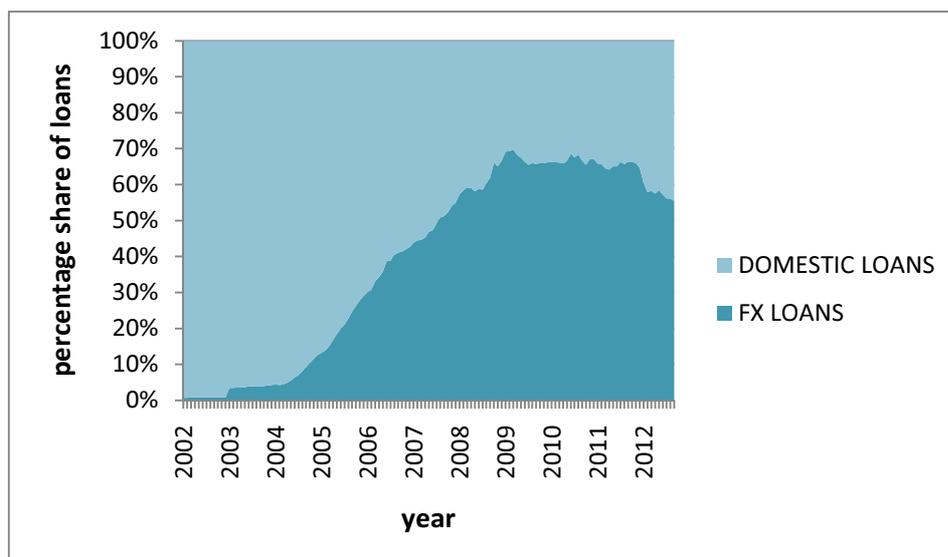
Source: MNB, and authors' calculations.

4.3 Situation in Poland

During the 1990s, the Polish economy experienced a rapid credit growth in the private sector. In the beginning of the 2000s, the rapid growth trend calmed down mostly because of a decline in corporate sector borrowings, and in the following years the private credits continued to grow very moderately. In comparison to other new member states, Poland reached the lowest rate of credit growth.[47] The overall trend of credit growth was significantly impacted by the rapid growth of housing loans, comparable to Hungary.

During the time period from 2000 to 2003 the economy slowed down. It led to an increase in unemployment and slower growth of wages. All these indicators implied an increase in loans of households and a subdued growth in corporate credit. The decline of corporate credit reached the bottom in 2005 and started to recover again.

The number of mortgages grew around 40 % annually during the period from 2001 to 2005. The growth was driven by an increasing demand for houses and flats, decreasing interest rate and new taxes established by joining the European Union. The higher competition in the banking sector was another important driving factor of the increasing demand for private loans. More than 65 % of housing loans were denominated in foreign currency. This percentage was one of the highest in the European Union and significantly higher than in other new member states.[48]

Poland has a short lending history, which implies weaker legal and risk management frameworks than in other European countries. From the year 2005, the Polish government and authorities implemented new measures to avoid the risks associated with rapid credit growth and foreign currency denomination. The Commission for Banking Supervision increased the risk weight on private loans on houses and flats.[49] In the following year, the new recommendation was implemented as another governmental safety tool.

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[47] International Monetary Fund: Monetary and Capital Markets Department (2006).
[48] International Monetary Fund: Monetary and Capital Markets Department (2006).
[49] International Monetary Fund: Monetary and Capital Markets Department (2006). The previous international practice change caused the increase in the loan to deposit ratio from 50 % to 100 %.

In July 2006, so-called Recommendation S was introduced. It was a combination of measures targeted on the reduction of foreign borrowing and the non-binding guideline for bank institutions. According to the new recommendation, all banks should introduce the risks linked to foreign currency borrowing to all borrowers.

The authors Geršl and Jašová (2011) tested the effects of this recommendation and obtained the result that the increase in foreign borrowing was not stopped but rather the other way around. The share of foreign currency denominated loan continually grew and at a faster speed than before. As an advantage of Recommendation S we can state that borrowers are better informed about the possible risks linked to foreign currency borrowing. The disadvantage is that the measure does not hit the preferable aim, and credits denominated in foreign currency continue to grow.

The Polish loan to deposit ratio was one of the lowest in comparison to the rest of Europe in 2009 (around 120 %). The whole financial sector was heavily affected by the international financial crisis. The most significant effects were outflows of capital, increase in interbank rates, decrease in liquidity of banks and depreciation of national currency – Polish zloty (the depreciation reached nearly 30 % against euro).[50]

The relatively high currency depreciation significantly affected both households and firms with loans denominated in foreign currencies. The Polish government and central bank tried to eliminate the hard impacts of the international crisis with the new measure implemented in October 2008. The so-called Confidence Pact focused on three objectives:[51]

1. To provide banks with the Polish zloty for longer than one day.
2. To provide banks with other foreign currencies.
3. To expand the possibilities to obtain liquidity in the Polish zloty by broadening the range of collateral operations with national bank.

The National bank of Poland started to provide repo operations up to three months. It also introduced foreign currency swaps and foreign currency deposits as collateral for refinancing the foreign currency loans to reach the stated goals.

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[50] EBRD: Transition Report 2008-2011: Country assessments: Poland.
[51] Monetary policy instruments of the national bank of Poland in 2008.

Moreover, the central bank introduced modifications in the operational system of Lombard credits, increased the frequency of open market operations and established liquidity absorbing instruments (such as one week bank bills).[52]

The declining trend and significant outflows in the banking sector started to change in 2010. The corporate sector loans continued to decline by 4 % per year. The next year 2011 can be seen as a year of Polish banking sector expansion, mostly thanks to renewed mortgage lending. The private sector loans started to grow again by 9 % per year (an increase can be seen on both levels – household and corporate).

Nowadays, around 75 % of Polish banks are owned by foreign financial institutions. However, according to the National Bank of Poland it did not have any significant impact on the foreign borrowing.[53] The portion of foreign owned institutions had an increasing tendency during the last years (from 70 % in 2008 to 75 % in 2012).

According to the following charts, we can summarize the development of the currency composition of loans of householders during the examined period from 2002 to 2012. The rapid increase in the number of loans is mostly significant from the year 2006 and a rising trend continues to the end of the examined period, as can be seen in *Chart 5*. The number of foreign denominations reached a peak at the end of the year 2009, when the foreign loans represented more than 40 % of total value of loans. In comparison to the case of Hungary this portion is still very low; the maximum was reached in the first quarter of the year 2009, and foreign loans represented nearly 70 % of total value of loans.

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[52] NBP: Financial Stability Review (October 2008).
[53] Brown, Peter and Wehrmüller (2009).

Chart 5: Currency composition of loans in the household sector in Poland
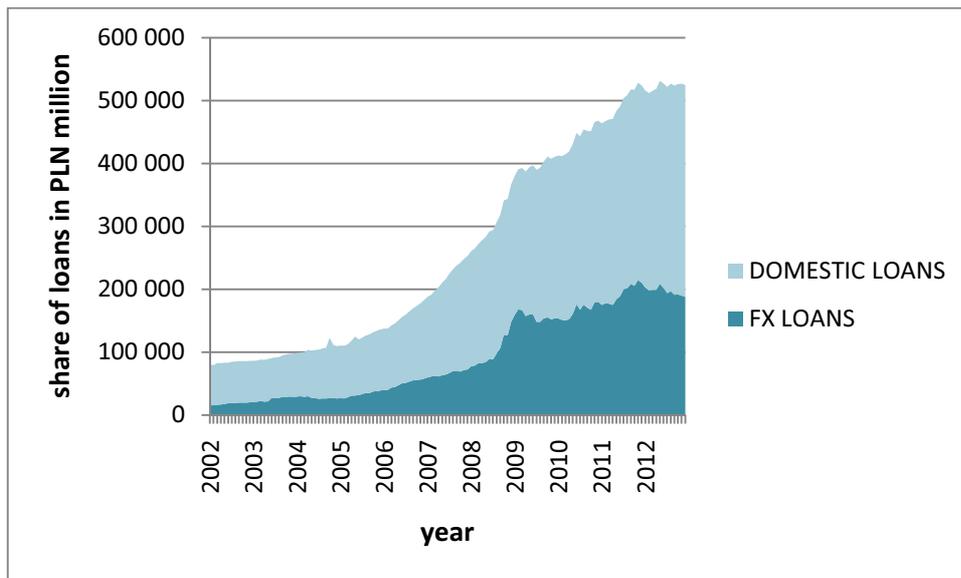
Source: NBP, and authors' calculations.

In *Chart 6*, we can see that the portion of domestic currency loans was higher than foreign loans throughout the whole examined period. The amount of foreign loans has been increasing very moderately with slight jumps over the whole period, from an initial share of less than 20 % of total loans to the final share close to 40 % of total loans in the private sector.

Chart 6: Share of domestic and foreign currency loans in Poland
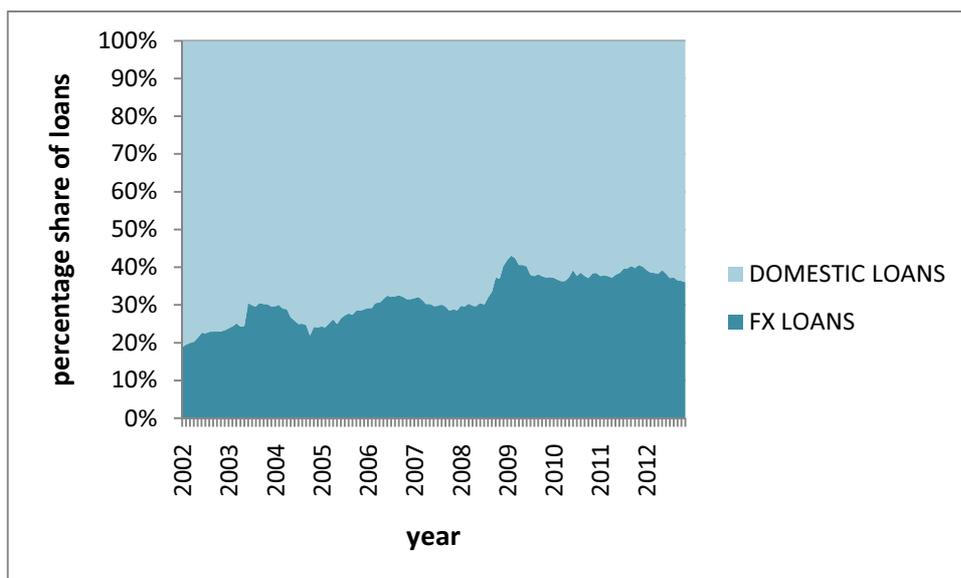
Source: NBP, and authors' calculations.

5. Empirical Part

We decide to use panel data for our empirical analysis, which allows us to look at dynamic relationships. We are looking for determinants of currency composition of mortgages or loans taken by the households. In this chapter, we firstly state arguments supporting the using of panel data in line with the Baltagi's book "Econometric Analysis of Panel Data" from the year 2005. Secondly, we describe in detail all variables used in our models and also our expected impact on the ratio of foreign currency loans. Thirdly, we write down three basic hypotheses, which we would like to confirm or reject according to regression results. We construct basic model that describes the relationship of dependent variable and independent variables. Lastly, we conclude the results of regressions and explain economic implications of the results.

5.1 Panel Data

The definition of the term panel data according to Baltagi (2005) is: *"panel data refers to the pooling of observations on a cross-section of household, countries, firms, etc. over several time periods".* We can list the most important benefits of panel data, such as better control of individual unobserved heterogeneity (in our case difference in each country), lower collinearity and higher efficiency (in comparison to time series or cross-sectional data). Panel data allows to better identification, measurements of effects and dynamics of adjustments. Regressions using panel data are more complex studies with limited or reduced biases. Moreover, we are able to control unobservable cross section heterogeneity in the data.

Working with panel data also has a negative side. Such limitations can be hard data collection or too short-time period (not all data are available or are not available on monthly or daily basis). Other problems can be measurement distortions, selectivity problems or the cross-sectional dependencies in the database. The particular advantages and disadvantages of our panel dataset are described later.

5.2 Variables and Dataset

For our empirical analysis, we choose Central European countries. The regression sample of countries contains three new EU member states from Central

Europe – the Czech Republic, Hungary and Poland. We exclude Slovakia, because it might cause a significant problem in our model. In the following, we summarize the reasons for Slovakia exclusion and also described the selected time period.

Slovakia is a country with different specification in comparison to other countries in our sample.[54] The euro adoption in 2008 indicated problems with the calculation of the share of loans denominated in foreign currency. Before the adoption, the foreign loans and deposits represented all loans and deposits denominated in euro, Swiss franc, dollar or other currencies. The problem arose after the year of euro adoption. All euro denominated loans became calculated as domestic loans instead of the foreign currency one.

That means, in the case of inclusion Slovakia in our dataset, there would be a significant point of structural change after the adoption of euro. The change in behaviour of the householders can also represent a source of bias of results. People expecting a currency change could start to borrow (take loans or mortgages) in future domestic currency before the official currency change to eliminate exchange rate risk or to lower transaction costs.

The panel data regression examines monthly data for chosen variables for an eleven years time period, from 2002 to 2012. We do not use earlier data because of the privatization and the restructuralization of the banking systems in individual countries before the year 2002. The data after the year 2008 can still be biased by the impact of the recent financial crisis. We work with 132 observations for every country and test variables using the Pooled Ordinary Least Squares (OLS) regression, Fixed effects and Random effects in econometric software Stata. Most of the data were derived from databases of national banks, the rest of data were collected from Eurostat, International Monetary Fund, European Central Bank, World Bank and OECD databases.[55] We compare the significance and signs of coefficients of explanatory variables. We also look at an explanatory power of individual models and run additional tests to find out which model is the most suitable for our sample.

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[54] Rosenberg and Tirpák included Slovakia to their sample, but they worked with dataset until the year 2008. In that year Slovakia adopted euro as domestic currency and after this year the view on the foreign currency loans had to be changed.

[55] All sources are listed in the end of the thesis in Section *Source of data*.

We have to highlight the fact that empirical studies of foreign currency loans (mostly concentrated on Central and Eastern European countries) suffer from data complications. The reliable time series are available only for recent years because of the different transformation and privatization structural changes. The data are often adjusted by methodological and frequency revisions. Some authors try to avoid the data volatility and inaccuracy, and they base their studies on special data collection. However, there can still be high data bias and relatively low comparability to the total borrowing population.[56]

When we decide which variables may be important determinants of the foreign currency loans in the household sector, we base our study on the Meta analysis comparing previous researches on this topic.[57] According to this analysis, the most used explanatory variables are exchange rate, inflation and their volatility rates, foreign currency sources in banks, interest rate differential and dummy variable EU membership.

According to availability of data and also other studies, we finally choose the following variables. Their impact on the amount of foreign denominated loans is not always strictly given, and it can be influenced by other factors. We try to explain our motivation for choosing each variable and also mention their expected impact on our dependent variable. The general information about each variable, such as maximum and minimum values or mean and standard deviation can be found in the *Appendix* in summary *Table 15*.

As the dependent variable, we investigate the ratio of *foreign denominated loans to total household loans*. The monthly data of domestic and foreign loans were downloaded from the databases of the national banks[58] of individual countries, and the share of FX loans was reached by authors' calculations.

The first independent variable used in our basic model is the *volatility of exchange rate (ex.volat)*. The source of monthly data of exchange rates was the Eurostat database (we took national currency/EUR for individual countries – CZK/EUR,

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[56] Cuaresma, Fidrmuc and Hake (2011).
[57] Cuaresma, Fidrmuc and Hake (2011).
[58] www.cnb.cz; www.nbp.pl; www.mnb.hu.

HUF/EUR, and PLN/EUR)[59]. We calculated volatility as a standard deviation of the previous twelve months. The impact on the dependent variable is ambiguous. According to Cuaresma, Fidrmuc and Hake (2011), the positive sign of this variable arises from the expected stability of repayment rates and the negative impact represents the credit risk default of unhedged borrowers. In reality, the final effect of this variable depends mostly on the elasticity of loans denominated in foreign currency and the rate of depreciation.

Data for calculation of the next independent variable were found in the European Central Bank database.[60] *Interest rate differential (ir differ)* was calculated as the difference between 3-month interest rate[61] of individual country and 3-month EURIBOR.[62] We assume a positive sign for this variable. Increasing difference between domestic interest rate and EURIBOR leads to higher dollarization of liabilities. The reason is that it is cheaper for households to borrow in foreign currency when the domestic interest rate grows. Thus, we assume rational behaving householders to prefer cheaper foreign loan to more expensive domestic loan.

As another independent variable, we decide to use a ratio of *foreign denominated deposits to total household deposits (fx deposit).* This ratio can be seen as a proxy for supply factor in our model. The variable, foreign deposits, is the most often used independent variable in majority of studies. We assume it to have a significant positive impact on the amount of foreign currency loans. That means with increasing number of FX deposits, the FX loans increases. The data of foreign deposits were gained from the databases of the national banks, and the ratios were calculated by author.

We also add the variable *loan to deposit ratio (loan to dep)* to the model, calculated as the total loans of householders divided by the total deposits of

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[59] For simplification, we used the exchange rate only against euro. According to the fact, that foreign currency loans are not denominated only in euro, but also in Swiss franc (in the case of Hungary the majority of foreign loans are denominated in Swiss franc), we can have biased results.

[60] sdw.ecb.europa.eu.

[61] We would like to use interbank rates in individual countries – PRIBOR, BUBOR and WIBOR. We had to use 3-month interest rates measured monthly because of the lack of data for interbank rates in monthly frequencies.

[62] The 3-month interest rate was used as monthly average without seasonal adjustment. EURIBOR (Euro Interbank Offered Rate) is considered as the benchmark rate of euro money market from January 1999 (source of monthly data of 3-month EURIBOR is ARAD database at www.cnb.cz).

householders. This variable can help us to control for banking sector changes; concretely, it allows us to measure the credit expansion financed by the inflows of foreign capital. We assume a positive sign, that means with increasing number of total loans, part of them can be denominated in foreign currency, and thus also the FX loans increases.

The next important variable is the *banks' net foreign assets (bank assets)* measured as a percentage of GDP. This variable reflects the indebtedness of an individual country and was calculated as a difference between the assets owned abroad by the home country and the domestic assets hold by non-residents of the country. According to the Czech National Bank, the net foreign assets are defined as the foreign assets minus foreign liabilities.[63] Based on the assumption that the banks substitute the foreign assets for foreign loans when they face a tight open position, we assume a negative effect on the foreign loans of households. The data for foreign assets of banks were downloaded from IFS, IMF database. Data for gross domestic product were gained from OECD database on a quarterly basis and then linearly decomposed to get the monthly data. The percentage was calculated by author.

As a last variable we add to the model a dummy variable, *EU membership (EU memb)*. We assume that joining the European Union would open the market and brings new opportunities, lowers uncertainty, and thus results in higher willingness to take foreign loans. That means we expect joining the European Union has a positive impact on the number of loans denominated in foreign currency.

5.2.1 The Complications During the Data Collection

We deal with some complications during the data collection for our empirical analysis. Because of the lack of data with monthly frequencies, we cannot use all important variables. We had to linearly decompose data of gross domestic product from the quarterly data to monthly data. The possible bias should not have significant impact on our results. We used GDP only for calculating the percentage of the banks' net foreign assets.

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[63] www.cnb.cz. The Czech National Bank listed *foreign assets,* such as money holdings denominated in foreign currencies, loans to non-residents and securities issued by non-residents. And *foreign liabilities,* such as repo operations, deposits of non-residents, shares and stocks hold by non-residents in the money market.

Another data collection problem had to be overcome for net foreign assets of Polish banks. The data were not available in monthly frequencies before the year 2004. We downloaded yearly data from the World Bank database and then linearly decomposed into the monthly data. Although it can significantly influence results for Poland in the first two years of examined period, we decide to use linearly decomposed values instead of excluding this variable from the model. There were not any problems with finding monthly values for two remaining countries.

We were careful during the data collection and thoroughly checked currencies and quantities used in different databases for individual countries. In the case of different currencies, we used the actual monthly exchange rates (used also for calculation of exchange rate volatility) for recalculating values to get the right comparable numbers.

5.3 Basic Model and Hypotheses

In our model we test the share of foreign currency denominated loans on the total number of loans in the household sector as a dependent variable. We suppose that before described variables determine our dependent variable. Based on the three chosen regressions, we examine the final effect of individual variables and test three hypotheses. The most important independent variables (described in detail before) are listed here: share of foreign denominated deposits to total deposits, net foreign assets of domestic banks, interest rate differential and exchange rate volatility.

We assume foreign currency loans to be determined not by present values of independent variables, but by their development in the past. For simplification, we expect the impact by one-month-old values of independent variables. In line with this assumption, we use all variables lagged by one month, excluding the dummy variable EU membership.

We also analyze models with more lagged variables, lagged by two or three months and by a whole year. Adding more past values of independent variables does not improve the descriptive power of the model. An interesting fact is that the sign of exchange rate volatility changed with adding more lags to explanatory variables, from an initially positive sign to a negative sign. Moreover, we obtain all variables to be

significant for the model with 12-month lagged variables. The adjusted coefficient of determination decreases, but its value is still very high, around 88 %. (Regression results can be seen in the *Appendix* in *Tables 6, 7* and *8*).

The basic model can be written using the following linear equation (1):

$$y_{it} = \beta X_{it} + c_i + \mu_{it} \tag{1}$$

where X_{it} contains all independent variables that vary for different models, c_i stays for unobservable effects (we can distinguish fixed or random effect)[64] and the last term μ_{it} stays for error term. We called it idiosyncratic errors or disturbances because of the change across country i and as well as across time t.[65]

We have to highlight the important advantage of panel data, all variables are dependent on *i* (denotes country) and *t* (denotes time). Our constant is denoted as $ß_1$ and we estimate values of coefficients $ß_2, ß_2 \dots ß_7$.

We can rewrite the basic model using all tested variables:

$$fx\ loans_{it} = ß_1 + ß_2 ex.volat_{it} + ß_3\ irdiffer_{it} + ß_4 fx\ deposits_{it} \tag{2}$$
$$+ ß_5\ loan\ to\ dep_{it} + ß_6\ bank\ assets_{it} + ß_7 EU\ memb_{it} + v_{it}$$

For our work we state three basic hypotheses that we would like to test using the econometric models:

1. The low interest rate in relative terms influences the borrowing in home currency.
2. The exchange rate volatility in the individual country influences the willingness to take foreign loans.
3. Joining the EU increases the availability of foreign borrowing, which influences the change in composition of private credit.

The first hypothesis will be confirmed or rejected according to the variable interest rate differential used in our model. A lower interest rate in individual countries implicates the lower interest rate differential. We do not reject this hypothesis in case

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[64] In case of Pooled OLS the unobservable effects are part of the error term that is called composite error. The equation changed to $y_{it} = \beta X_{it} + v_{it}$, where v_{it} denotes the sum of idiosyncratic errors and unobservable effects.
[65] Wooldridge (2005).

when the variable interest rate differential has a positive sign; otherwise, we reject it. We assume that householders are behaving mostly as rational market players and they are choosing the cheapest possible option. That means low domestic interest rate should motivate householders to take domestic currency loans; they have no incentive to look for another currency denomination.

If we assume, according to the theoretical base, that the uncovered interest rate parity condition holds, then any interest rate differential observed cannot be explained as expected currency appreciation or depreciation.[66] In that case, the changes in this variable have any impact on the amount of foreign currency loans. With respect to the stated argument, we allow the uncovered interest rate parity not to hold.

The second hypothesis comes from the resulted sign of variable exchange rate volatility. With increasing exchange rate volatility, we assume increasing number of foreign currency denominated loans. We do not reject the second hypothesis in the case that this variable has a positive sign. Again, we assume rational householder to care about the volatility of domestic currency with respect to foreign currency. In the case of high volatile home currency, the householder looks for other than domestic currency denominated loans.

The third hypothesis is based on the additional dummy variable EU membership used only in the OLS regressions. We assume that after the year 2004, (same for all tested countries) when countries joined the European Union, the composition of private loans changed in respect to foreign denomination. We confirm this hypothesis in the case that the dummy variable has a positive impact on the dependent variable. In this case, we assume easier access to foreign currency denomination, higher information availability and possibly a lower exchange rate and currency risks for householders.

5.4 Empirical Models

We construct a strongly balanced panel dataset from the before described variables for three Central European countries for the time period from 2002 to 2012.

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[66] Basso, Calvo-Gonzalez and Jurgilas (2007).

We examine different modifications of equation (1) by three methods described below and we test which of them fit our data best. All empirical findings and results come from the econometric software Stata.

Firstly, we run the Pooled Ordinary Least Square regression (Pooled OLS) using all six above described independent variables lagged by one month. The model can be described by the following modified equation:

$$fx\ loans_{it} = ß_1 + ß_2 ex.volat_{i(t-1)} + ß_3\ irdiffer_{i(t-1)} + ß_4 fx\ deposits_{i(t-1)} \quad (3)$$
$$+ ß_5 loan\ to\ dep_{\ i(t-1)} + ß_6 bank\ assets_{\ i(t-1)} + ß_7 EU\ memb_{it}$$
$$+ v_{it}$$

The left side of the equation represents the dependent variable. On the right side of equation, there are intercept signed as $ß_1$, six explanatory variables with coefficients $ß_2, ß_3 ... ß_7$ and composite error term represented as v_{it}.[67]

The regression well describes the real data. That is caused by the high value of the coefficient of determination, in the result tables sign as R-squared. The value tells us that 92 % of variation in the dependent variable is explained by the regression. We can also look at the adjusted R-squared that technically adjusts for the number of explanatory terms in the model.

Three of the tested variables are statistically insignificant (their absolute value of t-statistic is lower than 1.96) at 5 % significance level.[68] That means impact of exchange rate volatility, interest rate differential and EU membership on the amount of foreign currency loans is not important. We gradually tried to exclude the insignificant variables. Firstly, we excluded exchange rate volatility. Secondly, we excluded interest rate differential. In both cases the model acquired just a little better explanatory power, but was not significantly changed. The complex results can be seen in the following *Table 1*.

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[67] The composite error term includes both idiosyncratic errors and unobservable effects.
[68] Variable is significant if t-statistic is greater than 2.58, 1.96 or 1.64 at 1%, 5% or 10 % significance level respectively.

| | POOLED OLS | | | |
| | Dependent variable: Ratio of foreign loans to total loans in household sector | | | |
	Coefficient	Standard error	t-statistic	P>|t|
Exchange rate volatility	0.1042077	0.485348	0.21	0.830
Interest rate differential	0.0015329	0.0020016	0.77	0.444
Ratio of FX deposits	3.1950950	0.1074382	29.74	0.000
Loan to deposit ratio	0.6971660	0.0224343	31.08	0.000
Banks' net foreign assets	0.7382404	0.0716989	10.30	0.000
EU membership	0.0096004	0.0119912	0.80	0.424
Constant	-0.7208798	0.0294645	-24.47	0.000
R-squared	0.9257	Adjusted R-squared		0.9246
Number of observations	393			

Source: Authors' calculations.

Secondly, we run Fixed effects model (FE). We exclude the dummy variable EU membership that does not vary over time. The rest of the five independent variables are used with a one month lag. The model can be described by a following equation:

$$fx\ loans_{it} = ß_1 + ß_2 ex.volat_{i(t-1)} + ß_3\ irdiffer_{i(t-1)} + ß_4 fx\ deposits_{i(t-1)} \quad (4)$$
$$+ ß_5\ loan\ to\ dep_{i(t-1)} + ß_6 bank\ assets_{\ i(t-1)} + c_i + \mu_{it}$$

In this case, the left side of equation is stated same as before, and represents the dependent variable that is examined. The right side of equation is slightly changed in comparison to the previous case. We test intercept $ß_1$ and five independent variables with coefficients $ß_2, ß_3 \ldots ß_6$ similarly as before. The last two terms differ, c_i signed the unobservable effects in the model and μ_{it} is idiosyncratic error term.

The FE model assumes to study cases of changes within an individual country, it allows us to control for within effects. The FE model analyzes the impact of variables varying over the given time period and works with the fact that an individual country has its own characteristics influencing the impacts on the dependent variable. We assume non-correlated error terms and constants for individual countries. The FE

model regress the data similarly as the OLS with country dummies. For comparison we run the OLS with country dummies and the results of this regression are added in the *Appendix* in *Table 9*.

All variables are significant and have a positive impact on the number of foreign currency loans except the interest rate differential, which is statistically insignificant and has a negative sign. The values and signs of coefficients can be seen in the following *Table 2*.

Table 2: Fixed effects model

FE MODEL				
Dependent variable: Ratio of foreign loans to total loans in household sector				
	Coefficient	Standard error	t-statistic	P>|t|
Exchange rate volatility	1.0386510	0.4987776	2.08	0.038
Interest rate differential	-0.0037370	0.0023775	-1.57	0.117
Ratio of FX deposits	3.1921290	0.1513686	21.09	0.000
Loan to deposit ratio	0.7014334	0.0195846	35.82	0.000
Banks' net foreign assets	0.7541625	0.0923666	8.16	0.000
Constant	-0.7225254	0.0292399	-24.71	0.000
R-squared	Within 0.8487	Between 0.9803	Overall	0.9223
Number of observations	393	Number of groups	3	
F(5,385) = 431.91		Prob > F = 0.000		

Source: Authors 'calculations.

Thirdly, we examine the data using the Random effects model (RE). The model estimates the same equation as the FE model with one month lagged variables.

$$fx\ loans_{it} = \text{\ss}_1 + \text{\ss}_2 ex.volat_{i(t-1)} + \text{\ss}_3\ irdiffer_{i(t-1)} + \text{\ss}_4 fx\ deposits_{i(t-1)} \quad (5)$$
$$+ \text{\ss}_5\ loan\ to\ dep_{i(t-1)} + \text{\ss}_6 bank\ assets_{\ i(t-1)} + c_i + \mu_{it}$$

The explanation of the equation is same as in the previous case. Only difference is that unobservable term, represented fixed effects in the previous model, stays for random effects in this model.

Although, we expect that the FE model is the most appropriate for our data sample, we estimate our panel also by using the RE model. One of the motivations to

use the RE model can be regional differences of individual countries, which can have a significant impact on the dependent variable.[69] The explanation of coefficients in the RE model is trickier than for two previous analyses. The random effect coefficients include both within and between country effects.

The results are similar to OLS regression; again two variables are insignificant, exchange rate volatility and interest rate differential. The coefficients and their significance are depicted in the *Table 3* below.

Table 3: Random effects model

	RE MODEL Dependent variable: Ratio of foreign loans to total loans in household sector			
	Coefficient	Standard error	z-statistic	P>|z|
Exchange rate volatility	0.0031932	0.4684441	0.01	0.995
Interest rate differential	0.0015637	0.0020003	0.78	0.434
Ratio of FX deposits	3.177537	0.1051274	30.23	0.000
Loan to deposit ratio	0.7085157	0.0173798	40.77	0.000
Banks' net foreign assets	0.7488827	0.0704233	10.63	0.000
Constant	-0.7191856	0.293747	-24.48	0.000
R-squared	Within 0.8462	Between 0.9887		Overall 0.9256
Number of observations	393	Number of groups	3	
Wald chi^2 (5) = 4813.38		Prob > chi^2 = 0.000		

Source: Authors 'calculations.

5.4.1   Model Assumptions and Additional Tests

Firstly, we run two specification tests to find which of the used models is the most suitable for our data collection. Secondly, we examine additional tests and test the basic model assumptions. In the case of violations, we correct the model to be in line with the model assumptions.

The first specification test used is the Hausman test. It is often used as an indicator determining which of the FE and RE models better fit the data. We test

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[69] We assume insignificant regional differences because we work with narrow panel of only three regionally proximate countries.

the null hypothesis that the difference in coefficients is not systematic, in such cases the random effects model is more appropriate. We reject the null hypothesis according to the probability of Chi^2 lower than 0.05. That confirms our expectation that the fixed effects model fits our data better than the random effects model. The results of Hausman test can be seen in the *Appendix* in *Table 10*.

The second test is Breusch-Pagan Lagrange Multiplier (B-P/LM) test for random effects. It helps us to find out whether the Pooled OLS regression or the RE model is more suitable for our dataset. We test the null hypothesis that variances across countries are zero, which means there is no panel effect. According to the probability of Chi^2, we reject the null hypothesis. We can conclude it that the OLS model is not suitable for our data, and thus according to the B-P/LM test we have significant difference among countries. The results of the test can be seen in the *Appendix* in *Table 11*.

According to the two previous described specification tests, we can summarize that the FE model is the most suitable for our dataset. We run all additional tests only for the FE model. We test the basic assumptions of the model and also the possible violations or data issues. All results of the tests can be seen in the *Appendix* in *Tables 12, 13* and *14*.

We look at the problem of cross-sectional dependence.[70] We use the Breusch-Pagan/LM test of independence to test the null hypothesis that the residuals across countries are not correlated. According to the probability of Chi^2, we cannot reject the null hypothesis. That means we have to deal with the correlated residuals in cross sectional data.

The next test that we run for the FE model is the Wald test, testing the heteroskedasticity in residuals. The stated null hypothesis is homoskedastic residuals that mean residuals with constant variance. We reject the null hypothesis according to a low value of probability of Chi^2. To conclude the rejection result, there is a problem of heteroskedasticity in our dataset.

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[70] According to Baltagi (2005), the cross sectional dependence is mostly a problem of long period dataset (20-30 years), macro panel data. We can rarely find cross sectional dependence in short time dataset, micro panel data. However, it is hard to decide if our dataset is small enough to exclude the problem of cross sectional dependence.

Both above stated issues, the problem of cross sectional dependence and the problem of heteroskedasticity in residuals, are solved by using the robust test.[71] We apply the robustness standard error correction for the FE model. To summarize the most important results, more than 20.4 % of variances are due to differences across panels. There exist positive correlation between error terms and independent variables (equal to 0.1458). The results corrected by robustness test can be seen in the following *Table 4*. All variables excluding the interest rate differential are now significant and positively correlated to the ratio of foreign currency loans. According to the t-statistic, the most relevant explanatory variables are the loan to deposit ratio and the share of foreign currency deposits on the total deposits of households.

The last test we run on the FE model is a test for serial correlations in the idiosyncratic errors. The contamination of the model by serial correlations in error term can make the standard error of coefficients smaller and R-squared higher than they actually are. We use the Wooldridge test for autocorrelation with a null hypothesis that there are no serial residuals. According to the probability of the F statistic, we cannot reject the null hypothesis and our dataset does not have a first-order autocorrelation.

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[71] To get rid of the cross sectional dependence, we can run regression with Driscoll-Kraay standard errors. For simplification we run only one additional regression with robust standard errors to eliminate both effects.

FE MODEL WITH ROBUST STANDARD ERRORS			
Dependent variable: Ratio of foreign loans to total loans in household sector			
	Coefficient	Standard error	t-statistic	P>|t|
Exchange rate volatility	1.038650	0.9307062	1.12	0.381
Interest rate differential	-0.037370	0.0070664	-0.53	0.650
Ratio of FX deposits	3.1921290	0.3276165	9.74	0.010
Loan to deposit ratio	0.7014334	0.0615710	11.39	0.008
Banks' net foreign assets	0.7541625	0.1159310	6.51	0.023
Constant	-0.7225254	0.0404632	-17.86	0.003
R-squared	Within 0.8487	Between 0.9803	Overall	0.9223
Number of observations	393	Number of groups	3

Source: Authors 'calculations.

5.4.2 Significance of Explanatory Variables and Their Final Impact

In this part, we look separately at each independent variable used in our models with one month lagged variables, and describe their economic and econometric impact on our dependent variable. Moreover, we compare our findings from the fixed effect model with robust standard errors with the results obtained by Rosenberg and Tirpák (2009). In the case of discrepancies, we discuss the sources of such differences. The complete results of all used models with one month lagged variables can be seen in the following *Table 5*.

Table 5: Complete estimation results

Dependent variable: Ratio of foreign loans to total loans in household sector				
	Pooled OLS	FE model	RE model	FE with robust SE
Exchange rate volatility	0.1042077 (0.485348)	1.03865[**] (0.4987776)	0.0031932 (0.4684441)	1.03865 (0.9307062)
Interest rate differential	0.0015329 (0.0020016)	-0.003737 (0.0023775)	0.0015637 (0.0020003)	-0.037370 (0.0070664)
Ratio of FX deposits	3.1950950[***] (0.1074382)	3.1921290[***] (0.1513686)	3.177537[***] (0.1051274)	3.192129[***] (0.3276165)
Loan to deposit ratio	0.6971660[***] (0.0224343)	0.7014334[***] (0.0195846)	0.7085157[***] (0.0173798)	0.7014334[***] (0.061571)
Banks' net foreign assets	0.7382404[***] (0.0716989)	0.7541625[***] (0.0923666)	0.7488827[***] (0.0704233)	0.7541625[***] (0.115931)
EU membership	0.0096004 (0.0119912)			
R-squared	0.9257	0.9223	0.9256	0.9223
Number of obser.	393	393	393	393

*Note: *,**;*** refers to significance at 10%, 5% and 1% level respectively. All models include the intercept and the standard errors are written in brackets. For the last model FE with robust errors, the robust standard errors are written in brackets.*

Source: Authors' calculations.

The impact of *exchange rate volatility* can be ambiguous and differs according to the expected repayment stability of householders or their credit default risk. We mostly obtain the result that variable *exchange rate volatility* has a positive impact on the amount of foreign currency borrowing in the household sector. It does not hold for models with more lagged variables. Unfortunately, the variable is in the majority of cases statistically insignificant, only for the FE model is significant at 5 % significance level. The increasing number of foreign loans with increasing exchange rate volatility can be caused by the composition of data sample. In our analysis, we use two out of three countries in which we can expect stable repayment of foreign loans. This fact can implicate the positive relationship of those variables.

In contradiction, according to the Pooled OLS regression with two or more month lagged variables, the variable has a negative impact on the ratio of FX loans. Only for model with 12-month lagged variable is the exchange rate volatility significant at 5% significance level. The findings are similar to those of Rosenberg and Tirpák (2009), and the explanation is below.

Authors Rosenberg and Tirpák (2009) obtained a negative impact of this variable. Their argumentation and explanation of the negative effect of exchange rate volatility on the amount of foreign denominated loans is based on the effects of joining the EU. It can also be given by the time period. The authors examined only the pre-crisis data in comparison to our study that includes pre-crisis, crisis and post-crisis data. An explanation of the time difference can be that, the time period before the crisis was described as a period of increasing confidence of economic agents in exchange rate stability, and thus market agents were more willing to bear the currency risk during borrowing in foreign currency. The negative impact of exchange rate volatility was found also in the works of Barajas and Morales (2003) and Luca and Petrova (2008).

Variable *interest rate differential*, which is used as an explanatory variable by many authors, is not significant for our data sample. We expect a positive impact on the number of foreign loans, which is gained in the Pooled OLS model and RE model, but in the FE models we acquire a negative sign for this variable. The insignificant impact on foreign loans can be caused by flexible currency regimes[72] in all examined countries and can be also influenced by other expectations, such as exchange rate movements or inflation differential.

A positive sign of the *share of foreign deposits* on the total deposits in the household sector confirms our assumption. The explanation can be that banks with high amount of foreign deposits are afraid of currency risks, and thus are highly motivated to shift the currency risk to borrowers by offering cheaper foreign currency loans. The explanation from another perspective can be that households prefer foreign currency saving given by the low monetary credibility, and it increases the amount of foreign deposits. The variable is highly significant at 1 % significance level for all used models and the result is similar to study written by Rosenberg and Tirpák (2009).

The next variable *loan to deposit ratio* is highly significant at 1 % significance level and has a positive effect on the number of foreign currency loans in all models.

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[72] In comparison to countries with pegged currency regimes (or currency board regimes), in countries with flexible currency regime much larger interest rate differential is necessary to affect the foreign currency loans. Borrowers in pegged currency countries are more willing to take foreign currency loans because of the possible lower exchange rate risk.

Generally, we assume that with an increasing number of loans of householders also some portion of them is denominated in foreign currency. That means with increasing number of total loans, the foreign currency loans increases.

The resulted impact of the *banks' net foreign asset* we do not expected. We obtain a positive and highly significant[73] impact on the share of foreign currency loans. It violates our assumptions and also contradicts results of Rosenberg and Tirpák (2009). From the definition, the variable explains the indebtedness of an individual country, and thus negatively influences the number of foreign currency denominated loans. In our case, we assume that increasing number of net foreign assets motivates the banks and other institutions for higher supply of foreign currency loans. However, according to the basic correlation relationship, the variable is negatively correlated with the dependent variable. That implicates that the relationship with the dependent variable is not stable. The correlation matrix can be seen in the *Appendix* in *Table 16*.

As we expect the dummy variable *EU membership* has a positive effect on the number of foreign currency loans in the household sector. The coefficient and significance are tested only by the Pooled OLS regressions because we cannot include the time invariant dummy variable into the models with unobservable effects. However, the variable is statistically insignificant in most of the cases. The *EU membership* is significant at 5 % significance level only for the OLS model with 12-month lagged variables. The positive effect is same as was gained by Rosenberg and Tirpák (2009). To summarize this effect, the householders borrow more in foreign currency with joining the EU.

In conclusion, the dollarization of loans in the household sector can be primarily explained by three explanatory variables: ration of FX deposits, banks' net foreign assets and loan to deposit ratio. Other tested variables are not statistically significant for various specifications of our model.

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[73] Variable is significant at 1 % significance level for all models.

6. Conclusion

In this thesis, we looked at the development of foreign currency loans in the household sector in three Central European countries. We analyzed the historical evolution and changes in the official and unofficial dollarization process and looked deeper on the situation in the individual countries. We based our empirical study on the previous literature studying dollarization of loans and deposits, and we focused only on the unofficial dollarization of loans. The study written by Rosenberg and Tirpák (2009) served as the baseline paper that was updated.

The rapid credit growth in private sector was visible in all examined countries during the 1990s. The share of foreign currency loans was not significant in the Czech Republic. Throughout the examined period it was ranging from a maximum 1.5 % to a minimum 0.1 % of total loans. The case for other examined countries was rather different. In Hungary, more than 60 % of credit growth was caused by a foreign currency denomination. The share of foreign loans reached a peak of 70 % of total value of loans in 2009. Poland represented a mid case from previous two. The share of foreign loans was fluctuating between 20 % and 40 % of total loans in the household sector. The maximum of 43 % was reached in 2009.

For the empirical analysis, we collected monthly data spanning for eleven years and constructed a strongly balanced panel dataset for three Central European countries, the Czech Republic, Hungary and Poland. The empirical analysis investigated the determinants of the ratio of foreign currency loans to total loans in the household sector.

We chose six independent variables that we assumed to be significant determinants of the foreign currency loans share in the household sector. The selection process of the most important variables was mostly based on previous Meta analysis. Unfortunately, we were limited by data availability. Finally, we examined effects and significances of the following variables: exchange rate volatility, interest rate differential, share of foreign currency deposits, banks' net foreign assets, loan to deposit ratio and dummy variable EU membership.

We estimated basic model by three different methods. Firstly, we ran different modifications of Pooled OLS regression (with one-month, two-month and twelve-month lagged variables) and also OLS with country dummy variables. Secondly, we ran models with unobservable effects: fixed effects and random effects models, both with one-month lagged variables.

We ran two specification tests to distinguish, which of the regression method is the most appropriate for our panel data. According to the Hausman specification test and Breuch-Pagan Lagrange Multiplier test for random effects, we arrived to the conclusion that the fixed effects model is the most suitable for our data sample.

We tested basic model assumptions and looked for data issues. According to the Breuch-Pagan Lagrange Multiplier test of independence of residuals, Wald test and Wooldridge test, we found out that we had to deal with heteroskedasticity and the problem of cross sectional dependencies. Both complications were corrected using robust standard errors.

We tested three basic hypotheses using different adjustment of three regression methods. According to the fixed effect model with robust standard errors, we rejected the first hypothesis that a low interest rate influences the home currency borrowing. The resulting sign of interest rate differential in our study was negative and insignificant, implying that it is hard to speculate about the correctness of this hypothesis for our data sample.

We could not reject the second hypothesis that the exchange rate volatility influences the willingness to take foreign currency loans, based on the results of the fixed effect model with robust standard errors. Also in this case, we can speculate about the correctness of our conclusion because of the insignificance of the variable. Moreover, as said before, the effect of the exchange rate volatility was not clear.

For the comparison, based on the Pooled OLS regression with twelve-month lagged variables, we rejected the second hypothesis. In this regression, the coefficient of the variable is negative and significant. To summarize the ambiguous impact of the exchange rate volatility on the share of foreign currency loans, we finally decided to reject the second hypothesis as well.

The third hypothesis was tested using various modifications of the Pooled OLS regression. Based on the positive sign of the dummy variable EU membership, we could not reject the third hypothesis that joining the EU increases the availability of foreign borrowing, which influences the changes in the composition of private credit. Again, we had problem with insignificance of the examined variable. The most suitable model was OLS with twelve-month lagged variables, where the variable EU membership was significant.

To conclude our findings, the increasing dollarization of credits can be primarily explained by the level of dollarization of deposits, banks' net foreign assets and loan to deposit ratio. Other variables such as EU membership, exchange rate volatility or interest rate differential do not have a stable and significant effect on the foreign currency liabilities.

Within the scope of this thesis, we could not have covered all the important determinants of foreign currency loans in the household sector. The environment of household sector is different than that of private or public sector and hence, some data are scarce. Thus, we were limited by a short term horizon of the period examined, given by structural changes in banking sectors in all the examined countries.

The thesis can be extended by an inclusion of more countries in a panel dataset or by adding additional independent variables into the models. For example, we can include variables containing information about financial situation or behaviour of householders. Moreover, the loans in household sector can be examined separately by different currencies of denomination (to look individually at impact of euro, Swiss franc or dollar denominated loans).

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Appendix

Table 6: OLS regression with 2-month lagged variables

	POOLED OLS (2-month lagged variables) Dependent variable: Ratio of foreign loans to total loans in household sector			
	Coefficient	Standard error	t-statistic	P>|t|
Exchange rate volatility	-0.0625016	0.5023634	-0.12	0.901
Interest rate differential	0.001865	0.002093	0.76	0.449
Ratio of FX deposits	3.15971	0.1110738	28.45	0.000
Loan to deposit ratio	0.6867808	0.0233167	29.45	0.000
Banks' net foreign assets	0.6895194	0.0753946	9.15	0.000
EU membership	0.0127717	0.0123722	1.03	0.303
Constant	-0.6995314	0.0307309	-22.76	0.000
R-squared	0.9215	Adjusted R-squared		0.9203
Number of observations	393			

Source: Authors 'calculations.

Regression estimated the following equation:

$$fx\ loans_{it} = ß_1 + ß_2 ex.volat_{i(t-2)} + ß_3\ irdiffer_{i(t-2)} + ß_4 fx\ deposits_{i(t-2)} \quad (6)$$
$$+ ß_5\ loan\ to\ dep_{i(t-2)} + ß_6 bank\ assets_{\ i(t-2)} + ß_7 EU\ memb_{\ it}$$
$$+ v_{it}$$

Table 7: OLS regression with 3-month lagged variables

	Coefficient	Standard error	t-statistic	P>|t|
POOLED OLS (3-month lagged variables)				
Dependent variable: Ratio of foreign loans to total loans in household sector				
Exchange rate volatility	-0.2111411	0.519563	-0.41	0.685
Interest rate differential	0.0016717	0.0021913	0.76	0.446
Ratio of FX deposits	3.122596	0.1148096	27.20	0.000
Loan to deposit ratio	0.6756478	0.0242471	27.87	0.000
Banks' net foreign assets	0.6400768	0.0793628	8.07	0.000
EU membership	0.0162969	0.0127921	1.27	0.203
Constant	-0.6781285	0.0321044	-21.12	0.000
R-squared	0.09172	Adjusted R-squared:		0.9159
Number of observations	393			

Source: Authors 'calculations.

Regression estimated the following equation:

$$fx\ loans_{it} = \beta_1 + \beta_2 ex.volat_{i(t-3)} + \beta_3\ irdiffer_{i(t-3)} + \beta_4 fx\ deposits_{i(t-3)} \qquad (7)$$
$$+ \beta_5\ bank\ assets_{i(t-3)} + \beta_6\ loan\ to\ dep_{i(t-3)} + \beta_7 EU\ memb_{it}$$
$$+ v_{it}$$

POOLED OLS (12-month lagged variables) Dependent variable: Ratio of foreign loans to total loans in household sector				
	Coefficient	Standard error	t-statistic	P>|t|
Exchange rate volatility	-1.325574	0.6402145	-2.07	0.039
Interest rate differential	0.00551	0.0029872	1.84	0.066
Ratio of FX deposits	2.617968	0.1449427	18.06	0.000
Loan to deposit ratio	0.5827517	0.0304652	19.13	0.000
Banks' net foreign assets	0.2244523	0.1093114	2.05	0.041
EU membership	0.0162969	0.0127921	1.27	0.203
Constant	-0.4793772	0.0436117	-10.99	0.000
R-squared	0.8789	Adjusted R-squared:		0.8768
Number of observations	393			

Source: Authors 'calculations.

Regression estimated the following equation:

$$fx\ loans_{it} = \beta_1 + \beta_2 ex.volat_{i(t-12)} + \beta_3\ irdiffer_{i(t-12)} \tag{8}$$
$$+ \beta_4 fx\ deposits_{i(t-12)} + \beta_5\ bank\ assets_{i(t-12)}$$
$$+ \beta_6\ loan\ to\ dep_{i(t-12)} + \beta_7 EU\ memb_{it} + v_{it}$$

Table 9: OLS regression with country dummies

	Coefficient	Standard error	t-statistic	P>|t|
POOLED OLS with country dummies(1-month lagged variables) Dependent variable: Ratio of foreign loans to total loans in household sector				
Exchange rate volatility	1.030877	0.5054439	2.04	0.042
Interest rate differential	-0.037603	0.002392	-1.57	0.117
Ratio of FX deposits	3.188532	0.1557832	20.47	0.000
Loan to deposit ratio	0.7026462	0.0230635	30.47	0.000
Banks' net foreign assets	0.7563034	0.094936	7.97	0.000
EU membership	-0.0011568	0.0115793	-0.10	0.920
Country dummies				
HU	0.0375484	0.363266	1.03	0.302
PL	-0.0221808	0.0264236	-0.84	0.402
Constant	-0.7273317	0.030178	-24.10	0.000
R-squared	0.9336	Adjusted R-squared:		0.9322
Number of observations	393			

Source: Authors 'calculations.

Regression estimated the following equation:

$$fx\ loans_{it} = \beta_1 + \beta_2 ex.volat_{i(t-1)} + \beta_3\ irdiffer_{i(t-1)} + \beta_4 fx\ deposits_{i(t-1)} \quad (9)$$
$$+ \beta_5\ bank\ assets_{i(t-1)} + \beta_6\ loan\ to\ dep_{i(t-1)} + \beta_7 EU\ memb_{it}$$
$$+ \beta_8 dummyHU + \beta_9 dummyPL + v_{it}$$

```
. hausman FE RE

                  ——— Coefficients ———
                   (b)          (B)          (b-B)       sqrt(diag(V_b-V_B))
                   FE           RE           Difference         S.E.

L.exratevo~y      1.03865      .0031932     1.035456           .1712867
L.intrated~r     -.003737      .0015637    -.0053007           .0012851
L.fxdeposi~t      3.192129     3.177537      .014592           .1089068
L.loantode~o      .7014334     .7085157    -.0070823           .0090278
L.fxassets~p      .7541625     .7488827     .0052798           .0597675

                            b = consistent under Ho and Ha; obtained from xtreg
                 B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

              chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                      =       102.92
           Prob>chi2 =        0.0000
           (V_b-V_B is not positive definite)
```

Source: Authors 'calculations.

```
Breusch and Pagan Lagrangian multiplier test for random effects

        fxloansfxloanstotalloans[country,t] = Xb + u[country] + e[country,t]

        Estimated results:
                              Var        sd = sqrt(Var)

              fxloans~s    .0525324         .2291994
                     e     .003553          .059607
                     u        0                0

    Test:    Var(u) = 0
                           chi2(1) =     168.08
                        Prob > chi2 =      0.0000
```

Source: Authors 'calculations.

```
Correlation matrix of residuals:

           __e1      __e2      __e3
__e1    1.0000
__e2   -0.4512    1.0000
__e3   -0.0001   -0.4137    1.0000

Breusch-Pagan LM test of independence: chi2(3) =      49.079, Pr = 0.0000
Based on 130 complete observations
```

Source: Authors 'calculations.

Table 13: Wald test

```
Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (3)  =        27.99
Prob>chi2 =        0.0000
```

Source: Authors 'calculations.

Table 14: Serial correlation

```
Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F( 1,       2) =       11.782
            Prob > F =        0.0754
```

Source: Authors 'calculations.

Table 15: Summary statistics

SUMMARY STATISTICS					
Variable	Obs	Mean	Stand.Deviat	Minimum	Maximum
Fx loans	396	0.2394174	0.2289239	0.0008	0.6973
Ex. Volatility	396	0.0183136	0.0083534	0.0070	0.0472
Ir. Differential	396	2.4911620	2.7595630	-1.870	10.610
Fx deposits	396	0.1077485	0.0478449	0.0332	0.2019
Bank assets	396	0.1651366	0.1030167	-0.0036	0.3525
Loan to depos	396	0.6924765	0.3053926	0.1525	1.2094
EU member	396	0.7878788	0.4093274	0	1

Source: Authors 'calculations.

Table 16: Correlation matrix

CORRELATION MATRIX							
	Fx loans	Ex.Volat	Ir.Differ	Fx depos	Bankasset	Loantodep	EU memb
Fx loans	1						
Ex.Volat	0.4958	1					
Ir.Differ	0.4549	0.4209	1				
Fx deposit	0.5689	0.2698	0.6893	1			
Bank assets	-0.6940	-0.4105	-0.7193	-0.6543	1		
Loan to dep	0.8210	0.4675	0.2382	0.1216	-0.6237	1	
EU memb	0.3259	0.0383	-0.2214	-0.3372	-0.0631	0.6010	1

Source: Authors 'calculations.