Charles University in Prague

Faculty of Social Sciences

Institute of Economic Studies

MASTER THESIS

Family House Market in Europe during the Recent Crisis

Author: **Bc. Adam Béreš**

Supervisor: **PhDr. Pavel Vacek Ph.D.**

Academic Year: **2014/2015**

Declaration of Authorship

1. Hereby I declare that I have compiled this master thesis independently, using only the listed literature and sources.

2. I declare that the thesis has not been used for obtaining another title.

3. I agree on making this thesis accessible for study and research purposes.

Prague, January 5, 2015

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Signature

Acknowledgments

I wish to express my gratitude towards my supervisor PhDr. Pavel Vacek, Ph.D. for his positive approach and helpful insights throughout the process of writing this thesis. I also wish to thank my parents for their unquestionable support.

Abstract

This thesis analyzes family house market in seven European countries: the Czech Republic, Austria, Belgium, Denmark, Germany, Finland and Slovakia, together with two cities: Bratislava and Prague. The main goal is to compare family house price determinants in transitional countries with developed ones and capture possible effects of the recent economic crisis. In the first part, panel data models are employed to determine price determinants and any housing bubbles. Real GDP growth rate as a proxy for households' income, together with housing loan interest rate proved to be significant price determinant for both groups. Housing market in transitional countries is influenced only by demand side factors like unemployment. Housing market in developed countries is led by demand and supply side factors represented by labor cost index. In the second part of the analysis, VAR model is employed, for each country separately, to detect how price determinants contribute to the variance of real house prices. The results vary between the countries. The housing price persistence is common for all countries except for Germany and Denmark.

Abstrakt

Diplomová práca analyzuje trh rodinných domov v siedmich Európskych krajinách: Českej Republike, Rakúsku, Dánsku, Belgicku, Nemencku, Fínsku a Slovensku a v dvoch mestách: Bratislave a Prahe. Hlavným cieľom je porovnanie determinantov cien na trhu rodinných domov medzi tranzitívnymi a vyspelými krajinami a zachytenie možných efektov súčasnej hospodárskej krízy. V prvej časti je aplikovaný model panelových dát k určeniu cenových determinatov a možných cenových bublín na trhu s rodinnými domami. Reálny rast HDP, slúžiaci ako proxy pre príjem domácností, spoločne s úrokovou mierou sa ukázal byť signifikantný pre obe skupiny krajín. Trh nehnuteľností v tranzitívnych krajinách je ovplyvnený len dopytovými faktormi trhu ako nezamestnanost. Trh nehnuteľností medzi rozvinutými krajinami je ovplyvnený dopytovými, ale aj ponukovými faktormi ako index cien práce. V druhej časti práce je aplikovaný VAR model, individuálne pre každú krajinu, k zisteniu ako prispievajú cenové determinanty ku kolísaniu reálnych cien domov. Výsledky medzi krajinami sú rozdielne. Perzistencia cien domov je bežná u väčšiny krajín s výnimkou Nemecka a Dánska.

Klasifikace JEL	C22, G21, R21, R31
Klúčové slová	trh rodinných domov, determinanty cien nehnutelností, bublina na trhu nehnutelností, financná kríza, VAR
E-mail autora	adamko.beres@gmail.com
E-mail vedúceho práce	vacek@fsv.cuni.cz

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Acronyms

BIS   Bank for International Settlement
CEE   Central and Eastern Europe
CNB   Czech National Bank
CPI   Consumer Price Index
CZSO   Czech Statistical Office
ECB   European Central Bank
FE   Fixed Effects model
GDP   Gross Domestic Product
IMF   International Monetary Fund
IRF   Impulse Response Function
OECD   Organization for Economic Cooperation and Development
POLS   Pooled Ordinary Least Square model
RPPI   Residential Property Price Index
NBS   National Bank of Slovakia
VAR   Vector Autoregression model

Master Thesis Proposal

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

Author:	**Bc. Adam Beres**	Supervisor:	PhDr. Pavel Vacek Ph.D.
E-mail:	adamko.beres@gmail.com	E-mail:	vacek@fsv.cuni.cz
Phone:	721 484 941	Phone:	733 644 300
Specialization:	*Economics and Finance*	Defense Planned:	January 2015

Notes: The proposal should be 2-3 pages long. Save it as "yoursurname_proposal.doc" and send it to mejstrik@fsv.cuni.cz, tomas.havranek@ies-prague.org, and zuzana.irsova@ies-prague.org. Subject of the e-mail must be: "JEM001 Proposal (Yoursurname)".

Proposed Topic:

Family House Market in Europe during Recent Crisis

Motivation:

Real estate market is significant benchmark for economic conditions. Mostly, in less developed economies, this is the only asset in which people invest during their lifetime. Potential bubble burst in such condition can easily influence the rest of the economy, thus this bring interesting questions for economists to answer them.

The mortgage bubble which has evolved in the United States at the end of 2007 has transformed into the financial crisis which has lately flooded Europe unprepared. The real estate market plays a significant benchmark for such turbulent times. Low interest rates encourage investors to buy new assets which enlarge their prices beyond their real value until the bubble burst. Similar situation has happened in Europe, but with different results on real estate market.

My thesis will focus on the recent development of housing prices in several European countries. I will try to observe the impact of crisis from late 2007, when and how this has influenced the price determinants in several countries. i will perform this analysis on the two levels. Firstly, I will analyze only capital cities, where I expect sharper decline of housing prices, because of burst of the bubble. I will expect the similar patterns for capital cities in all countries - these are homogenous regions with highly developed economies and strong purchasing power. Secondly, I will perform the same analysis for the rest of the countries. I expect the different results in the structure of price determinants and impact on crisis between former transitional countries and developed economies in the western Europe.

Two interesting studies about real estate market have been conducted (Hlaváček, Komárek, 2009 and Égert, Mihajlek, 2007). First study applies similar methodology but its main focus is only for Czech Republic (and its regions). The other study tries to compare several eastern European countries with the (developed) OECD countries using different methodology (because of lack of sufficient data). I will try to combine the objects of this studies and present the differences (if any) of price determinants in developed European countries and transformation countries. The second study has been written before the evolution of the crisis, thus I expect that my results will be an extension in this research field.

Hypotheses:

1. Hypothesis #1: Price determinants of single family houses on national level are similar differ between former transitional counties and developed countries.
2. Hypothesis #2: Price determinants of single family houses are the same for all capital cities across Europe.
3. Hypothesis #3: Impact of crisis influences the weights of price determinants.

Methodology:

First step of this study is analysis of panel data (two dimensional: time-series and cross sectional) to determine which factors have the highest impact on single family house prices. The dependent variable is housing price index (approximation of housing price) I expect that as in similar studies the market is driven mostly by demand factors such as real income, unemployment rate or demographic factors. The reason for applying panel data is to make the results easily comparable to the similar studies. I will perform fixed effects model, this model is more appropriate if the focus is on a specific set of N objects which are not drawn randomly from large sample (population). The main focus of this study is to estimate price determinants of relatively small and selectively chosen group of countries/cities (N). There is also a method - Hausman test to show which panel model is most suitable to analyze the data. Similar model was used by Hlaváček, Komárek (2009) for analyzing price determinants of Czech regions.

Main part of this thesis is connected to time series analysis. Panel data cannot sufficiently explain all the relations among different variables which this study is supposed to do. I will apply vector auto-regression model (VAR) to describe dynamic interrelationship between stationary variables. Time series analysis is more demanding for the data, unfortunately this was the reason why certain countries cannot be analyzed and thus the results will be limited. I have decided to analyze the countries with at least 12 years of historical statistics of quarterly housing prices - 48 observations. The crucial part of VAR analysis contains impulse response function and variance decomposition. This is helpful to measure the effects on change of a particular parameter. Similar approach was used by Tsatsaronis, Zhu, 2004.

Impulse response function (IRF) shows the effect of (unexpected) shocks on the adjustment path of the variable. The advantage of using IRF is how they show the size of the shock (innovation) and also the rate at which such shock disappears, allowing for interdependencies. In this research topic, IRFs for individual countries show how the price of single family house responses to the shock of other variable (i.e. monetary policy - change in interest rates or drop of household income). Variance decomposition carries information about importance of a shock/innovation of variable to the other variables and also to itself in the VAR model. Those estimations prove to be valuable only in the short-run.

Expected Contribution:

I will perform an analysis how did the recent financial crises in Europe influence the price determinants of residential properties. In contrast to previous studies, I will focus on certain branch of real estate market - single family house market. I will take into account the differences between capital cities and rest of the country. The analyzed countries are divided into two groups: transitional countries and developed countries. I expect the difference in (weight of) price determinants of single family house between these two groups on national level, but I expect the same results for the residential market in all capital cities as the leading regions in all analyzed countries. The representation of the crisis (bubble) in the data makes this study more relevant, similar methodology applied makes it still comparable to the previous studies.

Outline:

1. Introduction: motivation for realization of research topic.
2. Studies of housing price determinants: I will briefly describe the economic theory of determinants which influence the real estate markets. I will explain the theories behind asset bubbles.
3. Previous empirical research: I will present similar research topic and briefly discuss their methodology and results.
4. Data description: I will explain how the data were collected from several sources and their transformation to fit this purpose.
5. Methodology: I will explain my empirical models. First model will work with panel date where fixed effects model will be applied. Second model will analyze time series data. I will apply VAR model and perform variance decomposition and impulse response function analysis.
6. Discussion: I will discuss my results and conclude the thesis.

Core Bibliography:

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Other missing data will be collected from central bank or national statistic offices.

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Author   **Supervisor**

Introduction

"The idea that we're going to see a collapse in the housing market seems to me improbable."

John Snow, Treasury Secretary *(2005)*

Real estate market stands as important benchmark for economic conditions. The relationship between house prices and overall economy has became serious topic since the end of dot-com bubble in 2000[1] and even more during recent financial crisis (followed by the subprime mortgage crisis). Easy explanation of this relationship is strong procyclical behavior. An analysis, if the current (past) prices follow the markets fundamentals, is quite appropriate in recent turbulent environment. Despite similar asset bubbles in history, still it is an uneasy task to observe them before they burst. Recent housing bubble in the United States has attracted many economists to further study this area. On the other hand, only few of them have focused their effort on cross country analysis with comparative approach. (especially, to analyze and compare housing markets between the developed and transitional countries). The most similar approach, in comparison to this study, was applied by Egert and Mihaljek (2008), where several OECD countries were analyzed and compared with each other. Unfortunately, this study can not explore the changes in house price determinants after the crisis.

Recent crisis enhanced interest in determinants of housing market, but there are other reasons why this topic is important for economists. Real estate market, directly or indirectly, creates non-negligible part of the economy, employs many people and influences financial market performance. Housing market accounts for the highest share of households' expenditures. Variations in house prices influence spending

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[1]Period is known for strong growth of house prices in the United States.

decisions of home owners. Through wealth effect, net wealth of households changes the same way as the change in the house value. The wealth effect influences not just households' consumption but further the ability to borrow or invest (Hirata et al. 2012, p.2).

This study contributes to the large body of research papers focusing on house price determinants, but previous literature is extended by two dimensions. Firstly, data set is based only on single family house prices (other studies do not differentiate between different types of dwellings). Secondly, the analysis is extended to cover price determinants not only at national level but also for capital cities of transitional countries (Prague and Bratislava). The non-negligible addition is the usage of the latest data with large time horizon after the peak of housing bubble in the United States.

Using econometric methods, this thesis tries to provide the answer for the following hypothesis. Price determinants of single family house prices, on national level, differ between transitional and developed countries. Next hypothesis expects similar price determinants for Prague, Bratislava and developed countries. This assumption is based on facts that both cities belong to the top 10 most developed regions in the European Union. Selected European countries did not experience recently any strong run-up of house prices, but possible bubbles are visible on fitted residuals plot. Last hypothesis is concerned with weights of house price determinant, respectively how strongly does any variable influence house prices in every country.

First step of this study is the analysis of panel data to determine which factors have the highest impact on the single family house prices. The dependent variable is family house price index (house price approximation). The reason for applying panel data is to make results easily comparable to the previous studies. Hlavacek and Komarek (2009) and Posedel and Vizek (2009) conclude, housing market is driven mainly by demand side factors, such as real income, unemployment rate or demographic factors.

Main part of this thesis is connected to time series analysis. Vector auto-regression model is applied, individually for each country, to describe dynamic interrelationship between stationary variables. Time series analysis requires longer time horizon, unfortunately, this is the reason why certain countries cannot be analyzed, and this obstacle limits the final results. The selection of countries was based on availability of sufficiently long time span of house price indices. The analyzed countries contain at least 12 years of historical quarterly housing prices - 48 observations. The crucial part of vector auto-regressive output contains impulse response functions analysis

and variance decomposition. This is helpful to measure the effects on change of a particular variable to other parameter. Similar approach was used by Tsatsaronis and Zhu (2004), but this study does not analyze transitional countries or influenced of the recent crisis.

The thesis is organized as follows: Chapter 1 and 2 briefly summarize the recent literature about the main issues of this thesis, such as housing bubbles and house price determinants. Firstly, economic theories connected to housing market are described, and next chapter summarizes empirical studies with focus on housing market in Europe. Chapter 3 describes the macroeconomic development and compares the differences in housing market among selected countries. Chapter 4 describes the data set, and the issues of collection of house price indices. Chapter 5 introduces several models used in this thesis. First of all, there is a theoretical description of fixed effects model – used for panel data analysis and vector auto-regressive model – applied for time series analysis. Then, concrete model is described together with an explanation why certain variables are used. Rest of the chapter discuses the results of both models together with explained results of impulse response functions and variance decomposition. Last chapter simply concludes the thesis and compares the results with other papers.

Chapter 1

Theoretical Studies Overview

1.1. Housing Price Bubble Theories

Price bubble is a well known phenomenon in economics. Economic science studies how efficiently certain agents (individuals, households, firms or countries) allocate scarce resources. Price bubble is one of many possibilities how misallocation can appear. The 21st century remembers, at least, two major asset bubbles and both of them happened in the United States. The notoriously known dot-com bubble which occurred at the beginning of new millennium.[1] The second bubble, called the subprime[2] mortgage crisis, occurred in housing prices at the end of 2007. Both bubbles (and other bubbles too) share the extended period of overvaluation. The growth in asset prices is replaced with sharp fall in prices when the sentiment is gone. If the bubbles are really big, the consequences of such bubble burst can slow rest of the economy or spill over to other countries. Asset bubble can be easily explained as willingness to pay higher price for a certain asset. Fundamental value is lower than its pricetag because of optimistic expectations of even higher (selling) price in the future. At certain point in time, this definition does not hold anymore, and the bubble bursts. Fundamental value of an asset means expected value of all reasonably discounted cash-flows yielded from this asset over its existence. Asset bubble is characterized by four common features: *"1) they tend to coincide with technological or financial innovations; 2) they tend to coincide with frenzied trading between investors and often active trading of new investors; 3) they are vulnerable to increase asset supplies; and 4) they may burst without any warning sign." (Xiong 2013, p.2)*

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[1] NASDAQ-100 index peaked on March 2000.

[2] Subprime lending is term describing a process of lending to clients who may have serious difficulties to repay the loan back.

Big discussion takes place among economic historians about first documented asset bubble - tulip mania. It happened in the Netherlands in mid-16th century. The imported tulips became a desired good. This situation influenced the price of tulip-bulbs, and they price rose sharply. Some economic historians explain this process by technical (new gardening methods) and financial innovations (new call option like instrument). On the other side some economists like Garber (1990) argues that even high price of the tulip-bulbs did not exceed its fundamental value – no bubble happened, just the rise of demand. Particular demand was not matched with required supply, and the price rose as for any other commodity with such market conditions. Still, the reason for rapid decline of the prices (below its initial value) was not sufficiently explained. In the case of tulips, all the conditions for bubble classification were satisfied. First condition, technological progress and financial innovations, together with second condition, proactive new type of investors, were supported by historical sources. Citizen from all social classes started "to invest" into tulip industry. Possibly, without any knowledge about the process of growing tulips, anybody can easily trade the bulbs. Third condition, easy increase in supply, holds too, because for seamen it provided no difficulty to carry tulip-bulbs on their ships and so easily increased supply side. Suddenly, after three months, the tulip bubble burst without any warning sign (fourth condition). Thus, all conditions for asset bubble were satisfied, even in the case of such unusual commodity.

In general, two different theories explain housing bubbles. One of them is supply side theory. This means that market is filled by excess of financial capital (easily available money). Such market conditions are usually visible in rising asset prices. Sometimes, only certain group of assets are influenced, such as real estates. Banking retail segment can transform "cheap money" into accessible mortgages. Professional investors can transform the available funds into financial instruments derived from housing assets. It is a speculative motive which drives demand for new houses.

The period prior to the housing bubble in the United States was characterized by strong development of securitization.[3] This was the starting point for future housing bubble. Now, after the subprime crisis and burst of housing bubble, the economists discuss when the bubble actually started to rise. Data shows that at the end of year 2006, the prices stopped their rising path. Short review of timing of housing bubble is described by Levitin and Wachter (2012). Some economists say that the bubble began in year 1997. This is based on housing price index adjusted for inflation. The index

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[3]Securitization is a process used by banks for pooling various assets, such as mortgages, and transforming them into marketable securities. Massive development of this product has started since 2004.

rose upwards until 2007. After the subprime crisis, index felt to its 2000 values. This may imply fundamental growth in housing prices prior to dot-com bubble. Another group of economists say that bubble began just after the burst of previous dot-com bubble, and one of the main reasons was the lowering of interest rates by Fed (central banking system of the United States) in 2001. Low interest rates, at that time, meant cheaper loans. In the United States, loans take predominantly form of mortgages which are backed by the property. Thus, cheap credit was firstly visible in real estates, particularly in housing market. Other economists argue that the beginning of the housing bubble was in first quarter of 2004. This would imply shorter housing bubble. The period form 2001 until 2004 is described as boom of mortgage financing, but the bubble itself began when mortgages applying procedures were lowered and made easier for obtaining (in 2004) to gain similar earnings (for banks) as in previous period. Another explanation of the housing bubble are the federal state policies towards affordable homes for citizens. Mortgage institutions were encouraged (by lowering their possible risk) by special federal financial institutions[4] *"to facilitate credit access and homeownership among lower-income and minority households."* *(Levitin and Wachter 2012, p.1219)*

Second group of theories, described by Case and Shiller (2003), contains demand side theories – bubble was led by growing demand for houses. One theory from this group explains the bubble by irrational expectations of never decreasing house prices. The investors and households were willing to buy houses, because they believed that prices of their assets can not decrease.[5] This theory is usually challenged by missing explanation, where would potential investors obtain (additional) financial capital for their purchases. At some point before bubble burst, this may add fuel to the fire, but this was not a sufficient cause of recession in the largest economy.

During such serious bubble, as housing bubble which evolved into mortgage crises with worldwide impact, there is not just one single cause. All above explained reasons have higher or lower impact on final result, and it is probably impossible to find one unite theory to explain all the mistakes which were made in the past few years.

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[4]Government-sponsored enterprise housing goals.

[5]Among ordinary people, there is still a notion that house prices can not decrease. Perhaps, this idea is supported by misunderstanding of differences between real and nominal values and relative long time span between purchase and sale of a house.

1.2. Theories of Price Determinants

The most important sub-division of real estate market, for both policy makers and households, is residential or housing market. There are several reasons for this. The purchase of a house or a flat is the largest investment for every household during their existence. This implies, major financial risk the households are facing is the risk of price change on the housing market (Glindro et al. (2011)). The purchase of a property is usually financed through banks via mortgages. The property is used as collateral for such loan. This explains why credit cycles are highly interconnected with housing cycles. Both markets – housing and credit – show the same patterns during the crisis. This effect was visible during former housing bubble and subprime mortgage crisis in the United States. Housing market patterns and credit market patterns are positively correlated. When the prices of houses go up, banks are willing to finance the purchase of new ones. Banks lower conditions for obtaining mortgages because in case of inability of a client to repay the mortgage, banks still have access to the collateral which, in this case, is a house with higher value than the initial value of the mortgage. This policy was applied among many retail banks in the United States, and this policy has added fuel to the fire of housing bubble and increased the demand for houses.

Real estates are heterogeneous market, and the same holds for its sub-market – residential market, which can be divided into market for flats and houses. Usually, such investment alternatives are not direct substitutes, but they share common features as price development. This paper analyzes mainly residential market of single family houses. Still, there are non-negligible differences between family houses. The most obvious difference is age of a dwelling. Statistical offices should separate between newly constructed and existing houses. Other factors can influence fundamental value of different houses. This problem is solved by construction of hedonic indices.

Hedonic equations are helpful to compare different houses or the same ones but in different locations. Malpezzi (2002) explains them simply as a regression of expenditures on housing characteristics. This methodology reveals another issue: Which characteristics of residual market should be chosen to construct a hedonic index? The typical house characteristics are taken in structural form (types of a property and number of rooms), area (neighborhood, distance to business district) or contract conditions (between buyer/seller or lesser/tenant). Such information is not publicly available or hardly measurable. This methodology can be used only for a limited number of studies. Usually, it is for small areas like city or part of the city.

Still, there are some exceptions when hedonic indices were applied on national level.

Housing price determinants are related to macroeconomic characteristics as any other asset. Thus, housing prices are influenced by both demand and supply factors. Even on highly liquid markets, the transaction costs are non-negligible. The most common transaction costs, according to Zhu (2005), are dependence from external finance (bank credit), limited ownership of an asset (house is a collateral against mortgage) and limited availability of short sale[6]. As mentioned above, the demand side is highly influenced by disposable income. Size of wages and salaries is further influenced by labor market characteristics such as unemployment rate. Higher income influences housing prices positively, but higher unemployment rate in negative way. Demographic factors, like population growth, age structure or divorce rate, may play some role among housing price determinants, but those factors hardy change their trends within one generations, and they have only limited impact. One of the most important demand side determinants are monetary policy of central banks and overall financial market conditions. The lending conditions on the market such as real interest rates or availability of housing loans (mortgages). Higher interest rate encourages people to save, and this lowers overall housing prices. Higher share of housing loans moves housing prices upwards. Another important factors could be government policy for encouraging people to buy properties through building societies as in Czech Republic or Slovakia. Other important price determinants are prices of other financial assets as stocks or bonds, overall development of the region, tax conditions or other transaction costs (liquidity risk).

Supply side characteristics are the availability of land, respectively, construction or labor costs. Housing market features certain differences in comparison to the other markets. The most obvious difference is the inelasticity of supply. Building a new house takes time, so new supply can not be brought to the market immediately, respectively rental contracts are usually settled for longer period (at least one year), thus supply can response to change in demand only after several lags.

Most of the studies analyzes time series data using VAR models. This dynamic system can describe how innovations in determinants influence housing prices. Other studies use panel data and usually apply fixed effects models or pooled mean group models. Both approaches are used in this study, to gain better results and to be comparable with the results showed in other empirical studies of similar countries.

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[6]A short sale in real estate is a type of sale when the resources from the sale are not sufficient to cover the debt secured against the property. However this type of sale was heavily used during subprime mortgage crisis in the United States.

Chapter 2

Empirical Studies Overview

2.1. Price Determinants

This short sub-chapter summarizes the research papers and their empirical results relevant to the topic of housing price determinants. The focus is aimed to the newest analytical studies, because the recent crisis may influence the weight and structure of price determinants. Papers analyzing European region are mostly presented to simplify comparability to this thesis.

The study prepared by group of economists led by Stepanyan et al. (2010) analyzes the price determinants of former Soviet Union countries (only 12 of them). This study is unique, it provides direct comparison between several countries. The authors of this study try to estimate the fundamentals of house prices by adding uncommon explanatory variable – workers' remittance which proves to be significant. The model is applied on panel data. The obstacle for this study is the same as for other similar studies – limited number of collected data and for capital cities only. The fact of high social discrepancy between capital city and the rest of the country (so common in the region of former Soviet Republics) limits the results. The panel data were analyzed through pooled mean group estimator. This model restricts the long-term relationship between house prices and their fundamentals. The results show demand side factors, such as GDP growth rate, remittances and foreign financial inflow, have significant impact on house prices in this region.

Paper by Kholodilin et al. (2007) analyzes house price determinants on developed markets as Germany and Canada. These two markets were characterized by falling prices during period 1975-2004 (according to real house price growth). For the analysis of panel data was used pooled mean group estimator. The result shows that the main determinants for house prices are disposable income, real interest rate and

population growth. Coefficient of real interest rate in regression model has negative sign. The results are similar for both countries. The only disadvantage of this study is its data set which did not contain the impact of housing bubble or recent economic crisis.

The most extensive study is written by Egert and Mihaljek (2008). This paper is the first one which focuses on CEE region. The comparison approach is similar to this study, where less developed countries are compared to "old" OECD members. Model in this approach is mean group panel dynamic OLS estimator. The result shows strong significance with positive sign of GDP per capita for all countries. Price elasticity is higher for CEE region. This means that small change in income, respectively GDP per capita has a huge impact on house prices. The real interest rates have negative sign. Lowering interest rates makes credit more available, this pushes the demand and house prices move upwards. This determinant has higher impact in CEE region. Other important factor is a change in the ratio of private sector credit to GDP. The demographic characteristic determinants are significant with higher impact in less developed countries. The economists pointed out that in "old" OECD countries prevails the substitution effect. The correlation between equity prices and house prices is negative. This means that house are considered more as an investment and if the investors think about too high prices in house market then they move its investment to other assets or equities. On the other side, in CEE region prevails the wealth effect and correlation sign is positive. This result is more surprising, when considering fact that people in CEE region do not favor holding equity. The study show that the house price determinants do not differ across Europe. The biggest difference is the elasticity. This fact may be caused by smaller supply in house market on CEE region. This is also an explanation for highest growth in real estate among OECD countries.

The latest study is focused on housing price determinants in Czech Republic, and it is developed by Hlavacek and Komarek (2009). The data were analyzed in three ways: Czech Republic as whole; country without capital city and for Prague itself. The main issue of this study is similar to the others – lack of data even thought that this study was provided by Czech National Bank. Quarterly data from this study cover period January 1998 – June 2009. Firstly, panel data are analyzed by fixed effects model, this model is used in case when (cross-sectional) component is not chosen randomly from the sample and/or number of objects (Czech regions in this case) is relatively low. The results for Czech Republic as whole country show that the most significant determinants are average monthly rate, rent per month and vacancy/labor

force ratio. Less significant determinants are net migration/population growth and price growth of building plots. Similar results hold also for the whole country except capital city. The third analysis focused on Prague shows slightly different results. Unemployment rate and economic activity are significant factor of price determinants of capital city. Similar conclusion can be found such as for other studies such as all forces which move the housing market are on demand side. This study also applies time series approach for further analysis of Czech regions. Other important effort of this study was the discovery of some bubbles on the housing market. The authors conclude that housing price bubbles occurred in 2002-03 and 2007-08. Authors explain growth of prices in second period by growing fundamental value of real estates, thus we cannot observe housing bubble (or of such size) as it was at that time around the (western) world.

2.2. Housing Bubbles

The empirical literature about housing bubble in CEE region is still in a process of development. There are two different approaches how to evaluate a real estate bubble. Several papers examine the long-term equilibrium housing prices which are influenced by demand and supply side factors of the market. Equilibrium price are compared to the observed housing prices. Another approach looks easier and helpful for benchmark. These are price to rent ratios or price to income ratios. Work by Hlavacek and Komarek (2009) analyzed the occurrence of housing bubbles in certain market, but still the number of literature in this topic is low. In next few paragraphs are briefly summarized results of the latest papers.

Krusinskas (2012) analyzes the occurrence of hosing bubbles among capital cities of Baltic States and CEE region. Methodology of this paper follows price to income ratio approach. The bubble, in this case, is defined as a situation when the price of houses grows faster than real income. Estimation of a size of housing bubble is calculated as correlation between salary index and housing price index. The results show that biggest bubble was among Baltic States, size of the bubble reached to circa 50%. The other central European countries perform better, and the lowest bubble has occurred in Ljubljana, capital of Slovenia, where the size of the bubble slightly hit 30%. Another conclusion is that the housing bubble was the lowest in countries which adopted euro as Slovenia and Slovakia.

Cadil (2009) analyzes the occurrence of housing bubble in Czech Republic using VAR analysis. Flats and family houses are analyzed differently. Author operates with

asset bubble defined as self-fulfilling prophecy. In other words, the main reason of a high price of an asset is investors' believe of high price of the asset in the future. Author calls such believe a speculative demand. In the model, this speculation is substituted by the influence of former prices to current house or flat prices. This parameter proves to be significant. The other significant parameters are income, population of people in age 20-39. Interest rate was important only in case of house prices. Again, supply side fundamentals did not prove to be significant, thus the market in Czech Republic is led only by demand side factors. The main contribution is the decomposition of contribution of significant parameters into housing price dynamics. Author uses formula of average share of a factor which is simply a ratio of sum of significant explanatory variable multiplied by regression coefficient and sum of housing prices estimated by the model. The most important factors which influence the property price are speculative demand and household's income.

Another housing bubble analysis in Czech Republic was written by Zemcik (2009). The study analyzes separately housing bubble for the whole country using annual data over period 2001-2008 and for Prague on monthly data from 7/07-2/09. The relationship between house prices and rents is analyzed by panel data stationarity and Granger causality techniques. The main idea how to identify housing bubble is to test if the housing prices are higher than stream of future cash-flows (rents). Result shows that hosing prices for both whole country and Prague are overvalued, but the scale is not severe. The present-value model confirms that change in housing price influences change in rent and vice versa.

Agnello and Schuknecht (2011) study the bubbles and bursts (persistent deviations from long-term price trends) on housing market among 18 OECD countries. Authors identify deviations with application of triangular methodology (explained in detail on p.12). After adjustments, the random effects panel probit model was applied to identify the main reasons for housing bubbles over period 1980-2007 and measure their impact on probabilities of such events. There is a strong correlation between the persistence and magnitude of booms and burst. The results show that factors which influence the bubbles and burst are mainly past economic growth, short-term interest rate and mortgage deregulation. Authors of this study conclude that policies which try to limit credit growth can also lower the probability of a future bubble.

Paper by Kuttner (2012) analyzes the relationship between interest rates (defined by monetary policy) and housing prices, eventually bubbles. This study comes as part of a discussion about role of central banks in recent housing bubble. After bubble burst, two different approaches were discussed among economists. Firstly, monetary

policy should by more proactive in case of asset bubbles, respectively during growth of asset prices. The other view concludes that (wrong) monetary policy is the main reason of asset price bubbles. Study analyzes 36 countries in period 2003-2007 (until housing bubble burst in the United States) by using error correction model. The results show that interest rates have only small influence on housing prices and it was not the main reason for the beginning of housing bubble. However, in market conditions with rising house prices, interest rate influence may add fuel to the fire.

Chapter 3

The Evolution of the Recent Crisis

3.1. Housing Bubble in the United States

The housing bubble in the United States fully burst at the end of 2007, but warning signals could be observed sooner. According to van der Heijden et al. (2011, p.296), at the beginning of 2007, the number of defaults among American households started to growth rapidly. This was explained by fact, that mortgages in the United States usually do not have fixed interest rate but variable. Thus, the growth in overall interest rates, even minor one, can make mortgages unbearable. Another reason is so called "American mortgage", the collateral (the value of a house) equals mortgage loan. This mortgage policy used to be profitable during the period prior to bubble burst. The interest rate risk is minimal, because interest rate varies during maturity. In case of growing house values, the danger of inability of a client to repay its debs is overthrown by more valuable collateral. This mechanism may be the reason why the house prices kept rising for so long (at least since 2004, see previous chapter). Substantial losses for banks occur when people are unable to repay the mortgages, thus they can not afford to finance their houses, and the demand is lowered. Lower demand decreases house values. The value of collateral become lower than debt itself, and the client has to repay the resulting difference. In reality, two different scenarios occurred. If a household does not have enough resources for monthly mortgage payments, there is low chance for bank to claim any further money after the foreclosure of a house. State legislature[1] does not allow banks to call for any missing differences between mortgage value and collateral. Short sale transactions became possible. Probably, the final nail into the coffin of housing market in the United States was the uncertainty among investors about the size of potential losses in the future.

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[1]This policy does not hold for all US states.

The consequences of subprime mortgage crisis in the United States and strong interconnection of globalized economies were visible in Europe in 2009. Almost all countries in the EU slipped into recession, and less prepared ones had to be saved by IMF, like Hungary. On the other hand, true housing bubble, with massive shock in housing market, has emerged only among few countries, mainly in the UK, Ireland or Spain. Residential market and housing finance differ between Europe and the United States. According to ECB (2009) special report, mortgage market differs in euro area and in the United States. Almost half of households in the United States have a mortgage (45%). The share of mortgages among European households is only 20%. The main providers of mortgages in Europe are commercial banks (90%), and they are funded by deposits, overseas, the situation is different. *"The lending boom in the United States was fueled by the expansion of specialized non-depository lending institutions, primarily responsible for the diffusion of riskier contracts among lower-income borrowers." ECB (2009, p.76)* Strict lending policies and non-existence of mortgages with loan to value ratio above one[2] have made the European housing market stronger and without subprime mortgage crisis.

Several government measures were taken to compete against effects of the financial crisis. Across Europe, three main approaches were introduced to prevent a possible collapse of the financial sector (van der Heijden et al. (2011, p.298)): (i) strengthening bank liquidity by direct capital injections, usually in form of loans or for a share in the bank; (ii) guarantees for bank loans to support interbank lending; (iii) purchases of toxic assets at discount price.

3.2. Macroeconomic Development

The following sub-chapter briefly describes the macroeconomic and housing market parameters of all analyzed countries in this study.

The recent crisis has influenced German economy indirectly. Weakened demand in Europe has lowered German GDP growth rates in last two years almost to zero. Thus German economy can rely only on domestic demand or growth in European demand, but this does not seem possible in medium term. The housing market varies among developed countries, and Germany is an outlier. Germans rather rent their properties and do not own them. Occupancy rate is only at 43% level. This is below the average of 62% in euro area. The average growth of mortgage lending

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[2]Second mortgage on the same property is still possible in the United States.

in period 1999-2007 was only 3%, in other euro area countries, the growth was higher than 10% (ECB (2009, p.13)). These housing market conditions make it stable and immune against outside shocks. During the recent crisis, German government supported housing market only indirectly by encouraging people to do energy saving renovations. Stability of the residential market are reflected by real residential house price index on figure 3.1. The (green) index is almost flat, and its current values are below 2003 base year.
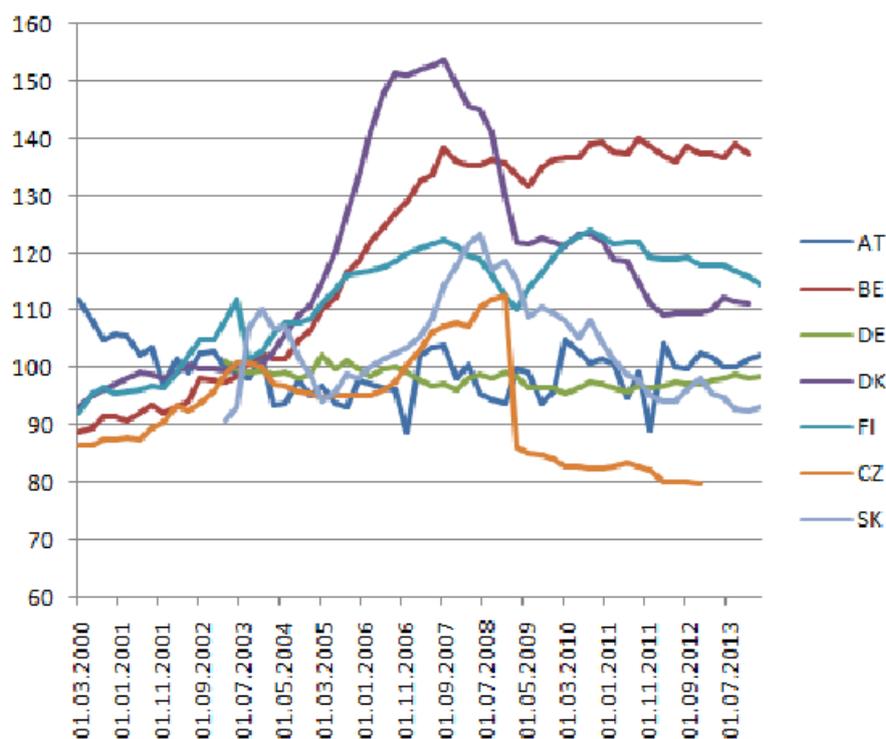

Figure 3.1.: Real RPPI, 2003=100
Source: BIS, CZSO, NBS

The Czech economy was only moderately hit by the crisis, but the economy has fallen into recession two years ago. The Czech financial sector was not hit directly by recent financial crisis in 2008, but the nervousness on global market indirectly influenced some of its features. At that time, investors moved their sources to safer euro area. Almost all the Czech banks are owned by big foreign banks, and some of them were severally hit by the crisis and had to be rescued by their governments (i.e. Belgian KBC, the mother of CSOB). Local currency became much more volatile, and the volume of interbank money market was lowered. Immediate reaction of Czech government was to increase state guarantees for bank deposits to prevent possible run on a bank. On the other hand, banks slightly strengthened lending policies. Czech banking sector is known for larger bank deposits than provided loans, thus the risk of

low liquidity was not an issue as in western Europe.[3] Later on, similar measure as in Germany to indirectly support housing market was approved - incentives for energy saving house renovations (Hegedus et al. (2011)).

The economy of Finland is one of the most developed on continent, but country was seriously hit by the recent financial crisis. The GDP year-to-year fall was by 8.3%. The value is almost double for average fall of Europe OCED countries in 2009. Last five year GDP growth average is still negative, -1.04%. This is the lowest value of all analyzed countries in this study. However, family house price index seems to be rising since beginning of the new millennium, and the recent recession in Finland has not changed the rising trend. The occupancy ratio stays at 65,1%, similar to European average, but government policy indirectly discourage low-income households to own their houses. Finish social housing scheme does not distinguish between renter and home owners, and thus the policy does not motivate to buy a house (Marrez and Pontuch (2013, p.6)).

The Belgian GDP decreased only by 2.3% in response to the crisis in 2009, but the government had to fight against own bank crisis and rescue some major Belgian banks like Dexia, Fortis and KBC. Formerly, the government only guaranteed for bank loans and did not plan further capital injections into banking sector (no reserves were established). Unfortunately, the sum injected into Belgian banks reached €18 billions by February 2009 (van der Heijden et al. (2011, p.299)). The residential market in Belgium has relatively high occupancy rate at 71.3%. The average growth of mortgages loans in period 1999-2007 was 11,5%. The growth of mortgage lending and already high level of home ownership has boosted the value of family houses. The recent crisis only stabilized the real family house index on its 2007 values, as depicted on figure 3.1. (red index).

The real economic output of Denmark decreased in 2009 by 5.1%, and after five years the average annual GDP growth is still negative at -0.7%. Danish economy belongs to the most developed, but the productivity growth has weakened in last decade. The impact of lower productivity has fully shown during the recent crisis in Europe. The housing market in Denmark was the only with the serious housing bubble. The family house index has increased by more than 50% since 2003, but the bubble peaked in second half of 2006, just prior to housing bubble in the United States.

The fall of the real Austrian GDP was below average of OECD countries, only by 3.8%, and recovery was relatively quick. Traditional Austrian banking sector

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[3]Bank crisis in the Czech Republic was successfully handled a decade ago.

was not so seriously hit as the Belgian one, but still the government had to respond and prepared some stabilization packages. The occupancy rate is below European average, at 58%, similarly as in Germany. On the other hand, the annual growth of house lending is 13,2%. The family house price index for Austria seems to relatively stable, and in first quarter of 2014, its value is almost same as in 2003 base year.

Slovakia used to be called an economic tiger of Europe. The annual growth of GDP five years prior to the crisis was always above 5%, with record year in 2007 with GDP growth at 10.7%. However, the crisis in 2009 struck hard, and GDP fell by 5.3%. During first phase of the crisis, Slovakia seemed not to be so severally hit as other countries in region. Slovakia adoption euro for its currency in 2009. During the subprime mortgage crisis in the United States, euro became a safe haven and Slovakia was not troubled with large exchange rate fluctuation as the neighboring Czech Republic. Later on, European sovereign debt crisis has surprised Slovak economy unprepared and euro has lost its stamps as safe currency. Two rounds of government packages were introduced to stabilize the economy. The most notorious one was the scrappage program. The scrappage of an old car and the purchase of a new one was subsidized by government.[4] The banking sector (mostly owned by foreign banks) proved to be strong, and no additional support from government was needed. Average GDP growth for last five years is above 1%, among the highest in Europe.

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[4]Automotive industry has strong presence in Slovak economy.

Chapter 4

Data Description

4.1. Data Issues

The following chapter interprets the main issues of data set in general and describes housing data used in econometric analysis. Similar studies in the field of residential market analysis are always challenged with lack of quality (different sub-markets mixed together) or insufficient data (too short) of residential real estate markets. Real estate market is itself a heterogeneous market which consists of different types of assets. Even if the researcher focuses on residential market, there are different types of dwellings which should be treated differently. Best statistical databases can differentiate between new and existing dwellings or even between the certain types of houses like terraced or detached. The issue evolves with the comparison between several statistical offices (countries), because certain data are missing. Even the international institutions in Europe like to specify how several shocks in the economy can influence family house prices. or Eurostat can not supply sufficient statistics for all the EU member states, thus the researcher has to deal with them with certain caution.

The strength of real estate market is measured by price per sq. meters or by residential property price indices. Property indices are used by several agents for decision making processes within the economy. House price indices are significant benchmark for development of other asset prices.

Economic growth is usually associated with growth in the real estate prices. This can be easily explained. Higher house prices stimulate construction of new houses, and this is reflected in higher GDP growth. There is also a non-negligible wealth effect. Higher value of house prices means that households consider themselves richer and they are willing to spend more on further consumption. The last effect

are higher taxes which can be collected by local government if properties are more expensive. Unfortunately, this also holds when the property prices are decreasing but in the reverse way. Property indices are also useful in setting accurate inflation targeting or as an indicator of financial stability.

Few years ago, residential markets were considered only as local markets, and the information about them were collected only by local (national) institutions. There was a belief that the different national markets are not interconnected, so there was no need for further homogenization of statistics. The recent crisis showed us otherwise. The simple possibility of taking mortgages in other currency than local currency makes local residential market vulnerable to the shocks in foreign countries in other countries. The subprime mortgage crisis in the United States brought "the biggest meltdown" to the world economy from age of great depression. This is the reason why more researchers (and also this study) pay more attention to the property market. This situation has brought international institutions to discussion about common methodology and index harmonization of residential property prices. Recently, there has been an initiative to get over these issues and to provide one comprehensive index for (at least OECD) countries. The Handbook on Residential Property Price Indices, developed by Eurostat together with other international institutions, was for the first time introduced in 2011. The main purpose of the RPPI is to introduce or improve methodology of national housing indices to make them comparable across different countries (mainly between developing and developed ones).

Another issue, why the statistical data about property markets are incomplete, are main features of residential market itself. Firstly, the dwellings are not homogenous. There are different types of structures as flats or homes, different locations as urban or rural, etc. However, there are no two identical dwellings, simply because they cannot be at the same place. *"...sampled house prices may be a poor indicator of all house prices because we cannot always reliably predict the sales price of a given dwelling from the price of another."* (Wood 2005, p.213). Secondly, we can record the market price only when the dwelling is sold. Overall price index is influenced only by the types of houses which are sold at certain period - this issue can be solved by different price indices for certain types of dwellings. Third issue is the irregular frequency of the trades. A dwelling is sold on average once per decade. There are also some depreciation costs between two sales which has to be adjusted somehow to make housing prices comparable over time. Author briefly explains three methods how to overcome these issues. Hedonic regression estimates the value based of chosen parameters as location, size. Mix-adjustment method differentiates and groups prices

of dwellings for different characteristics (location etc.) into sets. Average prices of different sets are weighted together to create a mix-adjusted price. Both methods give similar results. Last method is not commonly used for recording housing prices. It is based on repeat sales, where certain dwellings are sold many time, this gives an opportunity to study price changes among the sales.

Data can be collected by three different ways. The easiest way for central banks or statistical offices are transfer prices, these can be collected from tax offices or property registers. Transfer price data are accurate in value estimation but with certain lag in time. There is usually one quarter gap between occurrence of transaction and recording of it by some authority offices. This type of data are primarily sources for all real estate analysis. Indices based on transfer prices are regularly published by national banks or statistical offices. All housing prices in form of indices in this study are obtained by this way. On the other hand, there are supply side prices or seller's asking prices. Such information is collected by real estate agencies or real estate consultant firms and provides their core business. It means, those figures are not publicly available for free. The main disadvantage is that the prices does not necessary correspond to real values (or transfer prices) of properties. Such prices should be also adjusted for agency fee. The last option how to acquire the data is from lending institutions which finance the purchase of the property and know the exact value of the property (collateral). Those data exclude, by nature, the transactions purchased directly. Direct purchases may account for significant part of housing market, especially in developing countries. This study analyzes longer time period. Possible disadvantage of using government's data with one or two quarters lag is over-weighed by accuracy of transfer prices. Other non-negligible reason is the public availability of house prices.

4.2. Data Sources

This study tries to compare price determinants of specific residential property market - family houses across different countries and different regions - capital cities. It is a non-negligible issue to find the appropriate database of housing prices. The main source for this study is Bank for International Settlement. BIS[1] gathers the statistics from national authorities, even though some key statistics (indices for capital

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[1]BIS does not collect the housing prices or develop the indices. Still, it is a big help for researchers because some data would be otherwise unreachable, especially in foreign countries.

cities) were missing.[2] Usually, less developed countries do not provide sufficiently long time series to allow proper analysis of housing price determinant after recent crisis. Some other countries publish only general type of indices without a possibility to differentiate between different types of dwellings. This study works only with property indices of family houses which were available for both national and capital city level. All the data are publicly available and published either by national bank or statistical offices, thus the price indices use transfer prices. The countries are divided into two groups: transitional or caching-up countries are represented by the Czech Republic (Prague) and Slovakia (Bratislava). Developed European countries are represented by Austria (Vienna), Belgium (Brussels), Denmark (Copenhagen), Finland (Helsinki) and Germany (index for big cities). The data set contains 13 years and starts in Q1 2000 until Q1 2014, this means 57 observations per country.[3]

Austrian quarterly data are published by BIS and provided by Vienna University of Technology. The index is available since 2000. Several price indices exist. They are differentiated for regions, property type or quality of dwelling (existing or new). Belgian data are provided by Belgian Central Bank for price index measuring whole country, and index for capital city is measured from data gathered from real estate agencies. Both indices are available from 1973, and they are published by BIS. The best figures were provided by Czech Statistical Office (CZSO) which provide several quarterly price indices for both apartments and family houses, and sttistics differentiate between size and quality of the stock. Provided data covers also different regions of the Czech Republic and different types of urban areas. *"The system's data comes from real estate tax declarations, which owners or sellers of real estates are obligated to provide to the tax authority within 30 days."* (Matalík et al. 2005, p.190). Ministry of Finance later postpones the data to the CZSO. Various indices are available from 1998. Somehow, such detailed data are not published by BIS, thus the indices were provided directly from CZSO. Unfortunately, the data for 2013 have not been published yet (the last five observations are missing). Similar situation occurs for Danish RPPI, BIS provides data only for whole Denmark since 1971. Copenhagen price index is gathered from Danish Statistical office. German index is developed by Association of German Pfandbrief Banks and adjusted by means of hedonic method (to evaluate different dwellings condition). Quarterly German data covers the period from 2003-2013, thus the sooner data were linearly interpolated from annual form. The index of capital city is subsided for index of big cities. The index covers the period from 1991. RPPI for Finland as a whole country are published from 1988 and

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[2]If such data exist they have to be gathered differently, even through the source is usually the same.

[3]House price indices for Slovakia contains only 48 observations.

provided by Statistics Finland. The index for capital city and suburbs was obtained as well and covers the periods from 2000. Slovak National Bank provides the data for price index with help of real estate agencies. The housing index is again differentiated for regions and type of dwelling but covers only period from 2003 and first two years show only annual data (linearly interpolated for this study). Again, this is not reflected by BIS. All the indices were expressed in real terms, thus they were deflated by core inflation.
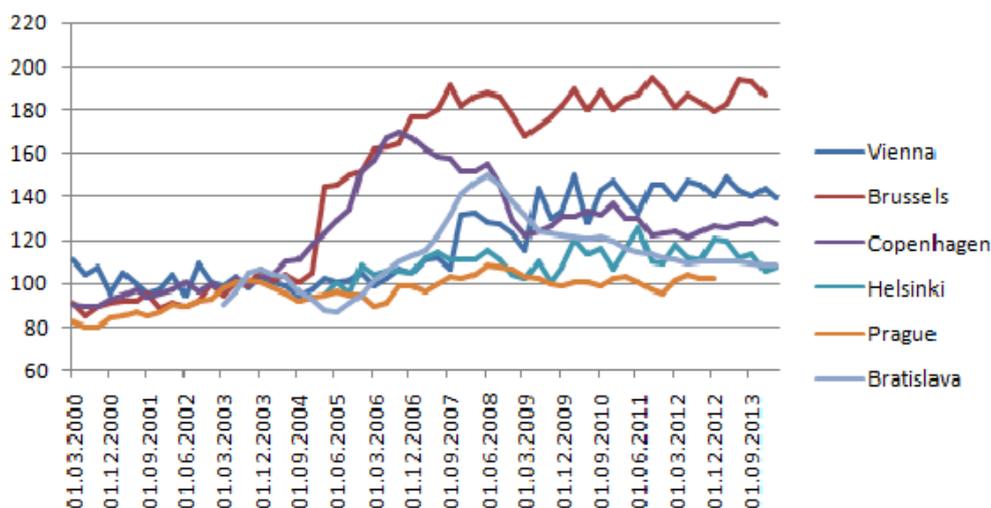
Figure 4.1.: Real RPPI for capital cities, 2003=100
Source: BIS, central banks

The rest of the data set, mainly economic and financial indicators, were taken from OECD statistics database: core inflation; seasonally adjusted GDP growth rate, long-term and short-term interest rates, share price index, labor costs index and unemployment rate. Bank credit was obtained from BIS and transformed into index by author. Housing loans interest rates were obtained from national central banks. Appendix A provides detailed description of the data used for this study.

Chapter 5

Methodology and Results

The simplest approach how to analyze housing price bubbles is price to income ratio or price to rent ratio. In this case, price means an average market price of a family house and income means cumulative real wage for 4 quarters. This approach brings many disadvantages (house prices are influenced by variety of factors which are not comparable between nations like taxes, demographics, "housing culture" and others), but still it is a good benchmark for seeing a trend or discovering any price abnormalities (possible housing bubbles) in previous years. This study tries to notice any housing bubbles by comparing estimated house prices to real ones.

This chapter analyzes selected hypothesis by two different approaches. In first part, models for panel data analysis are employed. There are several reasons for this approach. Firstly, the biggest problem is the lack of valuable data. Reliable quarterly housing data start only since 2000, but there are exceptions, when available data are only since 2003 (in case of Slovakia). This situation gives panel regression higher importance - shorter time span limits the analysis of long-term effects. Secondly, this approach was also used in similar studies, such as Hlavacek and Komarek (2009), and the results will be easily comparable. Last advantage of panel data is their ability to control for individual heterogeneity. If these unobserved specific effects are not controlled, this may lead to bias in the results (Baltagi 2007, p.295). Fixed effects model was used for analyzing panel data to estimate housing price determinants. Possible housing bubbles are visible on residual plots.

Time series analysis is the main part of this thesis to specify how several shocks in the economy can influence family house prices.. The limitations of data set (only 57 observations for a single country) can bring a dispute of employing time series analysis, but similar studies were concerned with similar problems, and short-term effects (in case of overestimation of family house values) are still worthy of analyzing.

5.1. Panel Data Analysis

Panel data (sometimes called longitudinal) consist, at least, of two dimensions: time series and cross-sectional. Data represent several objects over certain period in time. Cross sectional units consist of $i = 1...N$ individuals (countries). Time series units consist of $t = 1...T$ time periods (quarters). Several types of panel data exist, brief explanation can be found in Principles of Econometrics (Hill et al. 2007, p.383). This study works with long and narrow data set. The number of countries (N) is smaller than the number of time periods (T), thus $T>N$. The regression model for panel data looks similar as any other simple model (Baltagi 2007, p.295):

$$y_{it} = \alpha + X'_{it}\beta + u_{it} \tag{5.1}$$

where i denotes cross-sections, and t denotes time-periods, α is a scalar (constant), and β is K x 1, and X_{it} is the it-th observation on K explanatory variables. The disturbances take the form:

$$u_{it} = \mu_i + v_{it}$$

where the μ_i are cross-sectional specific components, and v_{it} are remainder effects. These effects are time-invariant. Usually, the fixed or random model are used for analysis of panel data. Characteristics of μ_i help to choose appropriate model. If the μ_i can be assumed random, $\mu_i \sim IID(0, \sigma_\mu^2)$, and the X_{it} and v_{it} are independent of μ_i for all i and t, then the random model is appropriate to use. This situation happens when individuals (N) are randomly drawn from a large sample (e. g. population). The other model - fixed effects model is used when cross-sectional units are not chosen randomly, and there is a correlation between μ_i and explanatory variables X_{it}.

Previous theoretical description supports application of fixed effects model. An assumption, if there is no correlation within regression between disturbances and explanatory variables, $E(u_{it}/X_{it}) = 0$, can be verified by Hausman specification test. Principles of Econometrics (Hill et al. 2007, p.404) *"The idea of the test is that both the random effects and fixed effects estimators are consistent if there is no correlation between u_{tt} and the explanatory variables X_{it}. If both estimators are consistent, then they should converge to the true parameter value β in large samples - the random and fixed effects estimates should be similar. On the other hand, if u_{it} is correlated with any X_{it} the random effects estimator is inconsistent, while fixed effects estimator remains consistent."*

Fixed effects (sometimes called least square dummy variable) model takes the following form:

$$y_{it} = \alpha + X'_{it}\beta + \sum_{i=1}^{N} \mu_i D_i + v_{it} \tag{5.2}$$

where D_i is a dummy variable for the i-th country. If the error term is independent with zero mean and constant variance for all observations, $v_{it} \sim IID(0, \sigma_v^2)$, then the best linear unbiased estimator (BLUE) is the least squares estimator (OLS).

Selected countries are divided into two groups according to level of economic development. First group consists of the Czech Republic and Slovakia. Both countries are taken as a proxy for the transitional European countries.[1] Second group represents western European countries represented by Austria, Belgium, Germany, Denmark and Finland. The hypothesis of this study assumes different family house price determinants for each of these groups. Next analysis estimates price determinants of the capital cities for Prague and Bratislava. The established models try to explain real family house prices separately, for country as whole and for its capital city. Following model contains six explanatory variables based on previous research papers about housing price determinants. The variables covers monetary policy (bank credit), labor market conditions (unemployment rate), household income (GDP growth). The share price index and housing loan interest rate are proxies for alternative investments (wealth effect). Supply side is represented by the labor cost index. When needed the variables are adjusted for inflation (in form of CPI). The model for estimation of price determinants looks as follows:

$$RHPI_{it} = \alpha + \beta_1 GDP_{it} + \beta_2 UN_{it} + \beta_3 SPI_{it} + \beta_4 LCI_{it} + \beta_5 BC_{it} + \beta_6 HLIR_{it} + \varepsilon_{it} \tag{5.3}$$

Stationarity of all variables was checked by Augmented Dickey Fuller test in form of Im-Pesaran-Shin test. Almost all variables in the model were non-stationary with exceptions of GDP and bank credit because these were already taken as growth rates. The first differences were used to gain stationary for rest of the variables. First and second lag of every explanatory variable was added to the model. House prices tend to react with certain delay in some variables. Results for the similar model without lagged variables are depicted in Appendix B.

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[1]Transitional country, in this context, means the country which successfully managed to transform its economic regime, but it has not met the same level of economic development as developed countries.

All indices were taken in 2003 prices with 2003 base year. *RHPI* represents the real family house price index. *GDP* growth rate stands as a proxy for household's income. *UN* represents the unemployment rate. *SPI* stands for the real share price index. *LCI* is the real labor cost index. *BC* is the bank credit growth, value of all house loans available to households in real terms. *HLIR* is the real housing loan interest rate.

Firstly, simple pooled OLS model was used to estimate price determinants. The reason for POLS is based on potential risk of fixed effects loss (specific characteristic of each country) caused by differentiation of dependent variable. To cover fixed effect, family house price index, lagged by one quarter, was put into FE model as explanatory variable. Comparing different versions of the model can answer the questions about stability and robustness of the results.

5.1.1. Countries

This part analyzes housing price determinants and potential housing bubble among transitional countries represented by the Czech Republic and Slovakia. Estimated results are summarized in table 4.1. Both approaches are consistent, in both models the same explanatory variables proved to be significant. Second and third column represent the results of restricted model separately by pooled OLS and by FE (table depicts only significant variables). The model with two lag variables is described. To obtain best results (restricted model) the least significant variables were eliminated from the model one by one. The same structure stands for all other tables.

The most significant variable at 1% level of significance is real GDP growth rate which is a proxy to household income. The sign is positive and supports basic economic notion. The prices are influenced by GDP growth in the same period and with one quarter delay. This may be explained by complexity of transactions in real estates, which may take several months to conclude. The second most significant variable at same level are share price index and bank credit growth. The importance of share price index comes as a surprise, because alternative investments into equities are not so popular among transitional countries. The unemployment rate shows its significance, but only after two lags delay. As expected, the sign is negative. The real GDP growth (proxy for household income) and unemployment rate can be considered as determinants for family house prices and so the market is predominantly led by demand side factors. Coefficients for bank credit growth and housing loan interest rates have different signs as expected, but this anomaly occurred only in this model.

Labor cost index was not significant at least at 10% level, it seems there are almost no supply side factors on housing market among transitional countries. More suitable model for this type of data is FE model. To cover fixed effects, lagged value of depended variable was added into explanatory variables. Lagged house prices showed to be highly significant, and there is high persistence in prices on family house market. Again, GDP growth at same period and lagged by one quarter together with the unemployment rate proved to be significant. Other variables are significant with similar coefficients.

	Restricted model	
	POLS	FE
Intercept	0.6251	-2.3604
	(0.6057)	(4.3569)
Family house prices (-1)	-	1.0311***
		(0.0438)
GDP growth	88,2148**	60.9525**
	(23.5796)	(24.3455)
GDP growth (-1)	95.5989***	96.4526***
	(24.4098)	(24.6813)
Unemployment (-2) (d)	-151.0106**	-151.1926**
	(72.3005)	(73.0434)
Share price index (-1) (d)	0.0640***	0.0710***
	(0.0209)	(0.0226)
Bank credit growth (-1)	-33.0277***	-37.5818***
	(11.8005)	(12.9335)
Housing loan IR (d)	107.5940**	103.5590**
	(43.5940)	(44.0902)
R^2	0.467	0.939

*** significant at 1%, ** at 5% and * at 10% level
d - difference; -1 - lagged by 1Q; -2 lagged by 2Q
71 observations; Std. errors in parenthesis

Table 5.1.: Panel data regression, CZ and SK

The previous results shows only family house price determinants. Any housing bubbles are visible as fitted plotted residuals as depicted on figure 4.1. Residuals were obtained from restricted FE model. Family house market in the Czech Republic looks to be overpriced twice. Firstly, the peak in first quarter of 2003 is followed by slow decline in prices until Q3 of 2004. The next overvaluation corresponds with the housing bubble in the United States. Housing bubble occurred as V shaped, with peak values in the middle of 2007 and 2008. Later, housing prices followed decreasing trend until 2014. The residuals for Slovakia are rather vulnerable (first three years

are missing). First overvaluation is similar as in the Czech Republic, the bubble just moved to the last quarter of 2003, but the decline is rather sharp and ends in Q3 of 2004. Slovakia registers family house market overvaluation with two peaks in Q3 of 2007 and Q1 of 2008. Then prices went down until first quarter of 2009 when Slovakia adopted euro as national currency.
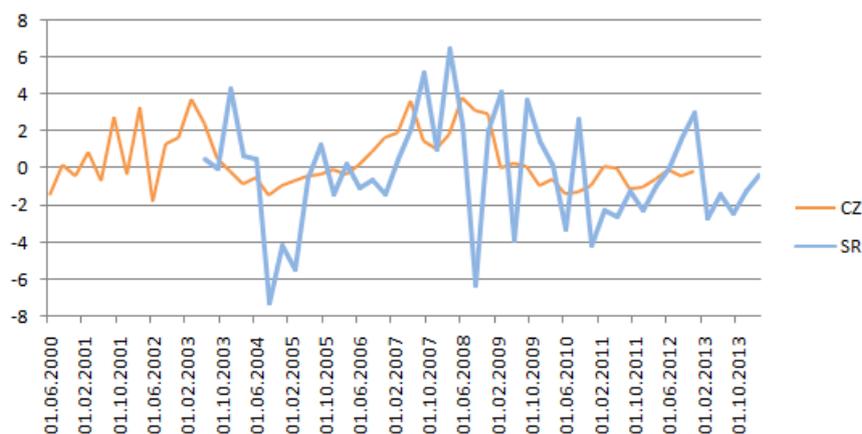

Figure 5.1.: Residuals for FE model

Next part analyzes housing price determinants of western European countries. Selected countries were less hit by financial (debt) crisis in Europe[2], so estimated results should be more comparable with results in previous section. Countries in this group are Austria, Belgium, Germany, Denmark and Finland. Estimated results are summarized in table 4.2. Estimated models with and without lags (see Appendix) give almost the same results. Model with two lags only specify how long is the time span of determinant's influence into house prices. As in the previous regression, GDP growth, as a proxy for household's income, is the most significant variable in the model. This time, it is the value of GDP at the same quarter as the price index. Surprisingly, the unemployment rate does not prove to be significant even at 10% significance level, in full model it was the least significant variable. Share price index is positively correlated with family house prices, this can indicate a possible wealth effect (people are willing to spend more on alternative investments - stocks, bonds if they are or assume to be wealthier because or rising house prices and vice versa). Another significant variable is bank credit growth with positive correlation to the family house prices. This indicates that housing loans for household have real influence on family house market among developed countries. Last significant parameter is real housing loan interest rate with negative sign supporting economic

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[2]In comparison to south European countries or Ireland.

notion. FE model estimates slightly different significant explanatory variables than POLS. Again, there is a strong persistence among family house prices. On the other hand GDP growth is the most significant among rest of the variables, but in this model GDP with two lags delay is significant too. The real housing loan interest rate is not even significant at 10% level. On the other hand, labor cost index proves to be significant which means real estate market in developed countries is influenced also by supply side factors.

	Restricted model	
	POLS	FE
Intercept	-0.2383 (0.2986)	4.6952*** (1.4977)
Family house prices (-1)	-	0.9587*** (0.0131)
GDP growth	62.5396*** (21.3963)	49.8677** (19.4315)
GDP growth (-2)	-	50.7182** (23.5186)
Share price index (d)	0.0238* (0.0144)	-
Share price index (-1) (d)	-	0.0250** (0.0123)
Labor cost index (-2) (d)	-	0.4138* (0.2180)
Bank credit growth (-2)	38.3463** (15.3613)	27.9233* (15.1749)
Housing loan IR (-1) (d)	-55.2963* (32.2426)	-
R^2	0.135	0.973

*** significant at 1%, ** at 5% and * at 10% level
d - difference; -1 - lagged by 1Q; -2 lagged by 2Q
218 observations; Std. errors in parenthesis

Table 5.2.: Panel data regression, developed countries

Housing bubbles among developed countries are more likely visible in residual plot obtained from restricted FE model. The figures are included in Appendix C. Belgium, Germany and Finland do not show any signs of housing bubble on family house market. This does not come as a surprise, because family house index for Germany is constant for whole period, and for other two countries, the index is slightly growing without any brakes signalizing inadequate valuation of family houses (see Figure 4.1. in previous chapter). Residuals plot for Austria is volatile, but without serious peaks to indicate housing bubble. Only visible housing bubble is

in Denmark with peak value in Q2 of 2006, prior to the housing bubble in the United States or financial crisis in Europe.

According to first hypothesis, family house price determinants do differ among different group of countries. As expected, household's income (substituted as GDP growth) has the highest impact on housing prices than anything else. The only difference for the Czech Republic and Slovakia is that their significant GDP is lagged by 1Q. Housing prices are also highly persistent. Housing market in Czech Republic and Slovakia is led predominantly by demand factors (unemployment rate) and in developed countries both supply (labor cost index) and demand factors (share price index, possible wealth effect - another proxy for household wealth/income) are visible. Strong price persistence holds for whole Europe. None of the countries show any evidence of bubble in family house market prior to recent crisis.

5.1.2. Capital cities

Following part focuses only on capital cities of transitional countries. The second hypothesis of this study predicts similar housing price determinants for capital cities and developed countries. Different economic performance between capital city and rest of the country may influence price determinants. Prague and Bratislava, as the capital cities, belong to the wealthiest regions of EU. This may imply, the price determinants should be more similar to those in developed countries.

The following analysis uses the same approach (POLS and FE model) as in previous sub-chapters. The results are summarized in table 4.3. GDP growth rate is strongly significant at time t and also in its lagged value. Previous results for transitional countries showed the unemployment rate to be significant factor, the same holds for capital cities. The coefficient for the share price index has negative sign, suggesting substitution effect. The growth in house prices motivates people to invest to other assets. Still, the coefficient is close to zero and any substitution effect is minimal. Index of family house prices is strongly influenced by housing loan interest rate, but this time with negative sign witch supports the notion: growing interest rates lower demand for loans (mortgages), and lower demand brings lower house prices.

| | Restricted model | |
	POLS	FE
Intercept	-0.4580	-0.2164
	(0.3508)	(3.5588)
Family house prices (-1)	-	0.9976***
		(0.0324)
GDP growth	90.7868***	92.1846***
	(20.5603)	(21.5668)
GDP growth (-1)	90.6300***	92.3364***
	(20.5403)	(21.1306)
Unemployment (-2) (d)	-135.6567**	-138.9997**
	(62.7623)	(63.9480)
Share price index (-1) (d)	-0.0572***	-0.0589***
	(0.0189)	(0.0195)
Housing loan IR (-1) (d)	-103.7565**	-106.1819**
	(44.2113)	(44.6719)
Housing loan IR (-2) (d)	-75.5001*	-77.5476*
	(40.9759)	(41.3525)
R^2	0.424	0.965

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

d - difference; -1 - lagged by 1Q; -2 lagged by 2Q

67 observations; Std. errors in parenthesis

Table 5.3.: Panel data regression, Prague, Bratislava

The results are no surprise. Comparing real family house price index between capital city and rest of the country in the Czech Republic and Slovakia, the same patterns emerge, as depicted on figure 5.2. Index for the Czech republic is almost flat. Real prices in Prague are the same at the end of 2012, as it was in 2003 (base year of the indices). Real prices for whole country shows sharp fall in 2008, below its 2003 value. Those price level are the same as in 2012. Slightly different situation happens in Slovakia. It is not simple to analyze up and downs between 2004-05 because lack of data prior that period. Probable bubble effect is visible in the middle of year 2008 with peak value significantly higher than in 2003, but this effect fades away slowly. In this specific case, transition to a common euro currency in Slovakia (adopted in 2009) may have some effect. Residential market could be seen as an alternative investment of spare Slovak crowns. The only difference between capital city and rest of the country are bigger extremes.
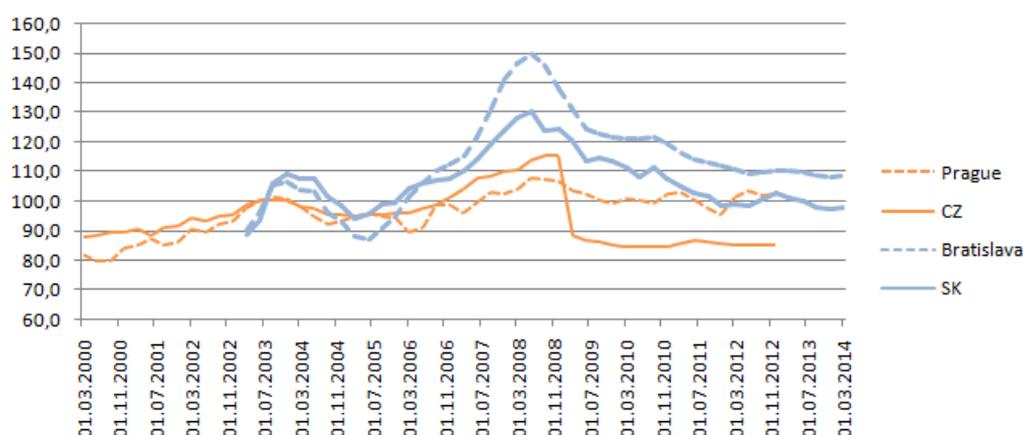
Figure 5.2.: Real RPPI for Prague and Bratislava, 2003=100
Source: CZSO, NBS

5.2. Time Series Data Analysis

Second part of this study consists of time series data analysis. Panel data can not sufficiently explain all the relations among different variables, which this study is supposed to do. To solve this problem, vector autoregression model is applied. Similar studies, as mentioned in previous chapter, apply the same methodology for analyzing time series data. The other reason is to make the results of this study easily comparable between them. On the other side, this approach highlights the limits of short number of observations in data set and the final results are limited with this inconvenience.

Principles of Econometrics (Hill et al. 2007, p.347) describes VAR model as a general framework to describe dynamic interrelationship between stationary variables. If all variables are I(0), the system can be estimated by least squares. If the variables x and y are stationary (or using first differences to gain stationary series), then simple (lag of order 1) VAR (1) model can be described as:

$$
\begin{aligned}
y_t &= \beta_{10} + \beta_{11} y_{t-1} + \beta_{12} x_{t-1} + \upsilon_t^y \\
x_t &= \beta_{20} + \beta_{21} y_{t-1} + \beta_{22} x_{t-1} + \upsilon_t^x
\end{aligned}
\tag{5.4}
$$

Our model contains six endogenous variables besides real house price index, *RHPI*, (1). Other selected variables are: (2) the real GDP growth, which provides a proxy for household's income; (3) the real short term interest rate, *STIR*; (4) the growth rate of bank credit (bank loans to households for home purchases) adjusted for inflation,

BC, which provides a proxy for monetary policy and financial system within the economy; (5) the real share price index, *SPI*, which is seen as a proxy for other investments in the economy; (6) the real labor cost index, *LCI*. The motivation to use these endogenous variables is based on results of previous panel data analysis, where such house price determinants were shown to be significant for at least one subgroup of analyzed countries. *STIR* is used instead of housing loan interest rate because of missing figures until 2003. Still, there is a space to include other variables such as the unemployment rate. Following model does not include unemployment rate, because all of its impact on overall economy can be seen in GDP growth rate. Secondly, coefficients of unemployment rate in FE models for developed countries were least significant, thus with almost no effect on family house prices. The dynamics of the model, in matrix form, looks as follows:

$$Y_{k,t} = C_k + \sum_{j=1}^{p} \Phi_{k,j} Y_{k,t} + \varepsilon_{k,t} \tag{5.5}$$

Let $Y_{k,t}$ denote a (6x1) vector containing the values that six endogenous variables assume at date t and for countries $k = 1,...,7$. C_k, the (6x1) vector, contains the constant term of VAR model. The matrices $\Phi_{k,1},...,\Phi_{k,p}$ contain the autoregressive coefficients, where $p > 0$ represents the lag length. $\varepsilon_{k,t} \sim IIDN(0,\Sigma)$.

Optimal number of lags for each country is crucial for the model. The lowest value of information criteria indicates the best lag selection. Akaike and Hannan-Quinnn information criteria together with likelihood ratio determined an optimal lag length. Lag length of 5 was chosen for Germany and Finland. Rest of the countries have lag of 4, except for Slovakia where lag of 3 was chosen (because of lack of sufficiently long data). All endogenous variables are adjusted for inflation (by the same way as in previous panel data analysis) and taken as log differences.

Ordering of endogenous variables is important for VAR models. The highest ranking variables are generally those with the biggest impact on overall (economic) conditions. Thus GDP growth as the main economic indicator has the top spot. The change in GDP growth affects all other variables, while the other variables have only limited impact on GDP growth. The last spot belongs to RHPI because explaining housing prices in the same quarter does not maintain economic logic, and the variables of this model are chosen to describe their influence on housing prices, not vice versa, - family house prices are highly persistent, thus placing this index before last place may negatively influence final results (biased results). Interest rate and bank lending have direct impact on financial market which is strongly tied with

real estate market, hence short term interest rate and bank credit growth take second and third place in ordering. The share price index is set before the labor cost index, this is based on previous results, where possible wealth effect proved to be more significant than supply side effect in real estate market. System of VAR equations looks as:

$$(GDP, STIR, BC, SPI, LCI, RHPI)$$

5.2.1. Variance decomposition

Variance decomposition carries information about importance of a shock/innovation of variable to the other variables and also to itself. Those estimations prove to be valuable only in the short-run. Thus, further assumption to the future can not be made

The following table 4.4. describes variance decomposition of housing prices at selected quarters (long run and short run effect). The normality test proved normal distribution of residuals for all countries. Variance decomposition simply says how much account impulse or innovation or shock to certain variable to variation of the fluctuation in real family house prices. Housing prices accounts for largest portion in variance decomposition after first quarter for all countries. The same results were proved by previous models and methods. This persistence exists after 2 years (Q8) almost for all countries with exception of Germany and Denmark, where other variable accounts for larger portion of variance. On the other hand, house prices take the last spot in ordering, thus there should have been a lower importance in overall dynamics of VAR system. Austria is characterized by housing price persistence in both short and long term horizon, when it accounts for more than 60% of house price variation. After two years, growth of bank lending and value of other investments (measured by share price index) gain relatively high share of variance (in comparison to the short run variance decomposition). GDP growth rate has the lowest share of variance among all other counties. Housing price persistence for Belgium has similarly large share of variance in first quarter as in Austria. In longer horizon, GDP growth and short term interest rate become important factors. The impulse to GDP growth in first year accounts for more than 20% variation of the fluctuation of housing prices. This effect is later diminished for the rest of variables. Variance decomposition of Germany shows relatively large impact of share price index in short term horizon, but in longer horizon the shock in bank credit accounts for the largest share variance (even larger than housing price itself). Denmark is the only country,

where GDP growth has higher impact on variance of housing prices. All developed countries share similar structure of variance decomposition, besides housing price persistence, GDP accounts for second largest share. Results for Czech Republic are rather similar to Denmark than Slovakia. Share of GDP growth in variance decomposition is almost the same as housing prices. The innovation to labor cost accounts for almost 19% variation of fluctuation in housing prices. In previous chapter this variable did not prove to be significant as price determinant among transitional countries, still it has relatively large impact on variance. Slovakia shares similar results with Austria in high share of variance in housing prices. The results for Slovakia might be limited by lower number of observations (data set starts from 2004).

Estimated results may differ in case of different ordering of endogenous variables. As suggested by Posedel and Vizek (2009), the new ordering, based on correlation between reduced form error terms, was set. The highest correlation coefficient among two error terms in correlation matrix impose different ordering. The variable with lower order was put before the other variable. All developed countries with exception of Austria show the highest correlation between GDP and the labor cost index. Thus *LCI* is put before GDP, at the top place. Germany and Denmark are only countries with change in determinants. In case of Germany, GDP growth accounts for more than one third of variance of house prices, followed by bank credit growth and house prices. In Denmark, the labor cost index became much more important and account for 24% of variance in house prices. Short term interest rate was put before GDP, because of the highest correlation for Austria and both transitional countries. The new ordering did not change the structure of variance decomposition of housing prices.

Variance decomposition describes also the influence of housing prices on other variables. Mostly in developed countries, the innovation to house prices accounts for large variation of fluctuation of GDP growth. The highest impact is in Austria, where house prices accounts for 19% of GDP variance, followed Germany and Denmark with 16%, respectively 14%. The housing prices in transitional countries explain 14% of labor cost variance. Strong magnitude of house price feedback effect is also in short term interest rate variance. The results differ from analysis of Posedel and Vizek (2009), where transitional countries show only minimal house price feedback effect. This analysis (7 years later) concludes that housing prices, respectively investments into family houses relatively strongly influence economy (such as GDP, labor costs) even in transitional countries.

Country	Period	GDP growth	ST interest rate	Bank credit	Share price	Labor cost	Family house prices
Austria	1Q	0.74	0.65	1.30	3.23	6.48	87.60
	8Q	6.42	6.37	10.14	9.07	5.97	62.02
	12Q	7.48	6.03	10.09	10.48	6.96	58.97
Belgium	1Q	0.02	0.18	4.63	0.05	7.75	87.37
	8Q	15.83	15.59	9.77	9.07	8.85	40.89
	12Q	14.47	15.52	10.14	9.64	9.34	40.90
Germany	1Q	1.94	0.40	4.15	21.69	5.30	66.52
	8Q	8.06	10.75	38.58	10.71	7.62	24.27
	12Q	8.90	10.41	37.58	10.42	9.26	23.43
Denmark	1Q	15.37	7.55	4.52	20.91	3.54	48.12
	8Q	31.68	18.77	7.39	9.08	4.34	28.75
	12Q	31.66	18.79	8.36	8.80	4.95	27.44
Finland	1Q	19.90	0.62	0.00	0.10	3.54	75.85
	8Q	19.15	4.43	8.09	17.02	8.92	42.39
	12Q	18.59	4.88	9.51	16.29	9.42	41.31
Czech Republic	1Q	32.52	0.07	1.21	0.62	16.10	49.48
	8Q	23.04	13.94	9.09	10.66	17.90	25.36
	12Q	22.56	15.65	8.56	10.55	18.72	23.97
Slovakia	1Q	1.14	11.12	0.19	0.43	6.94	80.18
	8Q	9.62	14.37	3.23	2.70	10.25	59.82
	12Q	9.85	15.02	4.67	2.61	10.31	57.54

Table 5.4.: Variance decomposition

5.2.2. Impulse response functions

Second part of VAR analysis explains impulse response functions. IRF shows the effect of (unexpected) innovation (shock) on the adjustment path of the variable in selected time horizon. IRF predictions are again limited by time horizon, but in short time IRFs are sufficient for analysis The main advantage of using IRF is how they show size of the innovation, and also the rate at which the innovation disappears allowing for interdependencies (variables mutually dependent one the others). IRF for individual country shows how the price of single family house responses to the innovation of other variables (IRFs between other variables could be interesting, but the main concern of this study are family house prices). The order of endogenous variables is also important for proper analysis. The same logic, for ordering, was used as for variance decomposition. Time horizon of IRF is set for 10 quarters (two and a half year).
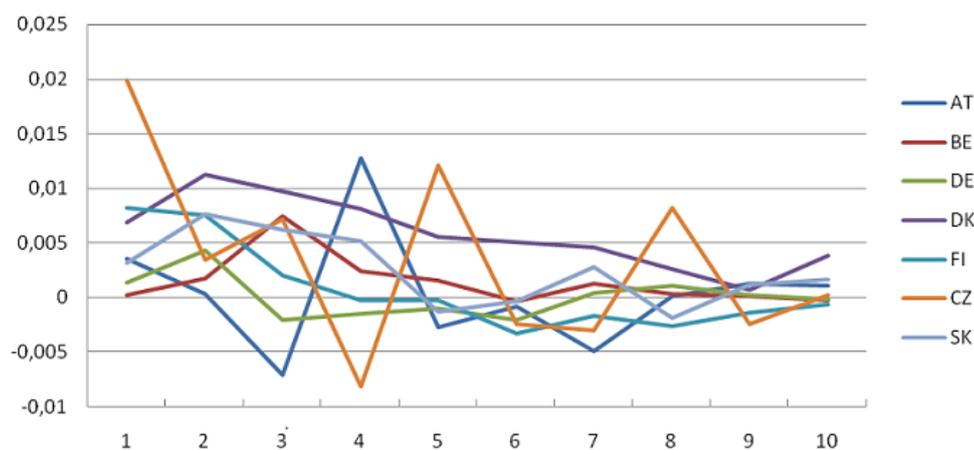

Figure 5.3.: Response of housing prices to GDP growth shock

Figure 5.3. shows the impulse response function of family house prices to GDP growth shock. All countries response positively to the shock in GDP during first quarter. Austria shows high volatility in a response to the shock. Positive effect in first quarter is changed into negative one during first year, but at the end of the same year the response is highly positive. Later, the effect dies out over Q10. The rest of the developed countries do not strongly react on changes in the GDP and oscillates within ±0.5% interval. The only exception is Denmark, where house price response gains highest value in second quarter and slowly dies out after second year with another positive response in last quarter. This is an usual situation, when housing price response remains volatile in longer horizon. Responses of transitional countries are

vastly different. Czech Republic follows Austrian path with high volatility. Slovakia remains relatively immune again GDP shocks.
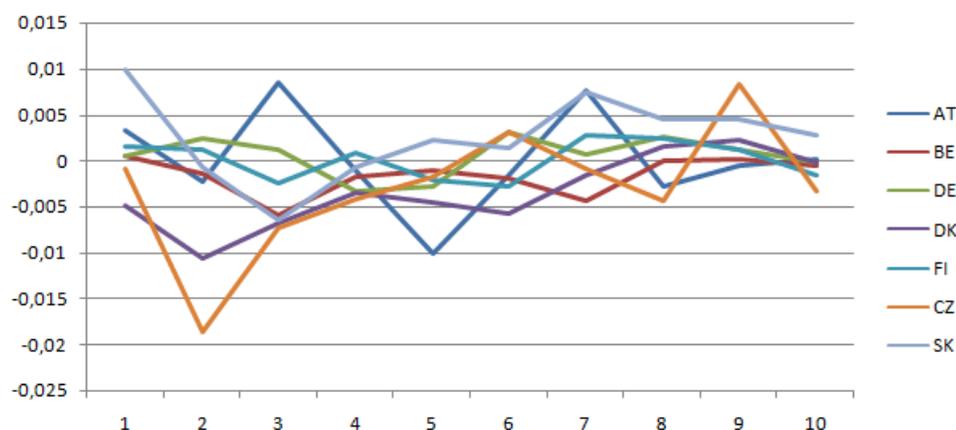

Figure 5.4.: Response of housing prices to ST interest rate shock

Figure 5.4. shows the response of house prices to shock in short term interest rate. After the shock, house prices decrease in the Czech Republic and Denmark. At the end of observed horizon, the effect dies out only in case of Denmark. On the other hand, IFR of the Czech Republic is still quite volatile, and even after two years this effect does not seem to die out. Slovakia follows the same path as Czech Republic with exception in immediate response to shock which is highly positive. Strong volatility is visible in Austria. The imperfect financial system may be the cause for high volatility among transitional countries, but in case of Austria, this could be an effect of European debt crisis in 2010. The negative impact after one quarter can be seen for Belgium which fulfills the expectations of lower housing prices to interest rate shock. Germany and Finland house price responses oscillate within 0,5% interval.

Next figure 5.5. shows the effect of the shock to growth of banking loans for house purchases. All countries respond differently, but the effect dies out in last tenth quarter. Both transitional countries response similarly to the shock. The strong negative impact shows on second quarter which turns into a positive one during sixth quarter. On the other hand, Germany and Austria immediately after the shock respond negatively, but after two quarters both increases to 0.9%, respectively to 1.6%. In the case of Belgium, Denmark and Finland, the countries do not respond outside of ±0,5% interval. This supports minimal share of bank lending growth in variance decomposition of these countries.

A shock to the share price index is visible in figure 5.6. *SPI* stands for alternative
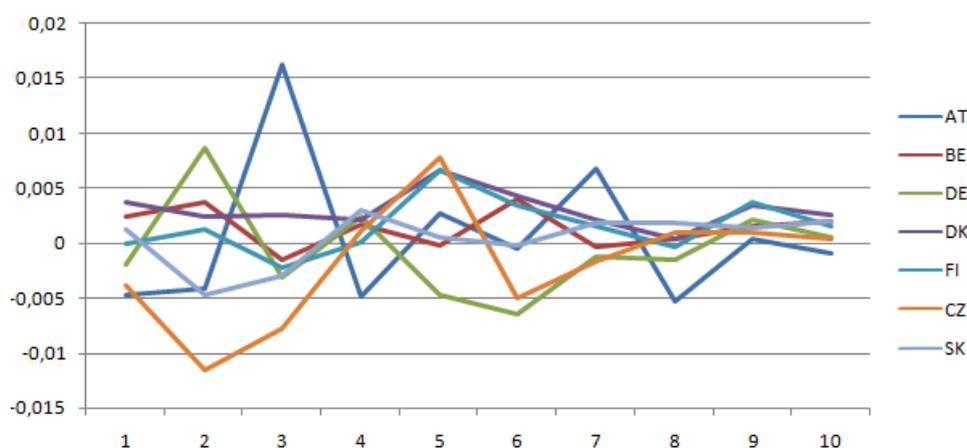
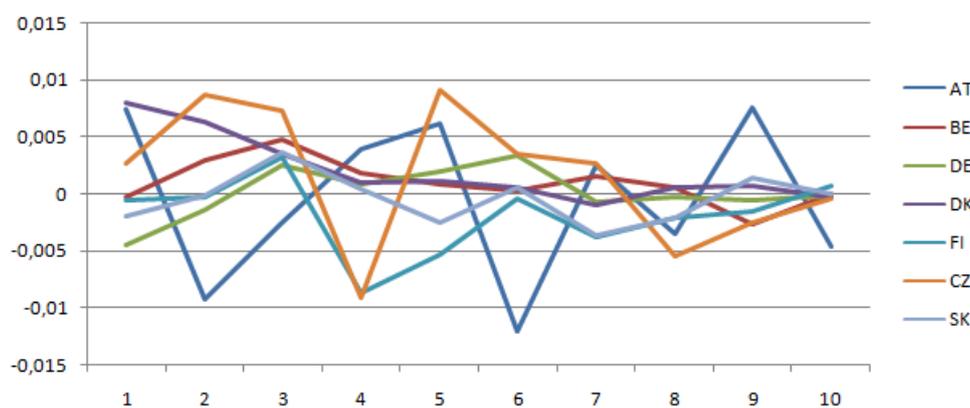Figure 5.5.: Response of housing prices to bank credit shock

Figure 5.6.: Response of housing prices to SPI shock

investment into equity market. IRF for all countries are quite volatile. This can be explained by different effects connected to housing and equity investments. House purchase is usually the largest investment for every individual. Higher house price may reflect the willingness to spend more money on family house than for other investment (such as equity market). This effect is called substitution effect. Another effect is called wealth effect. The individuals who already own a family house may feel wealthier with rising house prices, thus they can spend more money on alternative investments. In case of Finland, it seems that the substitution effect prevails as the impulse response is negative. Negative respond is visible also in Germany and Belgium, but this changes after second quarter. Austria, Denmark and Czech Republic respond positively to the immediate shock to share price index. Only in case of Denmark, the wealth effect is visible, but slowly dies out in sixth quarter. In Slovakia shock to the *SPI* has virtually no effect on house prices.

Following figure 5.7. depicts response house price to a shock in labor cost index. The high volatility is visible in case of the Czech Republic. After second quarter, the response is strongly positive, and it seem that the effect may die out after tenth quarter. In the case of Slovakia, the response follows almost the same path but less volatile. Developed countries does not seem to respond to the *LCI* shock, only Austria seems to have strong positive reaction.
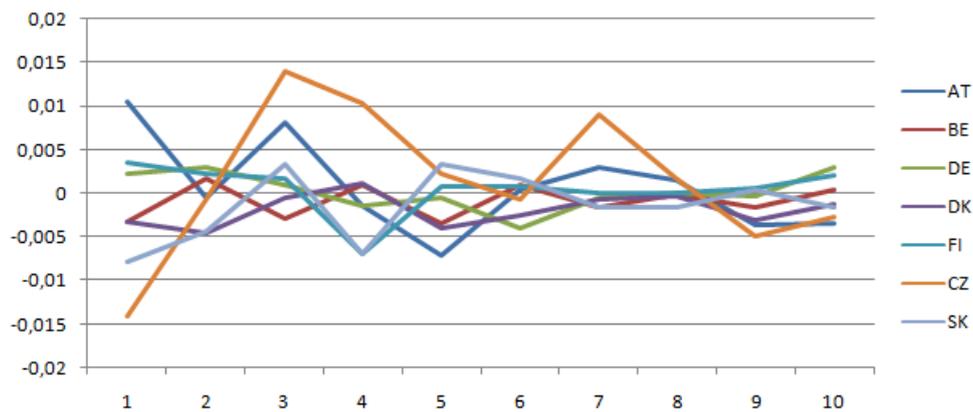
Figure 5.7.: Response of housing prices to LCI shock

The last figure 5.8. depicts the response of housing price to itself. Variance decomposition showed high persistence of housing prices. The only two countries with relatively lover persistence in housing prices are Germany and Denmark, but IRF does not show any visible differences to the rest of the countries. Austria is the only country which visibly differ from rest of them. An immediate positive impact of the shock falls from 4% to -2.5% in second quarter. During whole horizon, the response is relatively volatile and finally dies out after tenth quarter.
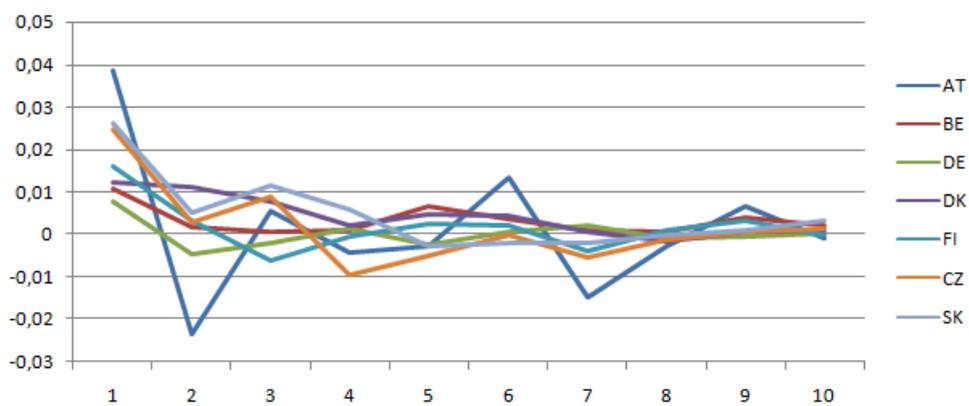
Figure 5.8.: Response of housing prices to housing price shock

The impulse response functions of transitional countries represented by the Czech Republic and Slovakia follow similar patterns. Usually, IRF of Czech Republic are much more volatile than its neighbor. The shock for Slovakia seem to be persistent over time and slowly die out after two years. Developed countries as a group respond similarly too, with exceptions of shock to share price index and bank credit growth, where high volatility is observed. Austria seems as an outlier in this group for its volatility which does not usually end after whole horizon. Response of house prices to itself shows no deviation and indicates high persistence, the same result was achieved by variance decomposition.

Conclusion

The main idea of this study is to discuss and interpret family house market in Europe during the recent economic crisis. Real estate market was previously discussed by different studies with focus mainly on apartment price (Hlavacek and Komarek (2009) Posedel and Vizek (2009)). This is the first study which deals with housing price index based on single family house prices. A family house is usually the single biggest investment for ordinary household during its lifetime. Strong fluctuations in house prices can influence household's behavior because of wealth effect. On the other hand, housing market makes a substantial part of the overall economy. These conditions make understanding of price determinants important, not only for policy makers (governments or central banks) but also for individuals within economy. The housing bubble in the United States brought attention of economists into this area. Still, their effort was limited mainly on residential market in the United States. This thesis provides a comparative study between housing price determinants among the transitional and developed European countries. Another output of this study is to prove or disprove the evidence of the housing bubble in last decade.

Despite many studies published after housing bubble, sufficient housing data are still an issue. This study uses house price indices collected by BIS. Still, there is large variability in methodology used to obtain the data. This happens partly because of heterogeneity of housing market itself, but this not answer the question why almost all countries apply different frequencies or methodology. The analysis is based on quarterly data since 2000. Authorities in Slovakia and Germany provides quarterly house price indices only since 2003, thus prior to this year, the data had to be linearly interpolated.

First part of this thesis analyzes panel data separately for transitional a developed European countries and compares the estimated results. As expected and proved by previous studies, the most significant housing price determinant, for both groups, is the households' income. The real GDP growth is taken as a proxy for disposable income. Other significant variable for both groups is housing loan interest rates

with negative sign. This imply, growing interest rates limits the growth in house prices, and people are willing to save money and less invest into real estates. The Czech Republic and Slovakia showed strong significance of the unemployment rate (negative sign of the coefficient, as expected). Other significant variable is share price index (lagged by one quarter) with positive sign indicating wealth effect. This results are relatively surprising, because people in transitional countries do not invest into bonds or stocks. However the variable is lower than one, thus the real impact is minimal. On the other hand, house prices in developed countries are positively influenced by amount of bank credit for house purchases in the economy. The only significant supply side determinant among developed countries is the labor cost index. Estimated FE model with added housing index lagged by one quarter results into high price persistence. Panel data analysis concludes that family house market in Europe is predominantly demand driven, but housing market in developed countries is influenced also by supply side factors, such as labor costs.

Possible evidence of housing bubbles is obtained from residual plots of restricted FE model. This approach confirms one visible bubble among developed countries. Denmark's housing bubble peaked in first half of 2006, too soon, prior to housing bubble in the United States. Transitional countries noticed first small bubble prior entering the EU. In the Czech Republic and Slovakia, next overvaluation corresponds with the bubble in the United States with its peak value at the end of 2007 or in first quarter of 2008.

The estimated results, for capital cities of transitional countries, follow its own path. The assumed hypothesis of similar house price determinants among developed European countries and both Bratislava and Prague is not fulfilled precisely. The assumption was based on recent statistics, that both capital cities belong to the most developed regions within EU. This may imply similar determinants to developed countries. However, the only variable where capital cities differ is unemployment rate lagged by two quarters. This result comes unexpected, usually, capital cites maintain almost no unemployment rate, thus the effect should not differ from zero. The estimated results are strongly limited by explanatory variables which are not usually collected for specific region or city, but only for national level.

Next part of this study employs VAR model for each country separately. This approach employs variance decomposition to measure relative importance of a shock in the overall dynamics of VAR. The results for variance decomposition after two years differ among countries and within groups. In Slovakia, the highest share of variance in family house prices belongs to price persistence. In the Czech Republic,

there is no dominant factor, share of variance is divided between price persistence, disposable income (proxied by GDP growth) and labor cost index. Strong price persistence is visible also in Austria. The volatility of family house prices is mainly explained by amount of bank credit in Germany and disposable income in Denmark.

Further part of VAR analysis employs impulse response functions. IRF tries to qualify and predict reaction (response) of family house prices to (unexpected) shock in one variable in the system over two and a half year time horizon (10 quarters). Similar results were achieved as in variance decomposition, response of house prices to itself indicates high persistence. The individual responses are similar for countries within the group with exception of shocks in share price index and bank credit. IRFs in these case are rather volatile and die out at the end of the time horizon. In case of Austria, IRFs to the shock in various variables stay volatile even after observed horizon.

Results of this study concludes similar price determinants on family house market as for apartment prices concluded by previous economists. High price persistence and household's income are significant determinants in both residential markets and across Europe. The study showed that even developed countries differ among each other. The real family house price index in Germany is almost flat during whole decade. On the other hand, Denmark registered its housing bubble in 2006, and house prices in Belgium tend to stay high even during the recent crisis. Further analysis of residential housing market may focus more deeply on capital cities among European countries. Current research is limited by accessibility of time series data and insufficient regional statistics. Another possible extension may follow, when the European economics overcome the recent economic crisis.

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Appendix A
Data set

Residential Property Price Indices

If not otherwise stated: single-family houses; quarterly data; source: BIS

`http://www.bis.org/statistics/pp.htm`

AT: Whole country excluding capital city & Capital city; existing; per square meter; index, 2000=100

BE: Whole country & Capital city; existing; per dwelling; index, 2005=100

DE: Whole country; all; pur price; index, 2003=100; Big cities; annually; existing; per dwelling; index, 2010=100

DK: Whole country; all; pur price; index 1980=100; Capital city; index, 2006=100; Source: Statistics Denmark

`http://www.dst.dk/en/Statistik/emner/ejendomme.aspx`

FI: Whole country; existing; per square meter; index, 2005=100; Capital city; index, 2005=100; Source: Statistics Finland

`http://www.stat.fi/til/asu_en.html`

CZ: Whole country & Capital city; existing; per square meter; index, 2010=100; source: CZSO

`http://www.czso.cz/csu/2013edicniplan.nsf/publ/`
`7009-13-r_2013`

SR: Whole country & Capital city; existing; per square meter; index, 2002=100; Source: NBS

`http://www.nbs.sk/sk/statisticke-udaje`

Housing loans interest rate

AT: Loans for house purchases, all loans; Source: Oesterreichische NationalBank
```
http://www.oenb.at/en/Statistics/Standardized-Tables/
interest-rates-and-exchange-rates/
Interest-Rates-of-Credit-Institutions.html
```

BE: Interest rates on loans in EUR to households for house purchases; Source: National Bank of Belgium
```
http://www.nbb.be/pub/stats/markets/markets.htm?l=en
```

DE: Effective interest rates of German banks. Housing loans to households with maturity of over 5 years: Source: Deutsche Bundesbank
```
http:
//www.bundesbank.de/Navigation/EN/Home/home_node.html
```

DK: Effective interest rate including fees (per cent); Households; Lending - Housing purposes; Source: Danmarks Nationalbank
```
http://www.nationalbanken.dk/en/statistics/find_
statistics/Pages/Interest-rates-and-exchange-rates.aspx
```

FI: Interest rate on housing loans to households over 1 year; Source: Bank of Finland
```
http:
//www.suomenpankki.fi/en/tilastot/Pages/default.aspx
```

CZ: Interst rate on loans for house purchases to household: Source CNB
```
http://www.cnb.cz/docs/ARADY/HTML/index.htm
```

SK: Loans to households for house purchases: Source NBS
```
http://www.nbs.sk/sk/statisticke-udaje
```

Bank credit

Credit to non-financial private sector; Borrowing sector: Households; adjusted for breaks, in local currency; Source: BIS
```
http://www.bis.org/statistics/credtopriv.htm
```

The following statistics were collected from OECD statistics.
`http://stats.oecd.org/#`

Core Inflation - Consumer prices (all items; non-food; non-energy); Percentage change from previous period

GDP growth - Growth rate of GDP (expenditure approach); Growth rate compared to previous quarter, seasonally adjusted

Share price index - Prices of common shares of companies traded on national stock exchange; 2010=100

Unemployment rate - Harmonized unemployment rate, seasonally adjusted

Labor cost index - Unit labor costs measure the average cost of labor per unit of output and are calculated as the ratio of total labor costs to real output; 2010=100, seasonally adjusted

Interest rates - Short term and long term interest rates; Percent per annum

Appendix B
Models

Following table depict the results of panel data regression (71 observations) for Slovakia and the Czech Republic.

	Full model		Restricted model	
	POLS	FE	POLS	FE
Intercept	-0.0305	4.417		8.359**
	(0.444)	(4.299)	-	(3.989)
Family house prices (-1)		0.953***		0.916***
	-	(0.043)	-	(0.040)
GDP growth	38.216	35.226		
	(30.826)	(31,088)	-	-
GDP growth (-1)	77.310***	77.588***	72.363***	90.351***
	(20.199)	(26.294)	(25.935)	(23.199)
Unemployment (d)	-122.828	-117.294	-144.489	
	(87.627)	(87.996)	(83.374)	-
Share price index (d)	-0.006	-0.014		
	(0.020)	(0.021)	-	-
Labor cost index (d)	-0.093	-0.112		
	(0.263)	(0.264)	-	-
Bank credit growth	-3.299	-1.954		
	(6.068)	(6.175)	-	-
Interest rate (d)	59.799*	59.147*	83.453**	97.989***
	(34.376)	(34.471)	(31.903)	(29.658)
R^2	0.287	0.924	0.210	0.904

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

d - difference; -1 - lagged by 1Q; Std. errors in parenthesis

Following table depicts the results of panel data regression (218 observations) for developed countries.

	Full model		Restricted model	
	POLS	FE	POLS	FE
Intercept	0.099	4.523***		4.970***
	(0.265)	(1.438)	-	(1.392)
Family house prices (-1)		0.961***		0.959***
	-	(0.012)	-	(0.012)
GDP growth	57.841**	55.884**	44.358*	70.745***
	(27.734)	(27.521)	(19.949)	(26.131)
GDP growth (-1)	11.218	6.694		
	(19.298)	(19.026)	-	-
Unemployment (d)	-40.716	-65.152		
	(68.732)	(68.244)	-	-
Share price index (d)	0.022*	0.025**	0.021*	0.028**
	(0.012)	(0.012)	(0.012)	(0.012)
Labor cost index (d)	0.244	0.302		0.412*
	(0.229)	(0.226)	-	(0.215)
Bank credit growth	25.390*	19.030	31.767***	
	(14.352)	(14.934)	(9.293)	-
Interest rate (d)	38.168	41.980	46.028*	46.724
	(27.643)	(27.249)	(26.026)	(26.865)
R^2	0.120	0.973	0.111	0.973

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

d - difference; -1 - lagged by 1Q;

Std. errors in parenthesis

Following table depicts the results of panel data regression (67 observations) for capital cities Bratislava and Prague.

	Full model		Restricted model	
	POLS	FE	POLS	FE
Intercept	-0.112	1.329	-	4.535
	(0.414)	(3.361)		(3.078)
Family house prices (-1)	-	0.986***	-	0.958***
		(0.031)		(0.029)
GDP growth	78.440***	77.782***	77.293*	68.130***
	(28.749)	(29.146)	(22.146)	(23.034)
GDP growth (-1)	61.195**	61.354**	43.580**	39.942*
	(24.432)	(24.693)	(20.307)	(20.619)
Unemployment (d)	3.079	7.157	-	-
	(81.719)	(68.244)		
Share price index (d)	-0.023	-0.025	-	-
	(0.019)	(0.019)		
Labor cost index (d)	0.458*	0.443*	0.438**	0.420*
	(0.245)	(0.248)	(0.213)	(0.245)
Bank credit growth	2.240	2.246	-	-
	(5.569)	(5.795)		
Interest rate (d)	28.144	27.475	-	-
	(32.058)	(32.299)		
R^2	0.269	0.961	0.182	0.953

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

d - difference; -1 - lagged by 1Q;

Std. errors in parenthesis

Appendix C
Residuals