Charles University in Prague

Faculty of Social Sciences

Institute of Economic Studies

MASTER THESIS

Do changes in the Interest Rate impact the Housing Prices?

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Declaration of Authorship

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

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Prague, July 31, 2012

Signature

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A special thanks to my family and Sereja Shyrko for their unbelievably strong support throughout the whole process of my research.

Abstract

The aim of this thesis is to examine the impact of the interest rate change on the housing market. We are using the quarterly data for GDP, consumption, investment, housing prices, short-term interest rate and unemployment to estimate two VAR models. The extended model contains all the variables just mentioned and for the estimation of the base model consumption and the unemployment rate is excluded. Our sample consists of Belgium, France, the Netherlands, Portugal, Sweden and the United Kingdom. We present the impulse responses of the housing price and GDP to a shock in the interest rate and variance decompositions of the housing price index. The results show that the changes in the interest rate can explain the evolution of the housing price index. However, the impact differs from country to country.

Keywords: housing price index, short-term interest rate, overvaluation, VAR model, impulse response, variance decomposition.

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Acronyms

AIC	Akaike criterion
BIC	Schwarz Bayesian criterion
BIS	Bank for International Settlement
HPI	Housing Price Index
HQC	Hannan-Quinn criterion
IFS	International Financial Statistics
OECD	Organization for Economic Cooperation and Development
VAR	Vector autoregression

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Master Thesis Proposal

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Proposed Topic:

Monetary policy and interest rate: empirical investigation

Topic Characteristics:

Recently there were arguments that low interest rate causes imbalances in the asset market which may even lead to a bubble. Taking a close look at the real estate market I would like to find out whether it is true for this market. I will investigate whether monetary policy influences property prices and how it does so. It is known that prices on housing changed dramatically during recent decades and I would like to investigate the main contributors to the price surge.
The data will be taken from Bank of international Settlement, IMF and ECB. I will also collect additionally some of the data by myself using other sources.

Hypotheses:

1. Low interest rate causes imbalances in the real estate market
2. Increase in the real estate demand is due to low interest rate
3. Decline in the interest rate is associated with rising asset prices on the real estate market
4. Boom in housing demand leads to surge in the housing price inflation
5. Loose monetary policy results in a rapid credit growth
6. The correlation between credit growth and increase in the real estate demand is strong

Methodology:

To investigate the issues described above I am planning to apply vector autoregression model following the methodologies of Gerlach (2008) and Jarocinski (2008). I will take a look at impulse responses of the variables which will give a possibility to trace out the responsiveness of variables to shocks. I am also planning to take a look at variance decomposition and analyze its results. To see how changes in one variable will influence another and whether some changes are possible I will use Granger causality test to find it out.

Outline:

1. Impact of changes in the interest rate on the real estate market
2. Outcomes of housing demand
3. Monetary policy and property prices:
    a. Channels of influence
    b. Outcomes of the influence

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Author

Supervisor

Introduction

It is well known that the primary objective of the Central Bank is to maintain price stability in the country. When some external or domestic shock occurs in the economy the Central Bank reacts to it by changing its policy. Thus, to reach price stability or achieve other objectives the Central Bank adjusts its policy instruments. As a result the economy is affected through different channels of transmission which touch various variables and markets with different speed and strength. To understand the transmission channels is of vital importance as by knowing it Central Banks will have the most efficient set of instruments which will effectively react to the shocks in the economy.

One of the main tools used by the Central Bank is the interest rate over which it has full monopoly power. By changing the interest rate the Central Bank impacts the price level through different indicators. Recently, after the financial crisis there were arguments about the degree the changes in the interest rate influence the housing market and whether it is one of the main contributors to the boom.

In recent decades the importance of the housing market substantially grew up. Its share in GDP is one of the largest among the single contributors resulting in dependency of the economies on the housing market changes. Beside the importance on the country`s level the housing market plays an important role in the balance sheet of a household being the largest asset and a liability at the same time.

Starting from the late 90^{th} the housing market all over the world experienced fast price surge. In some countries it was so fast that in a couple of decades the prices were twice higher than the historical long-term mean. One of the factors that cause imbalances in the housing market is considered to be the interest rate. Despite the clear transmission channels of the interest rate changes to the housing prices level there are still some arguments about the degree the interest rate impacts the housing market and whether it is one of the main contributors to the housing market bubble.

Taking all this information into account we are first of all interested in our research in analyzing the impact of the interest rate increase on the housing market. That is why we, firstly, discuss the existing transmission channels for the housing market in details highlighting the importance of the interest rate changes for the housing market.

Secondly, we make an empirical research for the 6 countries in order to show the importance of the interest rate for the housing markets of these countries. We apply VAR model which is the benchmark for estimation the problems as ours. Thus, we use quarterly data for GDP, consumption, investment, housing prices, short-term interest rate and unemployment to estimate two VAR models. The extended model contains all the variables just mentioned and for the estimation of the base model consumption and the unemployment rate will be excluded.

The empirical part includes the discussion about the impulse responses of the housing price index and GDP to a positive shock in the interest rate. In addition, we discuss the forecast variance decompositions for the housing price index in order to see the share of the interest rate in the evolution of the index.

The research is structured as follows. First chapter discusses the six monetary transmission channels for the housing market. Second chapter starts with an empirical part where theoretical issues of the VAR model are explained. After that we explain the two VAR models we use in our paper and the issues the researcher can face with when doing some similar analysis. We provide the detailed information about the data transformation we applied to our time series in this chapter as well. Third chapter provides the statistical overview of the development of some main macroeconomic indicators and the evolution of the housing price index for the six countries. Fourth chapter shows the results of the VAR model. Thus, the process of the lag selection is discussed together with the impulse responses of the housing prices index and GDP to a positive shock in the interest rate. We also provide results for the forecast variance decomposition of the housing price index in this chapter.

1. Monetary Policy Transmission Channels in the Housing Market

1.1. Introduction

Monetary policy includes actions and rules that monetary authority uses to accomplish its goals. The primary objective of the Central Bank is to maintain price stability in the country. The objectives may differ from country to country and may encompass confidence in the currency (Bank of England), maintenance of full employment or financial stability in the country in general.

When some external or domestic shock occurs in the economy Central Banks react to it by changing their policy. Thus, to reach price stability or achieve other objectives Central Banks adjust their policy instruments[1]. As a result the economy is affected through different channels of transmission which touch different variables and markets with different speed and strength. To understand the transmission channels is of vital importance as by knowing it central banks will have the most efficient set of instruments which will effectively react to the shocks in the economy.

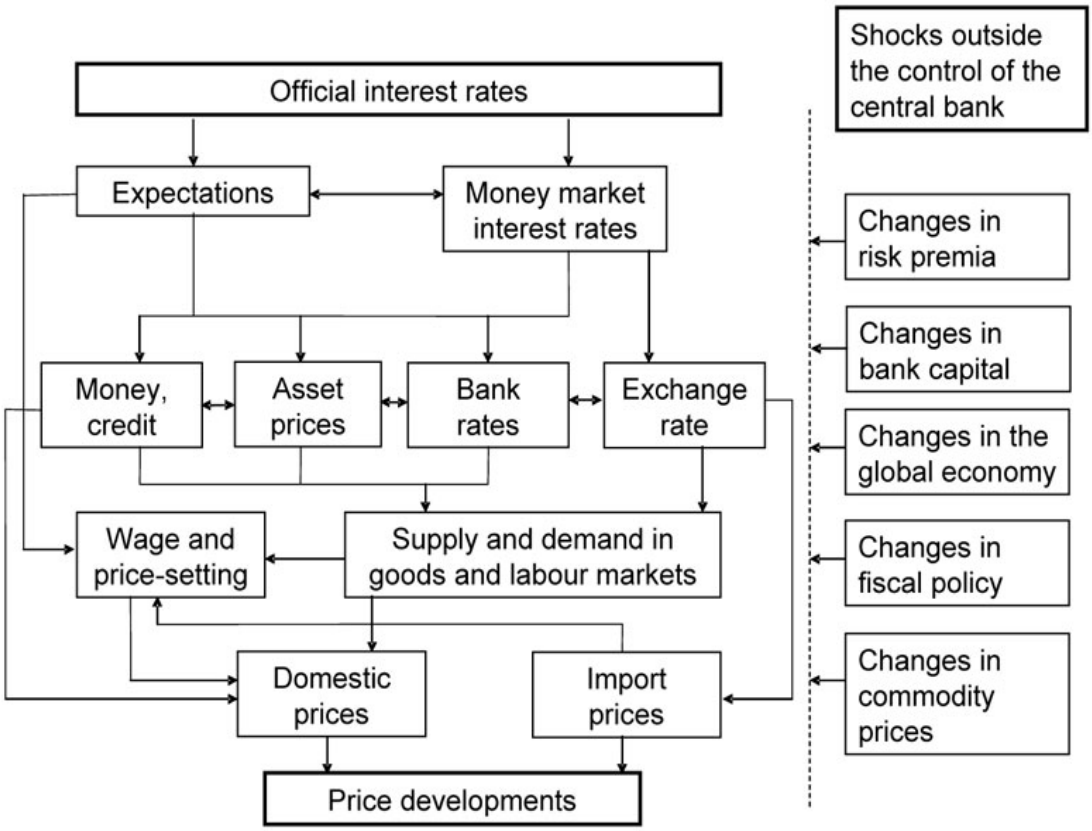
One of the main tools used by the Central Bank is the interest rate over which it has full monopoly power. By changing the interest rate the Central Bank impacts the price level through different indicators. Firstly, expectations of the future development of the interest rate are affected and thus medium and long-term interest rates. From Figure 1 one can see that it leads to changes in wage and price-setting which at the end determines the domestic prices. Secondly, money-market interest rates are directly affected leading to adjustments in supply and demand. There are also some other factors that influence the price level and are out of the control of the

[1] open market operations, standing facilities, minimum reserve requirements for credit institution (ECB)

central bank. Among them are changes in the fiscal policy, bank capital, risk premia and others.

Researchers were trying to take a closer look at each of the links leading from the interest rate to a price change separately and as a results several channels evolved. Thus the main four channels are the interest rate, credit, exchange rate and wealth channel (or the asset price channel). Egert & MacDonald (2008) discuss these four channels in details by taking a look at Central and Eastern Europe. Thus, we would not go deep into the details dicussing the monetary transmission channels as the authors provide the detailed information on the recent literature and empirical results on this topic.

Figure 1. Monetary Transmission Mechanism



Source: ECB

However, the literature on transmission channels in housing market is not that diverse. Thus, this chapter will provide an overview of the existing transmission channels in the real estate market, recent empirical literature on the housing studies and models the researchers use to track changes in the real estate market.

1.2. Transmission Channels in the Housing Market

The transmission channels discussed above are the general representation of affects of changes in the interest rate on the price level. These are the general channels which can be applied to different markets. For some markets different channels can be more important than others. Therefore, for the housing market, according to Mishkin (2007), there exist 6 channels the interest rate impacts the economy. Thus, changes in the interest rate directly influence (1) the user cost of capital, (2) expectations regarding the house price movements and (3) housing supply. Indirectly it has an influence through (4) wealth effect, (5) credit-channel effects on consumer spending and (6) housing demand. All the channels are described one by one in a greater detail below.

User Cost of Capital

According to Poterba (1984) and Jorgenson (1963) user cost of capital is one of the main determinants of the demand for residential capital. The formula of it looks as follows

$$uc = ph[(1-t)i - \pi_h^e + \delta] \tag{1.1}$$

Where:

i is the mortgage rate,

π_h^e is the expected appreciation of housing prices,

δ is the depreciation,

ph is the value of a housing.

This formula can also be adjusted to tax rates and mortgage interest rate (see Mishkin (1996) for more details). Thus, the adjusted formula can be rewritten as

$$uc = ph[\{(1-t)i - \pi^e\} - \{\pi_h^e - \pi^e\} + \delta] \quad (1.2)$$

Where $\pi^e$is the expected inflation rate and $\{(1-t)i - \pi^e\}$ is the real interest rate after taxes. It can be proved[2] that Formula 1.2 can be rewritten as Gordon Growth model of stock prices (Gordon, 1962). It evaluated the asset price based on the net present value of the future series of dividends that grow at a constant rate.

Asset Price = Dividend / (Interest rate – Dividend growth rate)

When we apply the model to the housing market it will look as follows (Mayer & Hubbard, 2008):

House Price =Rent/(Interest Rate – Rental growth rate)

This model shows that there is a convex relationship between the interest rate and the house prices. Therefore, the lower the interest rate falls the bigger the percentage increase in the prices. Thus, when monetary authorities rise interest rate it leads to an increase in *uc* and decrease of the demand in the real estate market. As a result housing construction falls leading to a decline in the aggregate demand in the economy.

As the empirical literature is concerned, the study by Hilbers *et al* (2008) shows that the Nordics, Belgium and Ireland, having bigger decline in the user cost, experienced higher-than-average increases in the housing prices. At the same time

[2] Under efficient markets and capital in real estate one can show that $ph \approx R/[(1-t)i - \pi^e - g + \delta$, where R is real rents, *i* is long run interest rate and on the long run $g \approx \pi_h^e - \pi^e$ (see Mishkin for more details)

Switzerland and Germany had lower-than-average increases in the prices with smaller declines in the user cost.

Expectations regarding housing prices

According to Case and Shiller (2003) expectations regarding the development of the housing prices ($\pi_h^e - \pi^e$) affect the user cost of capital and as a result the housing demand. When the interest rate rises, pressure on the housing prices declines due to a decrease in demand. Thus, the expectations that it can happen affect the expected real rate of appreciation of the housing prices leading to a decrease in demand and residential construction.

One of the questionable issues concerning this channel is whether the housing prices should be calculated taking into account the structure only or including the price of land on which the house is situated. If to include both it will affect the expected rate of appreciation in the user cost formula. That is, if appreciation is mostly due to increase in the land value, then there can be no influence on demand for buildings and as a result on the housing construction. However, the land price appreciation can stimulate new constructions in the suburbs where lend in cheaper than in the metropolitan area.

The results of the land appreciation are quite twisted and hard to measure. In this case one fact can lead to two different outcomes at the same time. Thus, evaluation of this channel is not an easy task.

Housing Supply

According to the empirical research by McCarthy (2002) there is an impact of the short term interest rate on the housing supply. The idea is that when constructors are building houses they need some financing to finish their job quickly. High short term interest rate will increase the cost of production and as a result decrease the

housing activity. Thus, this fact emphasizes the importance of the changes in the interest rate on the housing market supply side.

Some more recent theoretical paper by Levin and Pryce (2009) explores the responsiveness of the housing supply. The authors came up with the formula of the housing supply

$$Q_s = a + b[P - C] = a + \frac{bh}{r} - \frac{bl}{r} - bW \quad (1.3)$$

Where:

P - price of a house

C - construction costs

W - other construction costs (labor and materials)

h - stream of rents that a buyer avoids once a house is purchased

r – the real interest rate

l - stream of foregone alternatives of land (rental use for agriculture etc.)

From this equation several conclusions should be made. First, if the interest rate changes it affects both the land and the house prices. Second and the most important, decreasing the interest rate will increase the importance of the land development and for any development to occur *h* should exceed *l.* When the interest rate is law it leads to speculations from the developers side as they are reluctant to the land development. They believe that the profit from immediate development is lower than the one after they postpone it. Therefore, this simple algebraic model shows that the interest rate changes may cause weaker supply responses.

Wealth effect

Expansionary monetary policy implies decline in the interest rates awaking the housing demand and later higher house prices. As a result, an increase in total wealth encourages household consumption and aggregate demand. That is why wealth effect plays an important role in the monetary transmission mechanism.

According to the life cycle hypothesis of consumption and saving, developed by Modigliani & Brumberg (1954) and further investigated by Ando & Modigliani (1963), an increase in wealth despite the source of such increase (stocks, real estate or some other asset) should have the same impact on the household consumption. However, this view has been argued. The idea is that the changes in the housing wealth have greater impact on consumption than an increase in some other assets, like equity. Belsky & Prakken (2004) found that top 1% of stockholders owned one-third of total wealth in the stock market and the top 1% of houseowners had only one-eighth of the wealth in the real estate market which indicates that housing wealth is spread more evenly. Moreover, the housing prices are less volatile and thus the housing wealth is considered to be longer lasting.

Another arqument can be that an increase in the housing wealth has smaller effect on consumption because housing can work as a bequest. For homeowners who plan to live in their houses, and later to pass it to their children as a bequest, an increase in wealth, due to increase in the housing prices, will be followed by an increase in the costs of living in it. It means that despite the increase of housing wealth in will not increase their nonhousing expences. What is more, higher housing prices can even reduce consumption of those households planning to buy a new house.

Increase in the stock market wealth might have bigger effect on consumption than the housing wealth as it is more clearly connected to the developments in the productive potential of the economy. Increase in the housing prices may not be the evidence of an increase in the productive potential of the economy as it can be due to

supply constraints in the real estate market. One of the examples is the United Kingdom where supply restriction were very high. The housing stock rose by 7.6% starting from 1995 till 2005 compared to the United States where it rose at 40%. The prices in the UK have highly appreciated but the housing stock has not changed dramatically. It indicates that despite the housing wealth increase it does not immediatelly mean that the whole economy wins from it as well (Mishkin, 2007).

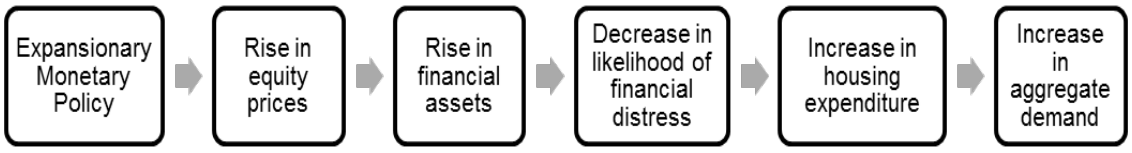
Credit-channel effects on consumer spending

In most cases the credit channel is discussed from the firms spending side and attention to th consumer spending is neglected. However, equal attention should be paid to both sides as the consumers spending on the housing and durable products play an important role in the household`s balance sheet and thus worth taking a closer look at. Restrictive monetary policy leads to a decrease in the bank`s lending and as a result to a decrease in the purchases of the housing and durables as some customers cannot effort high interest rates. The balance sheet of a household is negatively affected because consumers` cash flows are cut.

The balance sheet channel operating through consumers can also be explained by taking a look at liquidity of assets and its influence on the housing expenditures which according to Mishkin (1978) was an important factor during the Great Depression. The idea behind this is that consumers` ability and desire to spend is affected, rather than the lenders` ability to lend. It is known that the housing is quite illiquid asset and if consumers would like to sell it to get money quickly they will face big losses. Consumers will not be able to get the full price for their housing in the financial distress. The situation is quite different with the financial assets such as stocks or bonds. Owners can easily sell them for the full value and that is one of the reasons why consumers would prefer to hold financial assets if they expect to face the financial distress.

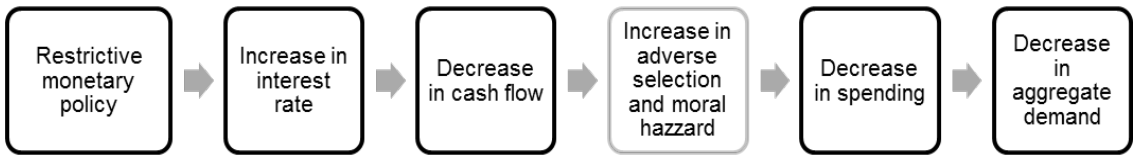
When consumers hold more financial assets than they have debts, they will be more willing to buy housing as they are not that sensitive to the financial distress. What is more, when the price on some financial assets rises the sensitivity to a distress weakens and consumers are more willing to spend money on the housing. For simplicity this channel is described in Figure 2 (Mishkin, 1996).

Figure 2. Credit Channel and Financial Distress



Another reason why consumer spending can decrease is explained by the scheme on Figure 3 (Mishkin, 1996). In this channel an unwillingness of consumers to spend influences the economy which is similar to the idea that lenders do not want to lend. The restrictive monetary policy raises the interest rate which leads to a decline in the households' cash flow and ability to spend. This channel influences consumer spending and as a results the housing demand.

Figure 3. Impact on the Balance Sheet of the Households



The important thing here is that by raising the interest rate banks increase problems with asymmetric information. Lenders are less willing to lend as they cannot distinguish whether the borrower can repay the loan. Even if the loan was given, the borrower has to invest into risky projects which will decrease the probability of repaying the loan. The solution to this problem is the presence of easily measured and valued collateral which can reduce problems with information. Under

such circumstances borrower will be less willing to invest into the risky project because in case of fail the borrower may lose the collateral.

When the house prices increase it automatically means that the value of the collateral increases. In this case the lender will be more willing to make loans and even improve the lending amount and its terms. This idea can also be explained in terms of the financial accelerator described by Bernanke & Gertler (1995). Even though an increase in the housing prices improves the balance sheet of the households it at the same time decreases the finance premium (the difference between the default-free and the effective interest rate).

As it was mentioned earlier higher the housing prices mean higher the collateral value which indicates that the households have higher ability to borrow. This can be simply called as a mortgage equity withdrawal which can increase the households` spending. It is considered an important channel with the help of which the households` spending can be identified (Greenspan & Kennedy, 2005). For example, Hatzius (2005) investigates the U.S. housing market for the period of 1990 till 2004 and finds that the mortgage equity withdrawals do decrease the personal savings and thus the real GDP growth.

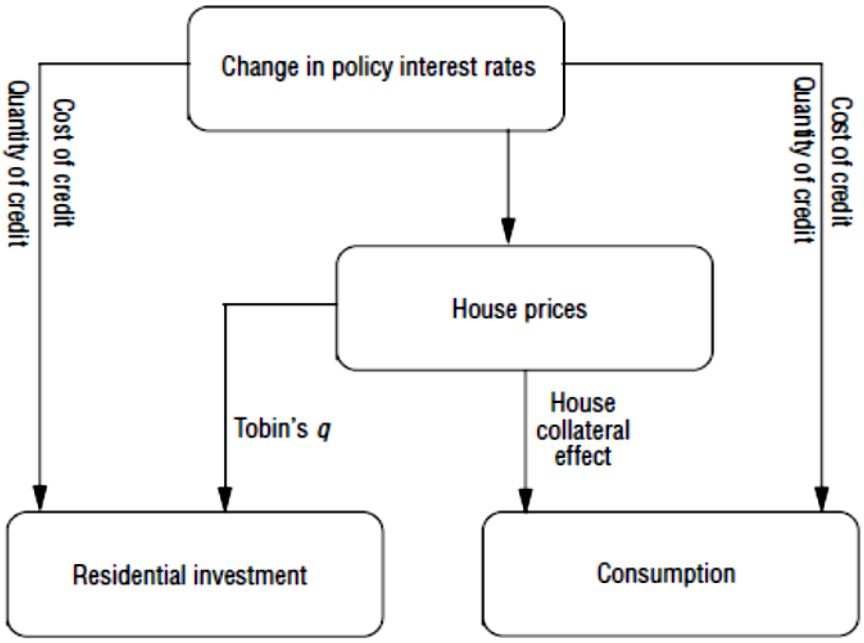
Credit-channel effects on housing demand

This channel has not been given much attention in the literature but its existence cannot be disqualifies. If households are credit-constrained it means that the housing demand is affected through households` cash flows. Reduction in the difference between consumers` income and expenses impacts the mortgage pie that they are qualified for and as it squeezes consumers can afford smaller housing amount. The empirical literature has quite mixed results of the effect of the cash flow (Hendershott, 1980), however, as the variety of the mortgage innovations broadens, raising the households` credit-worthiness, the attention to this channel may increase over time and thus make the effect clear.

From the other perspective the channel can be explained as shown in the Figure 4. When the interest rate changes it affects the domestic demand through the residential construction and the household spending plans. Households change their spending plans when the availability and cost of credit changes. Changes in the interest rate also move the house prices and those movements affect the aggregate demand. It can be explained by the Tobin`s q effect, which says that when the house prices are higher than the cost of construction it is profitable to construct new building, and by the ability of the household to use their houses as a collateral needed to finance the consumption.

Let`s take a look at the situation when the policy interest rate is very low. The domestic demand increases as the households would like to spend more due to the relative availability of credit. As a result the housing prices increase and if the rate is too low it may lead to a creation of a bubble which according to Brunnermeier (2008) means that the asset prices exceed its fundamental value because the owners of the asset hope to resell it at a higher price in the future.

Figure 4. Impact of the Interest rate in the Housing Market



Source: IMF (2008)

1.3. Conclusions

The channels discussed in the chapter show the importance of the interest rate in determining prices in the housing market. It also shows that changes in the interest rate can directly and indirectly influence the economy. However, there also exists an opposite point of view that the monetary policy is not the main factor leading to a bubble in the real estate market. There is a supporting literature saying that the housing market is one of the most vulnerable to the monetary policy actions (Boivin et al. 2010) and there is also an uncertainty to whether the policy actions can lead to a bubble in the housing market (Kohn, 2003). Dokko *et al* (2011) take a look at the U.S. housing market and compare it with other advanced economies. The authors came up to a conclusion that the monetary policy was not the main contributor to the bubble in the real estate. Thus, the effect of the interest rate changes is twisted and thus need further investigation. That is what we try to make clear in the following chapters for the 6 countries we have chosen.

2. Empirical model and data

2.1. Introduction

All the recent empirical literature uses the VAR model and its extensions to investigate the monetary policy impact on some indicator. Therefore, in our research we followed the pattern and used traditional VAR model to investigate how the monetary policy influences the housing prices.

We give some theoretical explanations and prehistory of the VAR model for those who have little experience with it. Thus, readers who are familiar with the model and its application can skip section 2.2 and go directly to the section 2.3 "VAR model in the housing market" were the model used in this research is described in more details.

The chapter also provides the information regarding the variables that were used. The data and its sources are described in details and the transformations that were done to it. Some explanations regarding the housing data issues a researcher can face with when doing some similar work are discussed as well.

2.2. VAR model

2.2.1. Prehistory of VAR model

The history of econometrics starts in the beginning of the 20th century when a group of econometricians and economists organized the Cowles Commission in the University of Chicago. At that time the VAR model as it is did not exist. What econometricians used was the simultaneous equation models (SEM)[3]. Only in 1980 VAR model was introduced by the econometrician and macroeconomist Sims (1980)

[3] See Baltagi (2002) for SEM or any other Advanced Econometrics book

whose intention was to analyse the causal relashionships among the time series variables. Such VAR models are also known as “structural” models as they are used to model the underlying structure of the economy (Stock & Watson (2007), see also Stock & Watson (2001) for the introduction of VAR). Now VAR models and its extensions are also used for the forecasting and due to its simplicity in implementation and estimation became a benchmark for the evaluation of the monetary policy transmission mechanism.

2.2.2. Structural and reduced forms of VAR

In general, the vector autoregression of order *p* is a set of *k* time series regressions. Regressors in this case are lags of all k series. VAR model is an extension of the univariate autoregression to a system, or “vector”, of autoregression equations. The general form looks as follows (Kratzig & Lutkepohl , 2004):

$$y_t = \alpha_1 y_{t-1} + \ldots + \alpha_p y_{t-p} + u_t \qquad (1.1)$$

For better understanding of the model VAR with two variables, y_t and x_t, is presented. For simplicity let’s consider first-order VAR (VAR(1)). The model will have two equations each of which will consists of its own lag and lag of other variable. The equations look as follows (Enders, 2003):

$$y_t = \beta_{10} - \beta_{12} x_t + \alpha_{11} y_{t-1} + \alpha_{12} x_{t-1} + \varepsilon_{1t} \qquad (1.2)$$

$$x_t = \beta_{20} - \beta_{21} y_t + \alpha_{21} y_{t-1} + \alpha_{22} x_{t-1} + \varepsilon_{2t} \qquad (1.3)$$

where ε_{1t} and ε_{2t} are uncorrelated error terms and are iid$(0, \sigma^2_{x,y})$; β`s are unknown parameters and y_t and x_t are stationary. From the structure of the system one can see that y_t and x_t are allowed to affect each other. Thus, if $\beta_{12}=0$, ε_{2t} does not have an indirect contemporaneous effect on y_t. If $\alpha_{21}=0$, changes in y_{t-1}do not effect x_t. The system of equations is written in so called *structural form* as there is the contemporaneous effect of variables on each other. To transform it into the reduced form one needs to follow the simple transformations. Rewrite the above mentioned system of equations into the following form

$$\begin{bmatrix} 1 & \beta_{12} \\ \beta_{21} & 1 \end{bmatrix} \begin{bmatrix} y_t \\ x_t \end{bmatrix} = \begin{bmatrix} \beta_{10} \\ \beta_{20} \end{bmatrix} + \begin{bmatrix} \alpha_{11} & \alpha_{12} \\ \alpha_{21} & \alpha_{22} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ x_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix}$$

or shortly

$$Bz_t = \Gamma_0 + \Gamma_1 z_{t-1} + \varepsilon_t \quad (1.4)$$

Where

$$B = \begin{bmatrix} 1 & \beta_{12} \\ \beta_{21} & 1 \end{bmatrix}, \qquad \boldsymbol{z_t} = \begin{bmatrix} y_t \\ x_t \end{bmatrix},$$

$$\Gamma_0 = \begin{bmatrix} \beta_{10} \\ \beta_{20} \end{bmatrix},$$

$$\Gamma_1 = \begin{bmatrix} \alpha_{11} & \alpha_{12} \\ \alpha_{21} & \alpha_{22} \end{bmatrix}, \qquad z_{t-1} = \begin{bmatrix} y_{t-1} \\ x_{t-1} \end{bmatrix},$$

$$\varepsilon_t = \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix}$$

To get a reduced form VAR one must premultiply the equation by B^{-1}. One will get the following standard form:

$$z_t = A_0 + A_1 z_{t-1} + e_t \quad (1.5)$$

where $A_0 = B^{-1} \Gamma_0$, $A_1 = B^{-1} \Gamma_1$, $e_t = B^{-1} \varepsilon_t$. In a non-martix form the model will look as follows

$$y_t = \alpha_{10} + \alpha_{11} y_{t-1} + \alpha_{12} x_{t-1} + e_{1t} \quad (1.6)$$

$$x_t = \alpha_{20} + \alpha_{21} y_{t-1} + \alpha_{22} x_{t-1} + e_{2t} \quad (1.7)$$

If $\alpha_{12}=0$ in the reduced form it means that lags of x_t do not help to explain the evolution of y_t ; $\alpha_{22}=0$ lags of y_t and do not explain x_t (Verbeek, 2004).

2.3. VAR model for the Housing Market

As it was already mentioned by our research we would like to prove that there is indeed no effect of the interest rate rise on the housing market and as a result on the economy as a whole. The estimation of the VAR model was done dividing the procedure into two models: base and extended. The base model consists of 5 variables and the extended of 7. The idea was to analyze to what extent the smaller model (base) differs from the one with more variables.

The vector of endogenous variables in the base VAR model looks as follows:

$$[\, y_t \quad HI_t/Y_t \quad hp_t \quad i_t \quad \pi_t]$$

Where:

y_t - real GDP;

HI_t/Y_t - housing investment as a share of GDP;

hp_t - house prices;

i_t - short term interest rate

π_t - inflation.

As for the extended model 7 variables were used as in the IMF (2009) and Dokko *et al* (2011). The order of the variables was chosen as one in the IMF (2009). The variables are divided into two categories as in Dokko *et al* (2011): monetary policy and housing market variables. Thus, the short-term nominal interest rate, inflation, the unemployment rate and real GDP are the set of variables used in monetary policy rules and are of particular interest to monetary policy authorities. Level of real personal consumption expenditures, the share of residential investment in GDP, and the real house prices are the housing market variables which are of particular interest in this research. These are the standard variables researchers use when they are trying to estimate the transition mechanism in the real estate market. Thus, the vector of variables in the extended model looks as follows:

$$[\, y_t \quad c_t \quad HI_t/Y_t \quad hp_t \quad i_t \quad u_t \quad \pi_t]$$

Where to the base model unemployment rate (u_t) and the real personal consumption expenditures (c_t) were added. In the empirical literature there exist some variations is the number of variables researchers use. Thus, Jarocinski & Smets (2008) use 9 variables[4] in their Bayesian Vector Autoregression (BVAR) model and try to estimate the influence of monetary policy and the real estate market on the U.S. business cycle. Dokko *et al* (2011) include the real GDP gap instead of the real GDP. As the quarterly data for real GDP gap was not available real GDP as in IMF (2009) was used in our research.

2.4. Sample and Data Description

For this research it was decided to use quarterly time series for 8 macroeconomic indicators used for estimating the effect of the short term interest rate increase on the housing prices in particular and the economy growth in general in the 6 countries. All the countries are developed ones from which 3 are the founders of the EU (Belgium, France and the Netherlands) and other 3 were joining the EU with the difference of 10 years.

Due to the data limitations the periods for which the models where estimated for each country varies. Thus, for the United Kingdom the data was available from 1985:Q1-2011:Q3, for Belgium and the Netherlands from 1995:Q2-2011:Q3, for France and Portugal from 1996:Q1-2011:Q3, for Sweden from 1993:Q2-2011:Q3.

The data was taken from the Organization for Economic Cooperation and Development (OECD) statistics, the International Financial Statistics (IFS) and the Bank for International Settlement (BIS). The exact sources for each variable see the Table 7 in the Appendix.

[4] Real GDP, the GDP deflator, commodity prices, the federal funds rate, real housing investment, real house prices, and the long-term interest rate spread.

GDP Gross domestic product - expenditure approach

GPSA: Growth rate compared to previous quarter, seasonally adjusted

C Final consumption expenditure of households

CQRSA: Millions of national currency, current prices, quarterly levels, seasonally adjusted

Inv Gross Fixed Capital Formation (proxy for investment)

national currency (euro), billions

hp Housing Prices

(see Table 1)

i Short-term interest rate

Per cent per annum

U Unemployment

All persons, Level, rate or quantity series, seasonally adjusted

Inf Consumer Prices- all items (proxy for inflation)

Percentage change from previous period

def Deflator

DNBSA: national base/reference year, seasonally adjusted

The housing price index data was available in different frequencies and measures. It is obvious that the nature the indexes are constructed differs as they are targeted for different audience and users (see Eurostat (2011), Chapter 9 for examples). For some countries the establishment of the needed infrastructure and system for the data collection for construction of the housing price index can be quite costly. As a result the data of property prices is collected by different agencies. Thus,

in the Netherlands and the UK the official source of data for the property price indexes is collected for the purposes of taxation and registration. In France indexes are calculated using the data provided by notaries. In Belgium and Portugal the sources for data are the housing consultancies, real estate agencies and research institutes. The comparability of data can be challenged due to different sources which have different goals for the data collection.

Changes in the methodologies and standards can also cause problems in the construction of the historical series needed for the analysis and modeling over more than one cycle. Moreover, the methodologies and sources of data are not often mentioned and inspection of the meta-data on the housing prices shows that it lacks harmonization. All this puts the implication of the international comparison of trends under question and, what is more, the credibility of the results.

Apart from the methodology the authorities of different countries use to compile the housing price index, data availability also faces the essential problems. Housing is heterogeneous in different dimensions (e.g., property in a capital is more expensive than the same property in some village) and beside that transactions in the market are not frequent which makes it hard to measure the housing prices objectively (see Eurostat (2011) for more details). Moreover, the asking price is negotiable which means that the final asking price can be different from the initial or expert price.

There also exist some other issues which describe Hilbers *et al* (2008) in their evaluation of the housing market in Europe. Thus, bearing all these facts about the data discrepancy for the housing price index in mind we did our best to make the data for the studied countries consistent. Our goal though was not to compare the countries but to investigate each country separately. As a result, for the Netherlands and Sweden monthly data was chosen which was transformed into quarterly by making averages. To make the data across the countries comparable it was decided to consolidate it according to the covered area (the whole country including capitals) and according to a priced unit (per dwelling). The only country for which the housing

price index was not available in per dwelling measures was Portugal. As a result it was decided to choose the index for this country in per square meters.

The consolidation was not possible in terms of coverage. For each country the index included different types of housing which could be hardly compared with the other countries. Thus, one can see the explanation of the data that was chosen to measure the housing prices in the Table 1 below.

Table 1. Description of the Housing Data

	Country	Priced unit	Unit Measure	Coverage
1	**Belgium**	per dwelling	Index, 2000 =100	Covers existing ordinary residential houses, villas, pensions, country houses, apartments, flats and studios
2	**France**	per dwelling	Index, 2010 Q1=100	Covers existing buildings
3	**Netherlands**	per dwelling	Index, 2005 = 100	Covers existing all types of dwellings
4	**Sweden**	per dwelling	Index, 1981 = 100	Covers new and existing one or two-dwelling buildings for permanent living
5	**Portugal**	per square meter	Index, 2005 = 100	Covers new and existing owner-occupied and investor dwellings, established and new dwellings, houses and apartments across Portugal (excludes islands)
6	**United Kingdom**	per dwelling	Index, 2002 Q1 = 100	Covers new and existing dwellings on mortgage lending by all lenders

With the introduction of euro on January 1, 1999 many currencies ceased to exist and as a result some transformations of economic variables happened. From that

moment the data was measured in Euros but not in the national currency. Due to that there exists a fixed exchange rate proposed by the Council of the European Union[5] at which national currencies were exchanged to euro starting from the day of introduction. Thus, 1 euro is equal to 40.3399 Belgian francs, 6.55957 French francs, 2.20371 Dutch guilders, 200.482 Portuguese escudos (The Currency Converter). These fixed exchange rates were needed to transform the gross fixed capital formation (proxy for residential investment) which was available only in national currency to some period of time into euro. After these transformations were done the data was divided by deflator mentioned earlier to make it in the real terms.

The housing prices and investment were not seasonally adjusted that is why before making any calculations these variables were seasonally differenced. The data for consumption was available in levels and in order to make it consistent with other variables it was transformed into log. These transformations were enough to find the stability of the system of equations for each of the countries (Appendix: Figure 19 and 20).

2.5. Conclusions

This chapter described the VAR model in general and the one we used for our research. As VAR already became a benchmark for the evaluation of the monetary transmission mechanisms it was the reason for using it for our research. There were some data limitations that we faced with when trying to find the data for the research and we did our best to find the longest reliable time series. We chose only six countries but would like to extend the sample in further research to a bigger number and, if possible, to collect the data for the Post-Soviet countries.

[5] by means of Council Regulation 2866/98 (EC) of 31 December 1998

3. Markets review

3.1. Introduction

The chapter describes the situation of the macroeconomic and the housing market variables for each of the country. In section 3.2 the evolution of GDP, unemployment are discussed. In section 3.3 the description of the housing markets for each of the countries is given. Thus, big attention was paid to a degree the housing prices are overvalued. Even though it was not an impetus of the research to find out what exactly caused boom in the real estate market but rather whether the interest rate contributed to it we still believe that highlighting main points are quite useful for the general understanding. Moreover, the evolution of the housing prices and finding the factors stimulating the boom is considered to be a topic for further investigation and as an extension to this research.

3.2. Evolution of the main Macroeconomic Indicators

With the adoption of the euro on the 1st January 1999 the eleven Central Banks deputed the responsibility for the monetary policy to one authority, the European Central Bank. This was historically first union which was not based on gold or silver. Even though each of the banks has contributed to the technical issues the final decision on the monetary policy conduct was on the ECB which started operating on the 1st June 1998.

Adoption of the new currency with no history denoted a regime shift with high the possibility of structural breaks (Lucas, 1976) and degree of uncertainty. The ECB had to unite the experiences from the National Central Banks and adjust it to a new situation that they faced with. One of the first steps was the goal of keeping price stability and thus anchoring the inflation expectations. Johannsen *et al* (2011)

compare the inflation expectation in the euro area and the United States and the authors make a conclution that the inflation expectations are anchored more firmly in the euro area than in the USA. It can also be proved by the history of inflation which was floating around 2% in the observed countries.

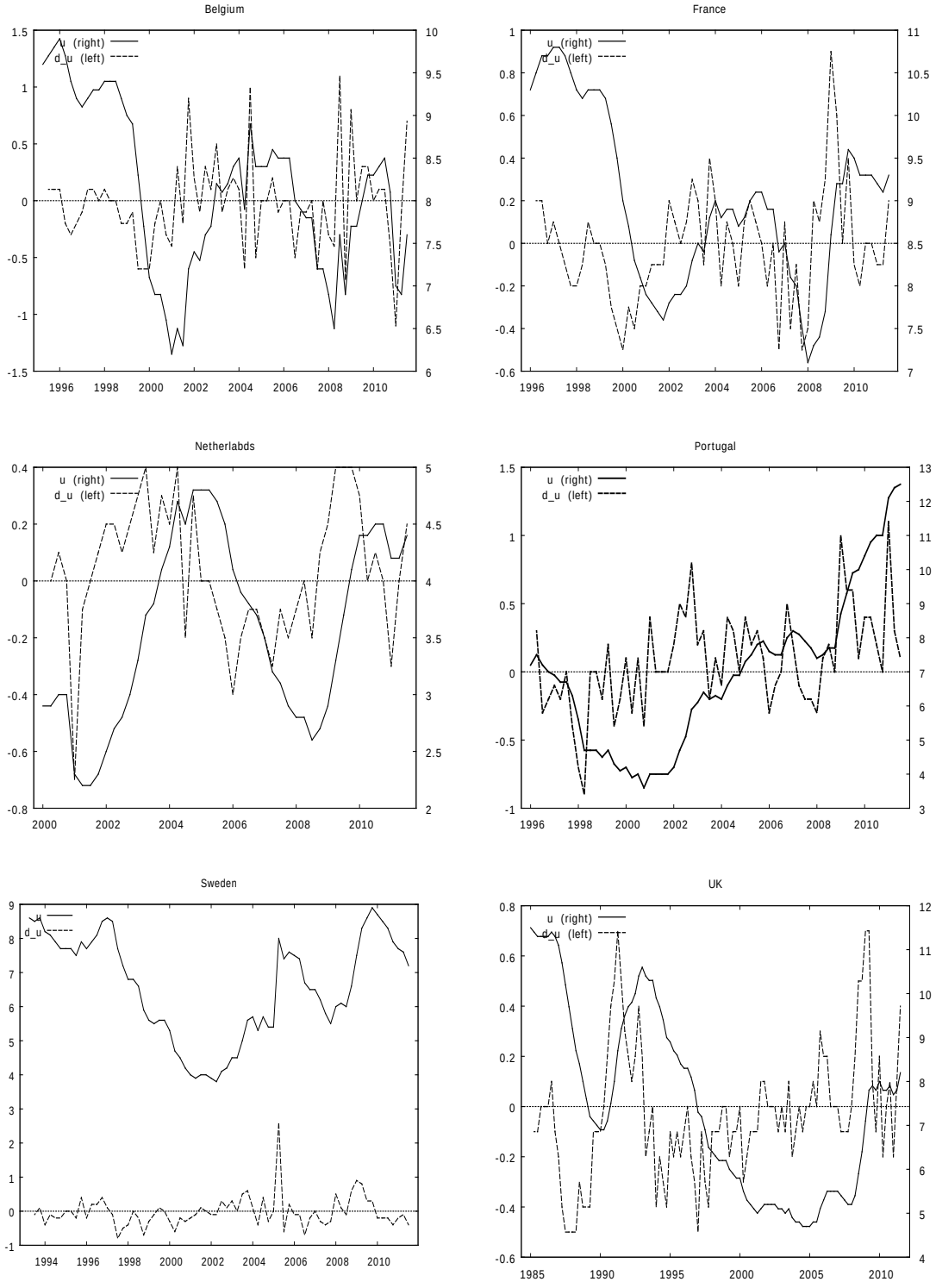
As for the economic growth the observed countries experienced 0.5-1% of GDP growth (see Apendix: Figure 24) before the crisis proceeded by 1-2% decline during the crisis resulting in the steady increase in unemployment (Figure 5). Some distinct features should be mentioned about the employment rate in the observed countries. Thus, the unemployment rate in the Netherlands is on average 3.6% and is the lowest among the observed countries. Belgium, France and the Netherlands employment markets follow similar pattern of low unemployment in 2001-2002 proceeded of a boom after the Dot-com bubble. There was another cycle of low unemployment rate in 2008 proceeded by surge in unemployment. Belgium and the Netherlands managed to decrease the unemployment rate even though time series show that it is surging in the recent years again. In France, despite the declining trend, the unemployment rate is at around 9%.

The British and Swedish markets seem to follow totally different patterns and after the crisis managed to stay at 8% and 7% unemployment rates respectively. Interestingly, the British employment market was more or less stable from 2000 till the last quarter of 2008 and was fluctuating around 5%. When the crisis hit the unemployment rate increased to 8% in one year.

Lastly, Portugal despite the decline in the unemployment rate in 2000 and 2008 still experiences persistent growth of it. From 3.6% in 2000 the rate was growing on average by 1% annually and as of today is around 13%. Taking into account the economic situation of Portugal[6] it is less likely that the situation will change dramatically in a couple of next periods.

[6] As of 2011Q3 Portugal is third in the list of countries (after Greece and Italy) with highest government debt to GDP ratio of 110% (Eurostat)

Figure 5. The Unemployment History



3.3. The Housing Market Development

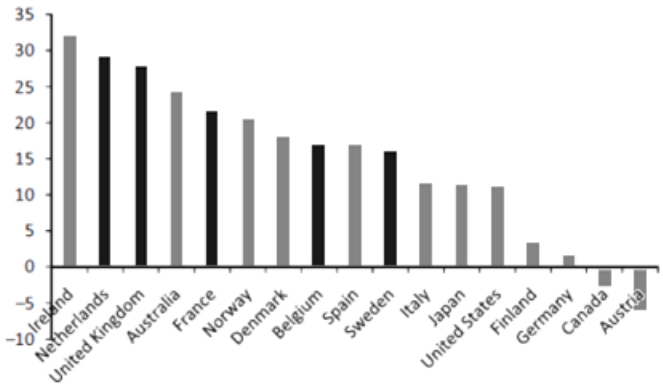
The fast rise in the house prices starting from 80th caused debates on whether prices are overvalued or it is just a normal growth. It is not that easy and straight forward to answer this question because there are different ways to define whether some asset is overvalued. According to Claussen *et al* (2011) the overvaluation is present in the real estate market if

- House prices are above their long-term trend
- House prices cannot be explained by the fundamental factors (such as financial wealth and mortgage rates)
- Model forecasts indicate decreasing house prices
- Price-to-rent and house price-to-income ratio shows overvaluation.

In recent years there were a lot of talks about the housing prices and the degree of overvaluation. In 2008 when the prices were at their peak the IMF published the report "The Changing Housing Cycle and the Implications for Monetary Policy" where they showed that on the eve of the crisis the housing prices were overvalued. Thus, Figure 6 shows their results. For the Netherlands and the United Kingdom the prices were over valuated by 30%, for France by 23%, for Belgium and Sweden by 17% and 16% respectively. There is no Portugal on this chart but according to Mayer & Mobert (2012) the overvaluation is less clear in this country. The same point is supported by Hilbers *et al* (2008).

We applied a simple technique to show that in most of the studied countries the rise in the housing prices was indeed accessive. Thus, Table 2 shows the results of our calculations. As one can see it does not corresponds to the results in the IMF report but it can be easily explained by the different indices,time span and techniques used (Claussen *et al* (2011)).

Figure 6. Price Overvaluations in the Real Estate Market, 2007



Source: International Monetary Fund (2008)

In the Table 2 we showed the results for averages of the housing price index for different periods of time and the value of the index at the end of 2011. We devided the calculations into three periods: before the crisis (second column), after the crisis (third column) and the long term trend (first column). We decided to choose 2008 Q2 as the breaking period as for the most countries this is the time when the housing price index started to decline. Even though for some countries it was 2008 Q3 we still decided to stick to the second quarter as we believe that these inaccuracies are quite small and can be neglected.

For all the countries we can observe the same pattern. Firstly, the averages for the “before the crisis” period are lower than for “after crisis”. Secondly, the long term average of the HPI is much lower than the value for 2011 Q4. According to these simple calculations Belgium, Sweden and France are among the top countries with the index being higher by around 50% than the long term average (column 5, percentage representation). The United Kingdom`s index grew up by 38% since 1996. The Netherlands and Portugal resulted in the lowest deviation of 17 and 15 percent respectively.

Table 2. The House Price Index Statistics

	2011 Q4	Average 1996Q1 - 2011Q4	Average 2005 Q1 – 2008 Q2	Average 2008 Q3 - 2011 Q4	Deviation from average		Standard Deviation (long term)
	(1)	(2)	(3)	(4)	(5)=(1) - (2)		(6)
					levels	%	
Belgium	141	93	114	133	48	52	37
France	110	75	99	104	35	47	26
Netherlands	102	87	106	107	15	17	24
Portugal	109	95	102	109	14	15	12
Sweden	524	357	438	520	167	47	132
UK	174	126	167	171	48	38	57

Description: column (4) was restricted to 1996Q1 – 2011Q4 to make it consistent. For example, the average of housing price index for Belgium from 1973Q1 till 2011Q4 was 56.93 points, for Netherlands starting from 1995Q1-2011Q4 it was 84.54, for Sweden from 1986 Q1 till 2011Q4 it was 286, and UK with the largest time series starting from 1968Q2 till 2011Q4 lead to 63.3. For France and Portugal the longest series was as indicated in column (4). The standard deviations in column 6 are calculated from the longest time series mentioned above.

Source: author`s calculations

Interestingly, that these deviations are even greater if the time span expanded. For example, the data for the housing price index for the United Kingdom was available starting from the second quarter of 1968. The average for this time span is 63 points which means that there was increase of 176% starting from 1968 till now. Of course one should not take these number seriously but still it should be mentioned that the changes are dramatic. The same story is with other countries. Thus, the Belgium price index changed by 147% starting from 1973 and in Sweden by 83 %

since 1986. In the Netherlands the change was around 20% which is not as big as in the other countries.

As for the standard deviations, the lowest one was in Portugal which accounted for 13% from the long run mean and in other countries it ranged from 28 to 40%. Index in the United Kingdom appeared to be the more disperce with the standard deviation of 45% of the long run mean.

Belgium

The history of prices in the Belgium real estate market has not deviated from the world`s trend. Starting from 2000 the prices appreciated quite quickly and the growth was even more rapid from 2004 till the crisis period. The average growth rate for the selected period is 1.89 % per quarter, which is 7.56 % annually (the pick was observed in 2008 Q3 according to the Bank for International Settlement data and in 2008 Q1 according to Global Property Guide). According to the Global Property Guide price boom in the real estate market was due to low interest rates, rising competition between banks and sturdy economic and wage growth. Starting from 2009 the appreciation of the housing prices continued but at a lower than before the crisis rate of around 3.46% percent per annum (Figure 7).

France

As one can see from the Figure 7 the prices in France peaked at 2008 Q3 and after that during 4 quarters sharply declined almost by 11%. The latest data shows that the property index in 2011 Q3 is even higher than it was during the financial turmoil. This could mean nothing if the disposable income of the households was increasing at the same pace. From the Figure 8 of the property under/overvaluation one can see that the overvaluation of property is indeed present in the French real estate market. Till 2000 the ratio was more or less stable but starting from 2000 it surged up fast and started to decline in 2008 when the bubble burst. Another fact that

should be mentioned is that high HPI does not really coincide with the periods of low interest rate

Figure 9). Especially it can be seen during the period before 2000 (see Appendix: Figure 23 for much clearer picture).

French Minister in charge of Housing, Jacques Friggit, in his presentation “Home Prices in France over the Long Run” made an analysis of the housing prices for the years 2000-2010 and as a result highlighted several ideas why it happened. He rejects the hypothesis that it could be because of the supply-demand of housing services as the supply-price elasticity is too low and there was not observed the rent rise. It is also mentioned that the household size decrease is not the case, as it is developing on the constant down sloping pace (see Appendix: Figure 22), as well as ageing and net purchases by foreigners. The land price and land scarcity were also not contributors to the HPI rise because the land price is determined by the building price but not vise verse (Friggit, 2012). Moreover, the construction volumes were growing, that is, to find a land was not a problem.

One of the reasons that indeed contributed to the housing price rise was the changes in the mortgage terms. According to their results one percent decrease in the interest rate leads to 6% increase in the property price, and a 5 year increase in the duration of a mortgage leads to 12% increase in the property price, ceteris paribus. Starting from 2000 the French interest rate was declining by around 2% annually (Appendix: Figure 21).

Figure 7. The Housing Price Index

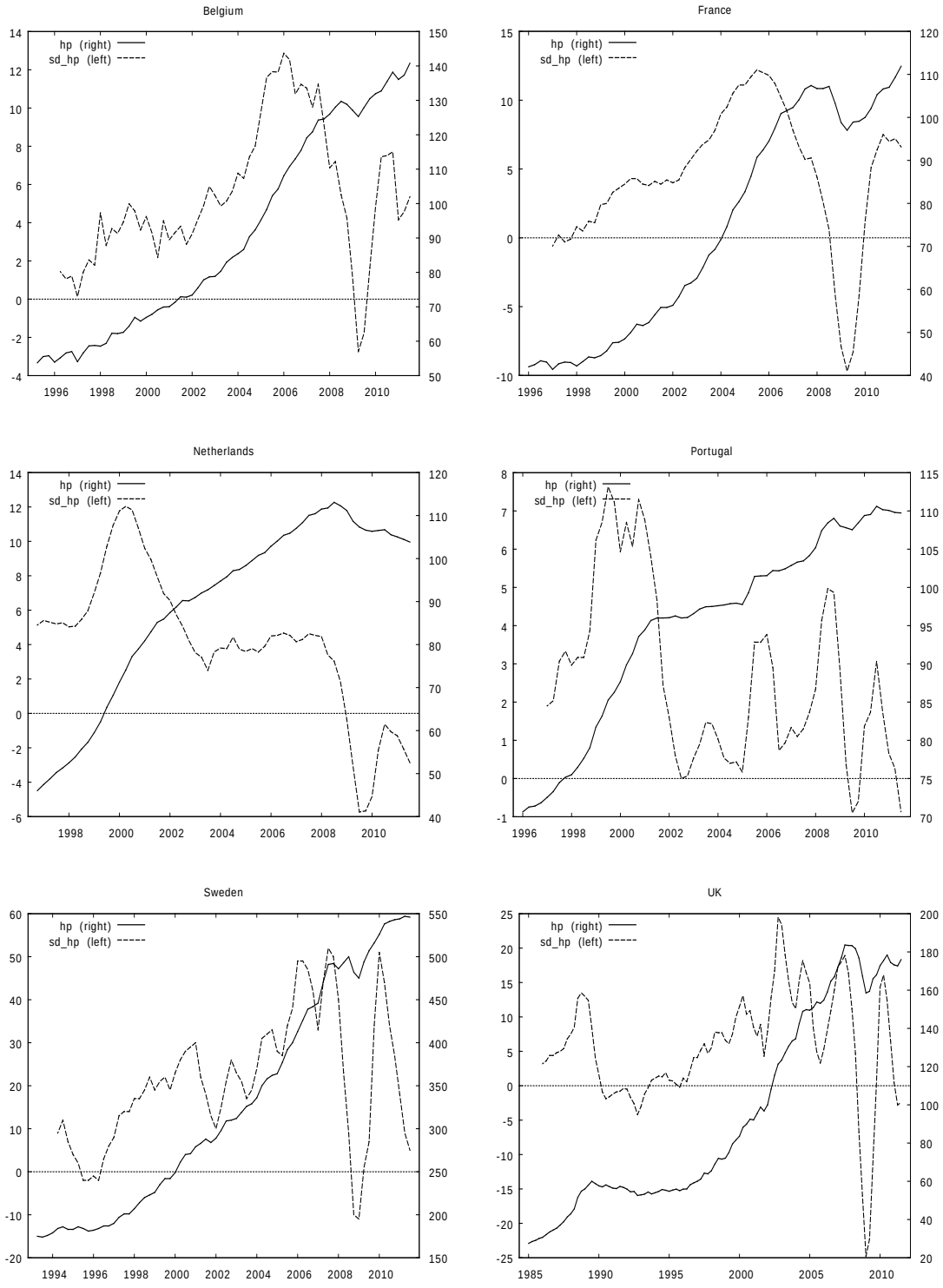


Figure 8. The Property over/undervaluation of Housing, France

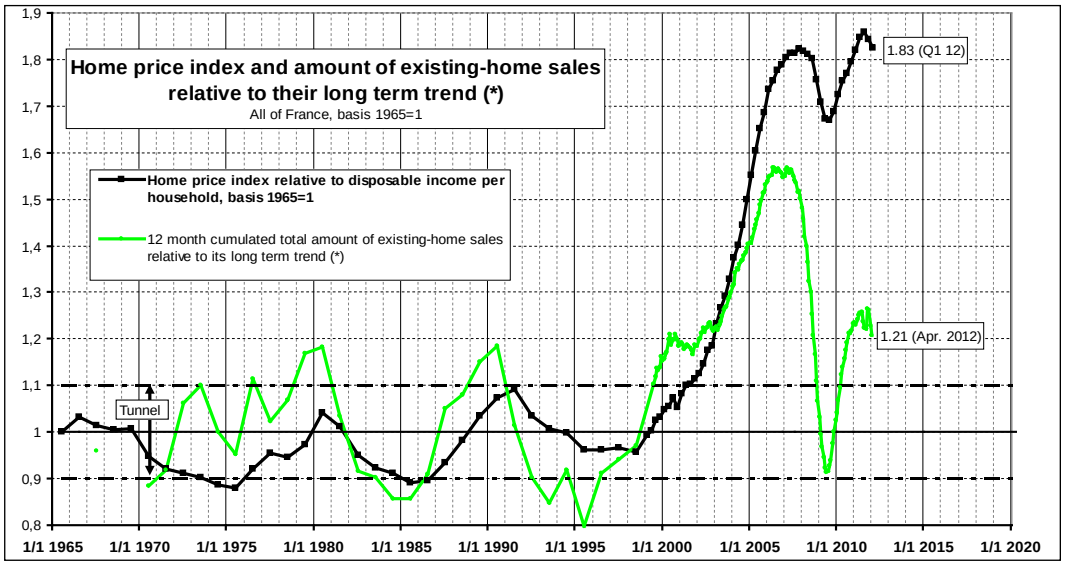
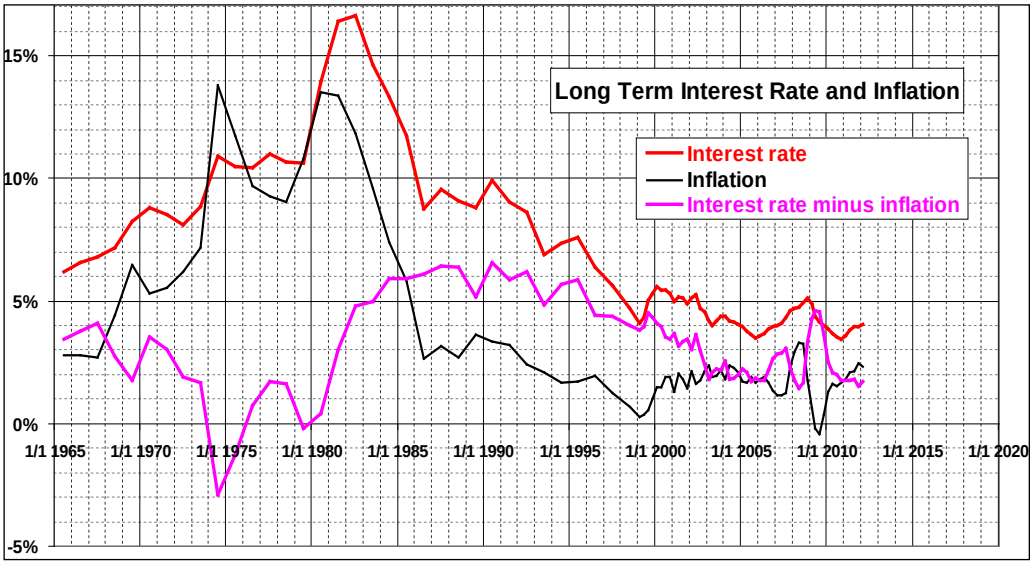


Figure 9. The Long Term Interest Rate and Inflation, France



Source: Friggit (2012)

Description: tunnel indicates ± 10% margin fluctuation of the parralel increase in house price index and disposable income.

The Netherlands

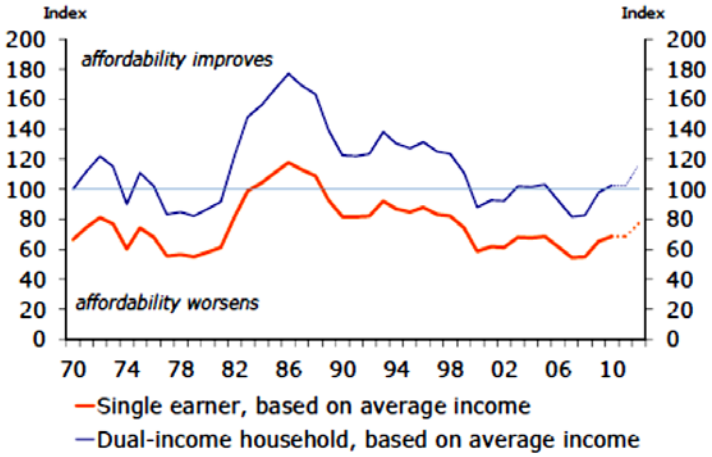
The expansion of the the real estate market in the Netherlands started from 1994. As the Statistics Netherlands recorded till 1998 the shortage in the housing fell by 30% and around 27% of those who rented an apartment wanted to buy one. It resulted in different from the other countries (except Portugal) evolution of the housing prices. Usually historical indices remind concaved up logarithmic function which starts at 1996 and ends somewhere in 2008. For the Netherlands the situation is different. The surge started in the mid 90th with a little bit faster growth at the end of the decade. It resulted in already high prices in 2002. After that the growth was not that strong and changed to negative after the crisis (Figure 7)

Interesting results presents William Xu-Doeve (2010) who made a research on the housing market overvaluation in the Netherlands. He makes a conclusion that for the first-time buyers with a middle income and usual for Dutch people mortgage interest rate of 6% the price of housing will be overvalued almost for 100%. The author argues the conclusions presented by Igan (2010) who says that “house prices are broadly in the line with long-tem fundamentals”.

There is another interesting paper by Sorensen (2006) who describes the history of the housing market in the Netherlands starting from the 17th century. The author came up to a conclusion that the housing prices in this country are in line with long term trend. Despite such results and arguments presented by author it is more realistically to believe that the prices are indeed overvalued. The prices in the Netherlands have not followed the “world`s trend”, that is, there was no high jump in prices in a couple of years but rather there was a steady growth. We would not go deep into details explaining why we think so but we believe that if affordability index shows that houses are not affordable for a household with average income it means that prices are indeed higher that they should be. In thr Figure 10 the history of affordability index is presented and it shows that the situation worthened since the 80th and for now is on the edge between the affordability and a burden. Thus, for

dutch people, especially for sigle-earners, with 6% interest rate the housing may become a life-long debt.

Figure 10. The Affordability index, the Netherlands



Source: Rabobank (2012)

Definition: The affordability index shows an ability of a household with an average income to purchase an average house in the Netherlands. If the index =100, the gross monthly burden for a household is 30% of gross income. If the index < 100, then the gross monthly burden is > than 30% of gross income. The index includes only housing costs.

Portugal

The results for Portugal seem less frightening in the sense that this country has the lowest indicator in terms of rapid growth of prices and overvaluation. The housing prices in Portugal were growing at more or less steady growth rate (around 1.5% before the crisis and less than 1% after). We may say that Portugal is one of those lucky countries that were not exposed to the housing bubble and prices did not boom.

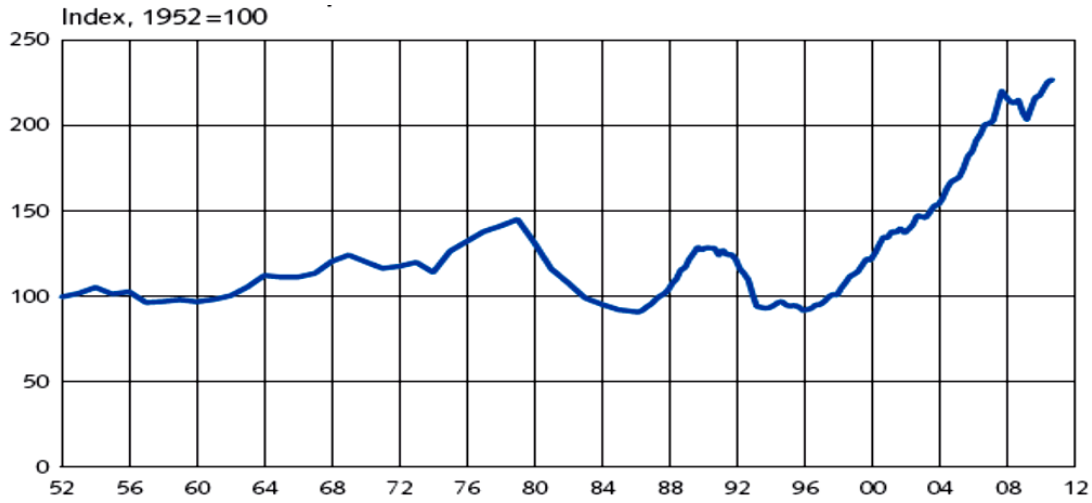
The empirical literature on the housing prices in Portugal is not that big. Probably, due to low increase in the housing prices this country did not attract attention of the researchers. Not surprisingly, Allen *et al* (2012) in their book "Fixing the Housing Market" mention that Portugal had only 0.2% increase in the housing prices in 2009. On the same year Ireland and the United States experienced 18.5% and 12.4% decline respectively making Portugal`s price change relatively stable. According to Ball (2011) Portugal together with Greece and Spain had moderate falls in the housing market despite their indebtedness and the economic situation in general.

Sweden

As one can see from the Figure 7 the HPI in the Swedish housing market was more or less stable for 1994-1996. The rise started right after that and proceeded with even more rapid growth starting from 2000 till the financial crisis in 2007. The same pattern is observed starting from 2009 till now. Interestingly, if one looks at the development of the house prices for Sweden starting from 50^{th} it is worth mentioning that in year 1952 the real house prices were at the same level as in 1996 (see Figure 11). Till 1996 the average growth rate was around 1.5% which increased to 6% in the following years. Thus, it makes the growth for the last 15 years unusual.

Researchers from the Central Bank of Sweden (Claussen, Jonsson, & Lagerwall, 2011) after running BVAR model found that the rising house pricing are well explained by such variables as the real mortgage rates, real disposable income of households and their financial wealth. Thus, for the period of 1996-2010 the rise in the housing prices is explained by over 35% by falling real mortgage rates. For the 80^{th} the share grows till 80% which proves the real estate market dependency on the mortgage rates.

Figure 11. The History of the Real House Prices, Sweden



Source: Claussen *et al* (2011)

Interestingly, the overvaluation of housing market in Sweden cannot be measured by the price-rent ratio. The market rates in Sweden differ from the one in the USA, for example, which makes the analysis somewhat meaningless. In addition, there arises a problem of comparing properties of rents, which have different structure.

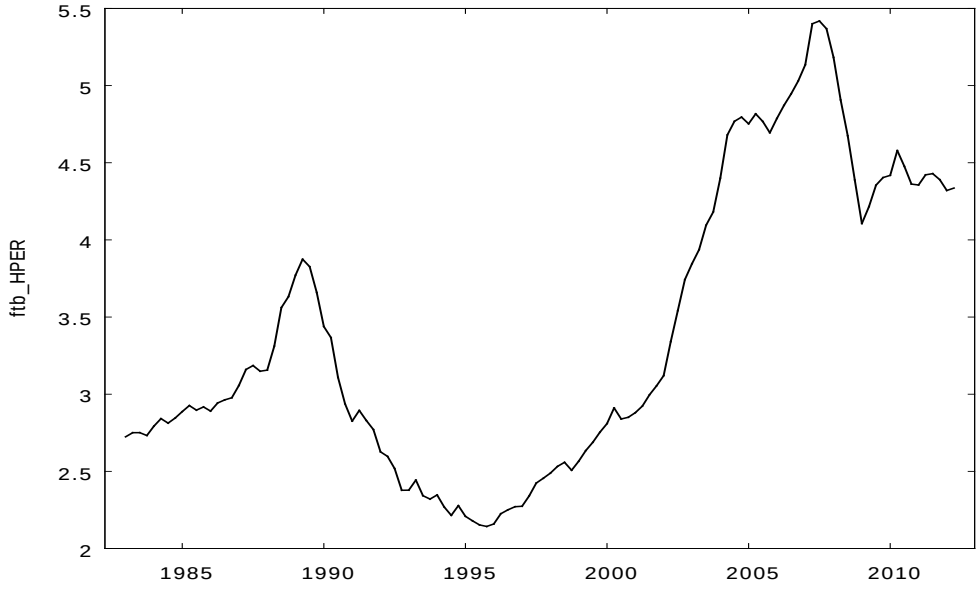
The United Kingdom

The British mortgage markets were highly regulated until the 80th which made it hard for the households to access credits. Thatcher removed credit controls (liquidity ratios) on banks which was a sign of financial liberalization. The appreciation of the housing prices started in the mid 80th when deregulation process was almost over. It raised competition in the banking sector and made credits easier to access during these days (Diamond & Lea, 1992). As a result the housing price index grew at 16% annually and in five years it doubled. After such a bubble the prices reversed and economy of the country was in depression. Now the prices cooled down and till 2000

grew on average at 1% annually. After that the growth was at almost 2% annually. In general, periods of price growth are much longer than periods of declines.

Of course all these changes influenced affordability of the housing which can be seen from Figure 12. After deregulation the affordability conditions started to worsen and peaked in the late 80th. There was another peak which was almost twice higher and exactly coincided with period of the overvalued housing prices and crisis in the country. For now the affordability index is still high but it has a declining trend.

Figure 12. The Affordability Index, the United Kingdom



Source: http://www.nationwide.co.uk/

Description: *ftb* - first time buyer. *ftb_HPER* is calculated as house price to gross earnings for first time buyers. The higher the index the less affordable housing is.

3.4. Conclusions

In this chapter we described briefly macroeconomic indicators and discussed the housing markets for the six studied countries. We tried to show that the housing prices in the chosen countries were indeed overvalued. We provided our own simple calculations and compared it to other researchers` results. Despite the different degrees of overvaluation stated by different sources the general conclusion that prices were indeed overvalued cannot be argued.

The time series for the housing price index for most of the countries reminds the concaved up logarithmic function starting from 2000. However, there were exceptions from this trend. Thus, the housing price index for the Netherlands started to surge in 90^{th} and it resulted in the moderate growth of the prices. Another country was Portugal which despite its economic situation had the lowest standard deviation from the long-run mean and did not experience price surge in the housing market.

4. Empirical results

4.1. Introduction

The last chapter presents our empirical results and is one of the most important parts in our research. In this part the regression results are presented. We used *Gretl* to make our estimations and due to its limitations we could observe only positive shock in the interest rate and its influence on the variables. In some sense it makes the research one-sided, however, it leaves room for the next research were we could estimate the impact of the interest rate decrease on the same variables.

First section shows the results for the lag selection tests which are the one of the first steps in the VAR model estimation. In the next sections the results from the impulse responses and the variance decompositions are discussed for each country. The differences between the results from the base and extended models are compared to each other to give an idea whether consumption and unemployment adds valuable information to the results.

4.2. Lag Selection

Before estimating the model we tried to find the optimal lag length. The maximum lag length we chose was 4 as we used quarterly data. As one can see from the Table 3 different criteria gave different results for some countries. For the base model for France, Sweden and the United Kingdom the results of the tests for each of the criterion were different. Only for Belgium all three tests showed first lag. In the tests for the extended model the results were as well mixed. For most countries the Akaike criterion gave forth leg which was logically clear as we used quarterly data. Hannan-Quinn criterion showed different lags for each country in contrast to Schwarz Bayesian criterion which gave 1st lag for each of the country. Taking all this

information into account we believe that to use forth leg is not parsimonious. Thus, due to the data peculiarities it was decided to rely only on the Schwarz Bayesian Criterion which gives the best results for the small samples. As a result the base and extended models for all countries were estimated using first lag.

Table 3. Selection of lag length

		Base model			Extended model		
	country	AIC	BIC	HQC	AIC	BIC	HQC
1	Belgium	1	1	1	4	1	1
2	France	4	1	2	4	1	1
3	Netherlands	4	1	1	4	1	4
4	Portugal	4	1	1	4	1	1
5	Sweden	4	1	3	4	1	1
6	U.K.	4	1	2	2	1	2

Description: The table shows the results for optimal lag length for base and extended model. The maximum lag length used was four. For Belgium there are 66 observations, for France 63, for Netherlands 67, for Portugal 63, for Sweden 74, for United Kingdom 107.

4.3. Impulse Responses

Base model

The impulse responses for the base model with five variables are presented in the Figure 13. The results are shown with 90% confidence interval. For four countries out of six (Belgium, France, Sweden and the United Kingdom) a positive shock in the interest rate leads to a decrease in the housing prices. For example, in case of France, an increase of the interest rate by one standard deviation, 1.2 per cent in this case, (see Appendix: Table 8 for statistical summary of the interest rate) will lead to a gradual decrease in the housing prices by 0.8 percent.

Even though there is a statistically significant effect of a positive shock in the interest rate on the housing prices it should be mentioned that economically it is not that big. What should be noticed in this case is the pattern of how the prices change. In all of the four countries there was observed a gradual decline of the prices during the first quarter which was followed by much steeper during the next 6 quarters. Thus, in general the housing prices decline during the 7 quarters and starting from the 8th quarter the prices start to grow and revert to the previous level.

The results of the impact of a shock in the interest rate on GDP are presented inFigure 14. In the case of Portugal, Sweden and the United Kingdom there was observed no statistically significant or quite small effect of the interest rate increase on GDP. In other three countries the effect of the first quarter is present. On average the first quarter decline is from 0.04 to 0.06 percent in the observed countries leading to a conclusion that despite the statistical significance the impact is not that strong economically.

Figure 13. Impulse Responses of the HPI to a Shock in the Interest Rate (Base Model)

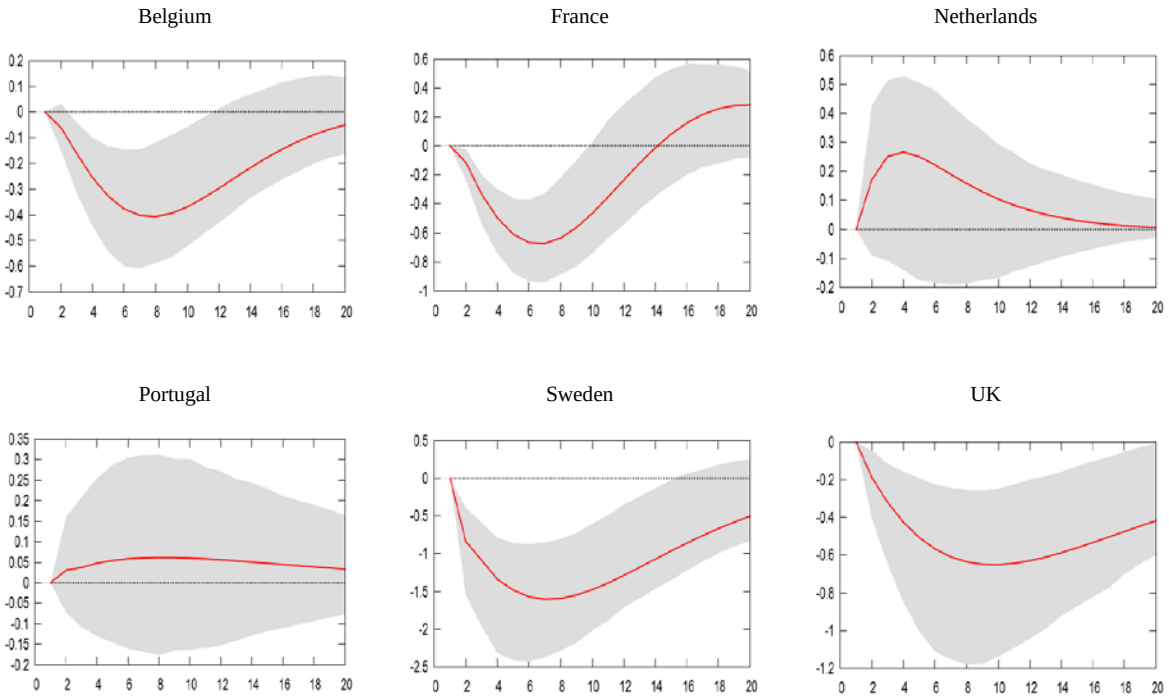
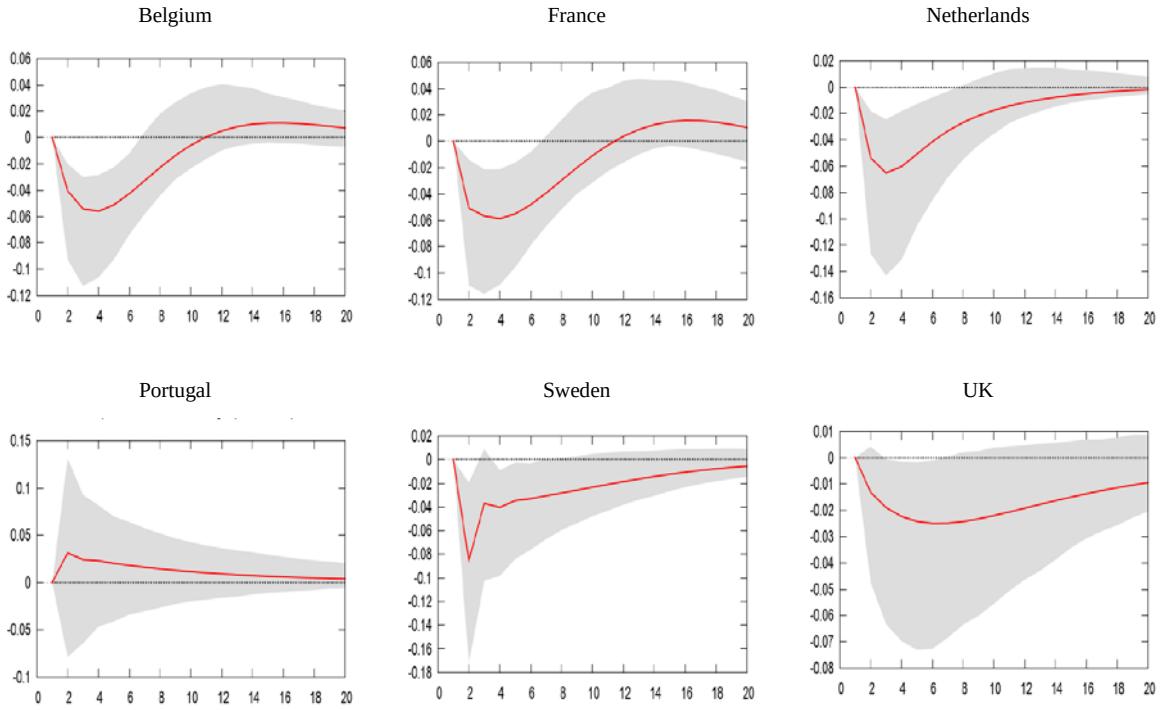


Figure 14. Impulse responses of GDP to a Shock in the Interest Rate (Base Model)



Extended Model

The impulse responses of the housing prices on the shock in the interest rate for the extended model are shown in the Figure 15. The results change from the one we got in the base model. There is still no significant effect for the Netherlands and Portugal and what is more for Belgium as well. We managed to improve the results for France, Sweden and the United Kingdom. Thus, for France, 1.2 percent increase in the interest rate will lead to one percent decrease in the housing prices. For Sweden, 2.26 percent increase in the interest rate will lead to 2.5% decrease in the housing prices. For the United Kingdom, 3.68 % increase in the interest rate will lead to 2 % decrease in the housing prices.

The effect of the first quarter is not vividly seen here and even the period for which the decline in the housing prices lasts has changed. In the case of Sweden the

Figure 15. Impulse Responses of the Housing Prices to a Shock in the Interest Rate (Extended Model)

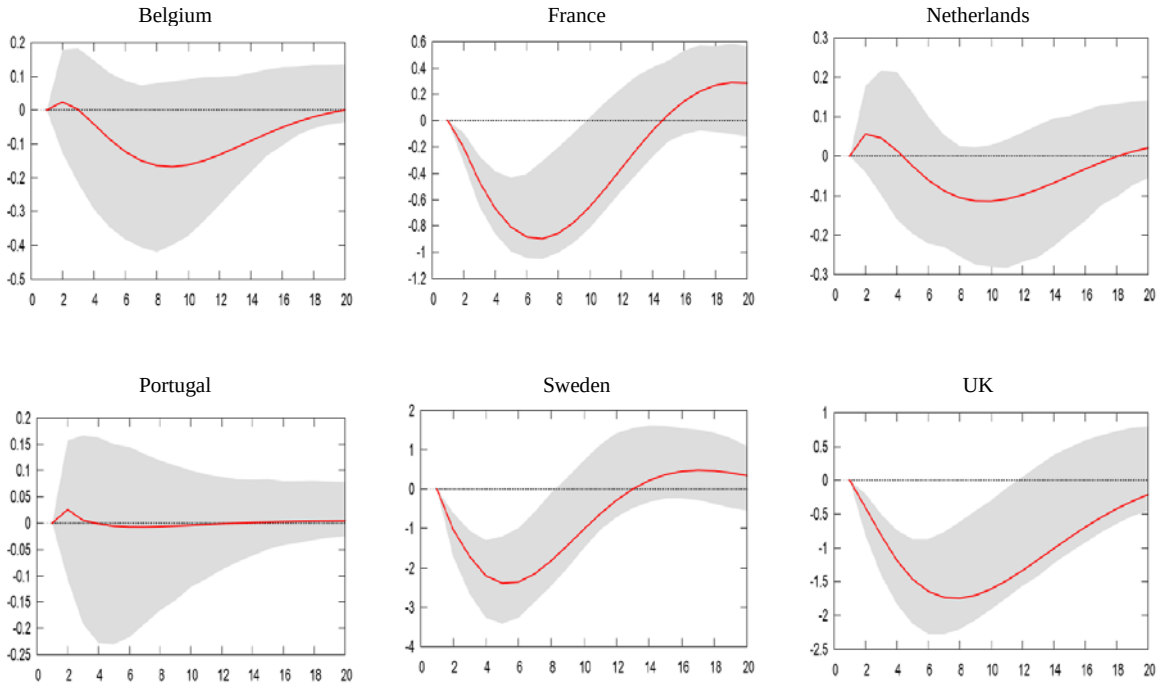
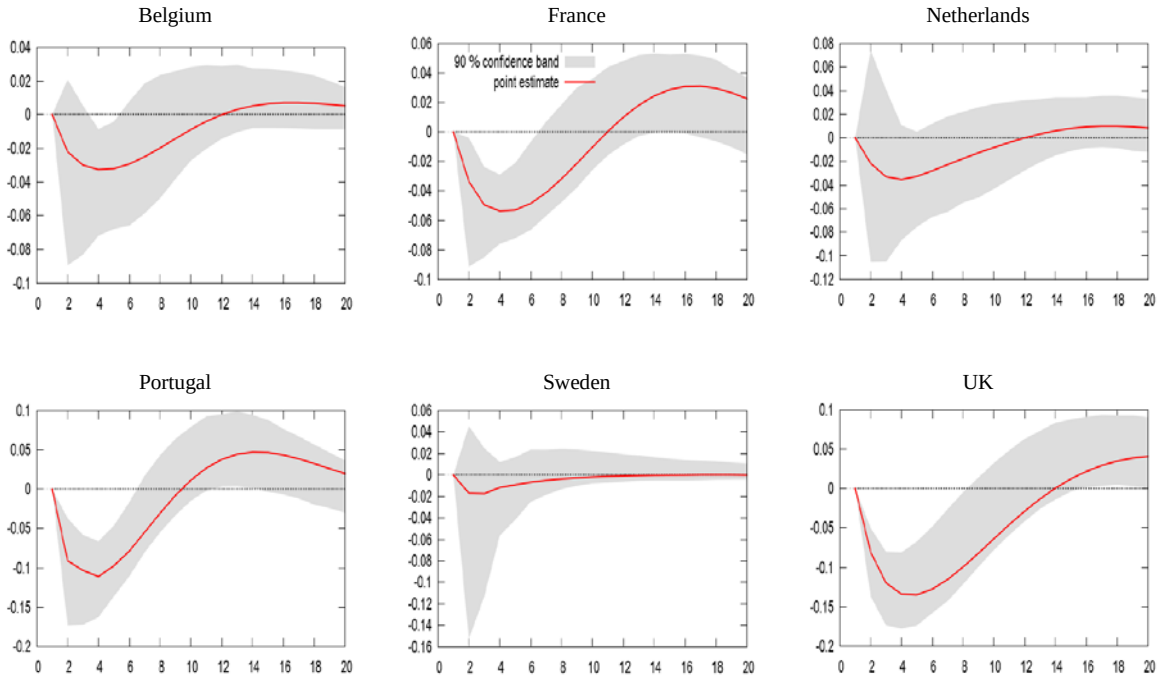


Figure 16. Impulse Responses of GDP to a Shock in the Interest Rate (Extended Model)



shock in the interest rate impacts the housing prices much faster and even with bigger impact. Lastly, the impact of the interest rate on GDP one can see from the Figure 16. Mostly the effect is either statistically not significant or it is quite small.

4.4. Variance Decomposition

Base model

As for the base model the results for the variance decomposition show that the housing price development can mostly be predicted by its own lag values for at least 2 quarters. After that the predicting power of the lags decreases. The interest rate during the first period after the shock has no predicting power for all the sample countries. For the Netherlands and Portugal the interest rate can only describe 1-2% of the housing price index development. The highest impact of the interest rate on the HPI is observed for the French housing market. After the 5th quarter it can describe around 20% of the HPI development with a gradual decline to 10% afterwards. For Belgium, Sweden and the United Kingdom it ranges from 9 to 15%.

Extended model

In the extended model the situation changed for some countries. After we added new variables to the base model we found that in the extended model for Belgium the interest rate does not explain the housing prices but newly added variable, consumption, does (20% after the 4th quarter). The share of GDP dropped from 40% in the base model to around 22% and the unemployment rate explains around 1%. It proves the findings of Claussen *et al* (2011). The authors tested for a large number of variables they waned to include into their model and they found that the unemployment rate, housing investment and monetary policy expectations had either wrong sign or were insignificant.

For the Netherlands and Portugal the situation has not changed as the interest rate still does not describe a shock in the housing prices. Interestingly, for the Netherlands the housing prices have less predicting power than in the base model and the behavior of GDP changed dramatically. For Portugal the most predicting power has the housing price development itself but it was not that strong in the base model. Moreover, the share of GDP dropped and the share of consumption is around 2 percent. For Sweden there were no dramatic changes except for share of the housing prices which drops much faster than in the base model.

Lastly, for the United Kingdom after the first quarter only the housing price index itself, GDP and consumption explain shock in the housing prices. After that the interest rate comes also into force which was not seen in the base model. Interestingly, the share of the interest rate growth till 40% and this is the highest number among the countries and models we observed.

4.5. Conclusions

The results from the impulse responses for the base model showed that shock in the interest rate does not have statistically significant impact on the housing price index of the Netherlands and Portugal. After adding new variables and estimating the impulse responses again the results for Belgium in addition to the Netherlands and Portugal were insignificant as well. The impulse responses of GDP to a shock in the interest rate showed that for most of the countries the results were statistically not significant.

The variance decomposition for the housing price index in the base model showed that mostly the variance is explained by its own lags and GDP. The share of the interest rate was from 1 to 10% for Belgium, the Netherlands, Portugal and the United Kingdom. For France and Sweden the shares of the interest rate were on average 15% and 10% respectively.

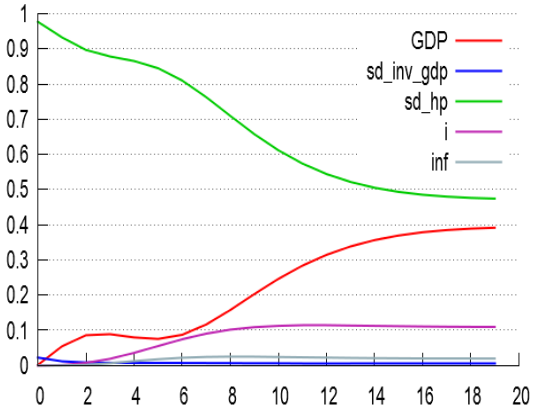
After we added consumption and the unemployment rate the interest rate share was around 32% and 40% for France and the United Kingdom respectively. The share of the interest rate for the other countries was from 0 to 12%. Interestingly, that the unemployment rate had no predicting power or was around 3% for the variance decompositions of the HPI for such countries as Belgium, Portugal, Sweden and the United Kingdom. As for the other countries the share was around 10%.

Consumption had no predicting power for the variance decomposition for the HPI for France. It was ranging from 1 to 2% for the Netherlands, Sweden and Belgium and was less than 5% for Portugal and the United Kingdom in the long run.

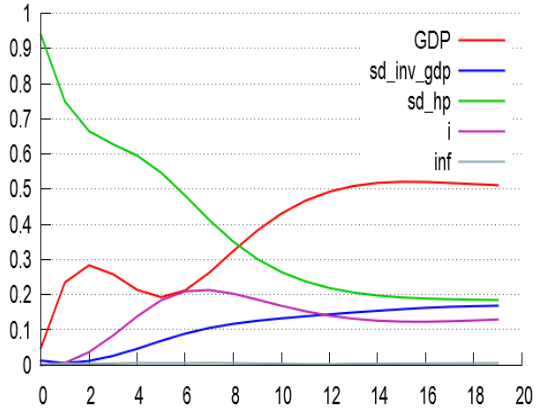
In general, several conclusions can be made. Firstly, the interest rate can explain the variance decomposition of the housing price index even though the percentages differ from country to country. Secondly, consumption and the interest rate help as well but the results vary.

Figure 17. Forecast Variance Decompositions (Base model)

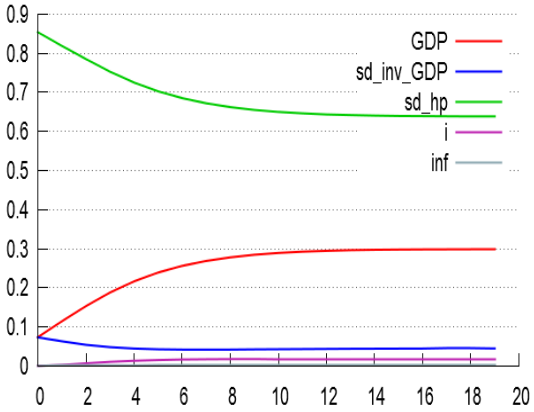
Belgium



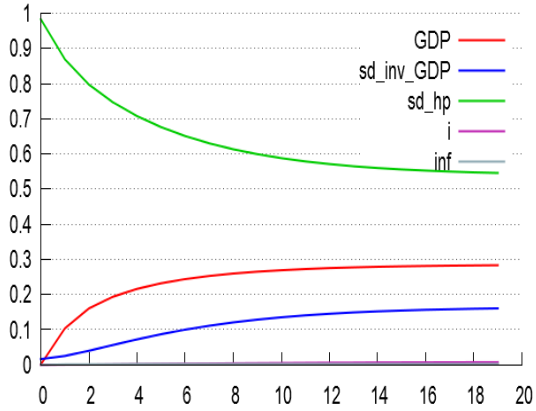
France



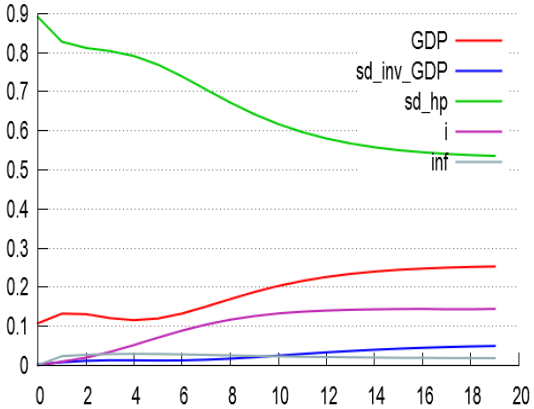
Netherlands



Portugal



Sweden



UK

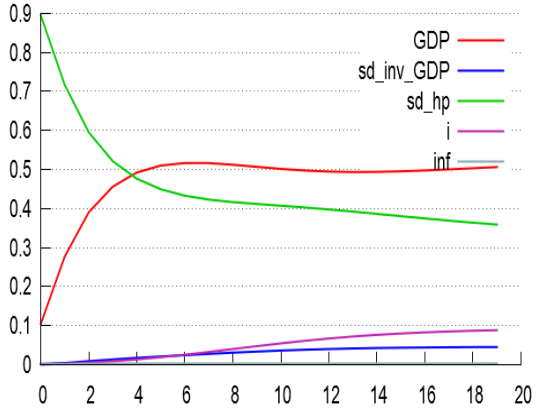
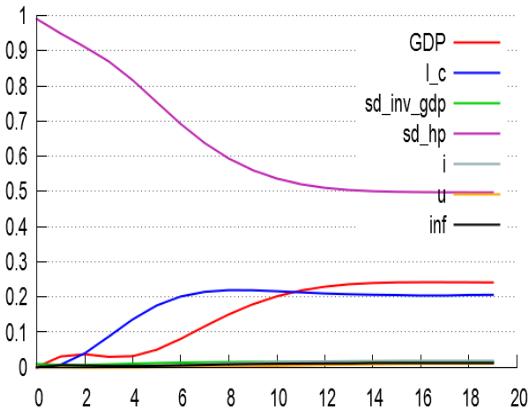
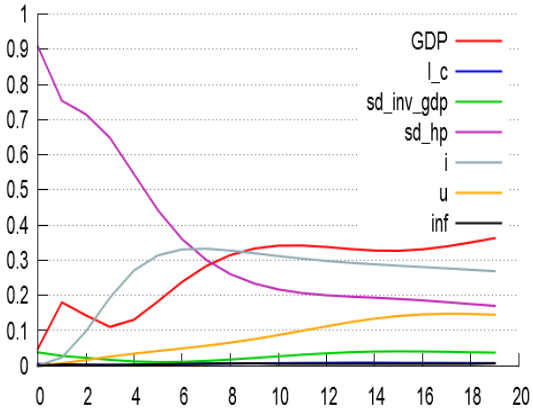


Figure 18. Forecast Variance Decompositions (Extended model)

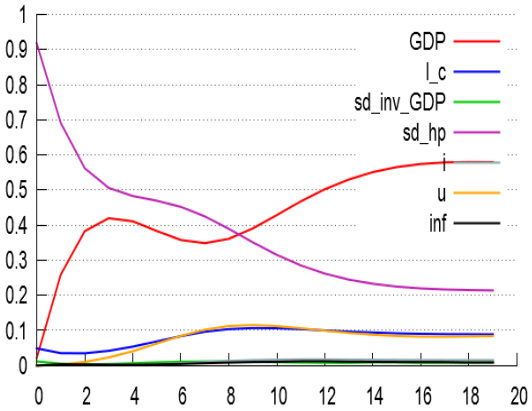
Belgium



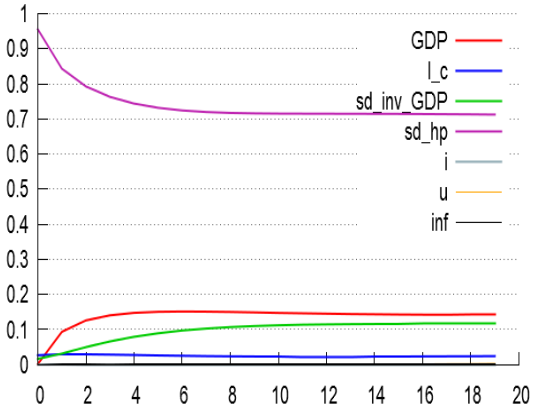
France



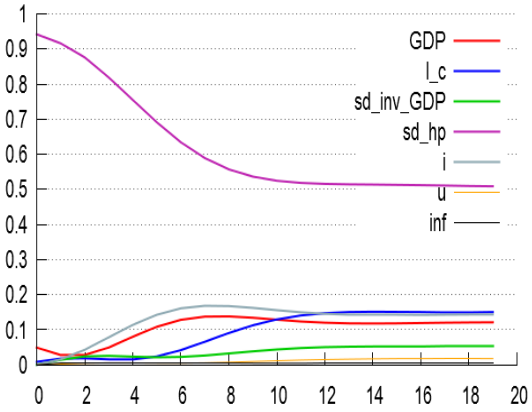
Netherlands



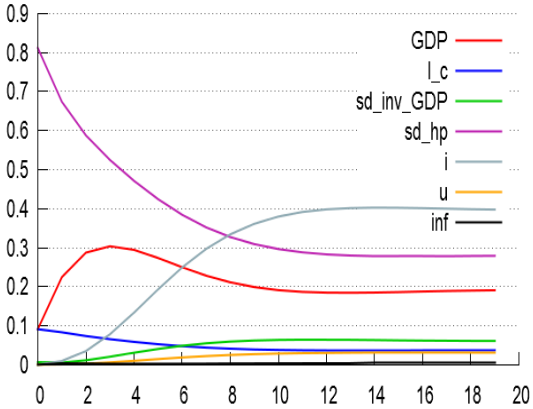
Portugal



Sweden



UK



Conclusions

The primary objective of the research was to analyze whether the changes in the interest rate have a significant impact on the housing prices and the economy as a whole. In the first chapter we discussed the main transition mechanisms showing the importance of the interest rate for the housing market. Thus, researchers distinguish six factors the changes in the interest rate impact: (1) the user cost of capital, (2) expectations regarding house price movements and (3) housing supply, (4) wealth effect, (5) credit-channel effects on consumer spending and (6) housing demand.

Taking the importance of the interest rate for the housing market into account we used Vector Autoregression model to estimate the effect of the interest rate changes on the housing markets of Belgium, France, the Netherlands, Portugal, Sweden and the United Kingdom. We used the quarterly data for GDP, consumption, investment, housing prices, short-term interest rate and unemployment to estimate two models. The extended model consisted of the variables just mentioned and for the estimation of the base model consumption and the unemployment rate were excluded.

Before the model estimation we tried to make the data consistent and thus applied some transformations to the variables we used (see section 2.4 for more details). The biggest difficulties we had with the time series for the housing price index. It was available in different measures and covered different types of dwellings. We decided to consolidate the data in terms of coverage (the whole country including capital) and the priced unit (per dwelling). However, the HPI for Portugal was chosen in per square meters as it was not available in other measures. The length of the times series for each country varies as well but we tried to get the longest reliable time series possible. Even though we chose only six country for this research we would like to extend the sample in further works to a bigger number and, if possible, to collect the data for the Post-Soviet countries.

In the chapter 3 we gave some statistical information about the development of main macroeconomic variables we used in our model. In addition we described the housing market for each country in order to give a reader an idea about the degree of overvaluation in the chosen countries. We provided our own simple calculations and compared to other researchers` results. Despite the different degrees of overvaluation stated by different sources the general conclusion that prices were indeed overvalued cannot be argued.

The time series for the housing price index for most of the countries reminds the concaved up logarithmic function starting from 2000. However, there were exceptions from this trend. Thus, the housing price index for the Netherlands started to surge in 90^{th} and it resulted in the moderate growth of the prices. Another country was Portugal which despite its economic situation had the lowest standard deviation from the long-run mean and did not experience price surge in the housing market.

In the empirical results part we showed the results for the impulse responses and variance decompositions of the housing price index for the base and the extended models. Due to the software limitations we were able to estimate the impact of the positive shock in the interest rate on the housing prices and GDP.

The results from the impulse responses for the base model showed that shock in the interest rate does not have statistically significant impact on the housing price index of the Netherlands and Portugal. In the extended model the results for Belgium in addition to the Netherlands and Portugal were insignificant as well. The impulse responses of GDP to a shock in the interest rate showed that for most of the countries the results were statistically not significant.

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Appendix

A. Base Model

Table 4. Lag selection

Belgium

VAR system, maximum lag order 4

The asterisks below indicate the best (that is, minimized) values
of the respective information criteria, AIC = Akaike criterion,
BIC = Schwarz Bayesian criterion and HQC = Hannan-Quinn criterion.

lags	loglik	p(LR)	AIC	BIC	HQC
1	294.00817		-9.103730*	-8.037984*	-8.688600*
2	314.66443	0.02128	-8.953946	-7.000077	-8.192875
3	342.34415	0.00044	-9.046350	-6.204359	-7.939337
4	361.86924	0.03642	-8.857560	-5.127448	-7.404606

France

VAR system, maximum lag order 4

The asterisks below indicate the best (that is, minimized) values
of the respective information criteria, AIC = Akaike criterion,
BIC = Schwarz Bayesian criterion and HQC = Hannan-Quinn criterion.

lags	loglik	p(LR)	AIC	BIC	HQC
1	395.78310		-13.301204	-12.206295*	-12.877794
2	437.12070	0.00000	-13.895298	-11.887965	-13.119046*
3	466.46223	0.00016	-14.053172	-11.133415	-12.924078
4	500.45052	0.00001	-14.380019*	-10.547838	-12.898084

Netherlands

VAR system, maximum lag order 4

The asterisks below indicate the best (that is, minimized) values
of the respective information criteria, AIC = Akaike criterion,
BIC = Schwarz Bayesian criterion and HQC = Hannan-Quinn criterion.

lags	loglik	p(LR)	AIC	BIC	HQC
1	332.04432		-10.238791	-9.182416*	-9.826425*
2	355.95277	0.00392	-10.201789	-8.265101	-9.445784
3	394.86696	0.00000	-10.673456	-7.856456	-9.573814
4	427.43010	0.00002	-10.929834*	-7.232521	-9.486553

Sweden

VAR system, maximum lag order 4

The asterisks below indicate the best (that is, minimized) values
of the respective information criteria, AIC = Akaike criterion,
BIC = Schwarz Bayesian criterion and HQC = Hannan-Quinn criterion.

lags	loglik	p(LR)	AIC	BIC	HQC
1	205.58284		-5.169177	-4.007996*	-4.710339
2	250.26775	0.00000	-5.765689	-3.775094	-4.979111
3	287.94985	0.00000	-6.149996	-3.329986	-5.035676*
4	317.13306	0.00017	-6.276759*	-2.627335	-4.834698

Portugal

VAR system, maximum lag order 4

The asterisks below indicate the best (that is, minimized) values
of the respective information criteria, AIC = Akaike criterion,
BIC = Schwarz Bayesian criterion and HQC = Hannan-Quinn criterion.

lags	loglik	p(LR)	AIC	BIC	HQC
1	233.16749		-7.387909	-6.293000*	-6.964499*
2	263.39563	0.00009	-7.578023	-5.570690	-6.801771
3	297.87824	0.00001	-7.922845	-5.003088	-6.793751
4	328.65168	0.00006	-8.132788*	-4.300607	-6.650853

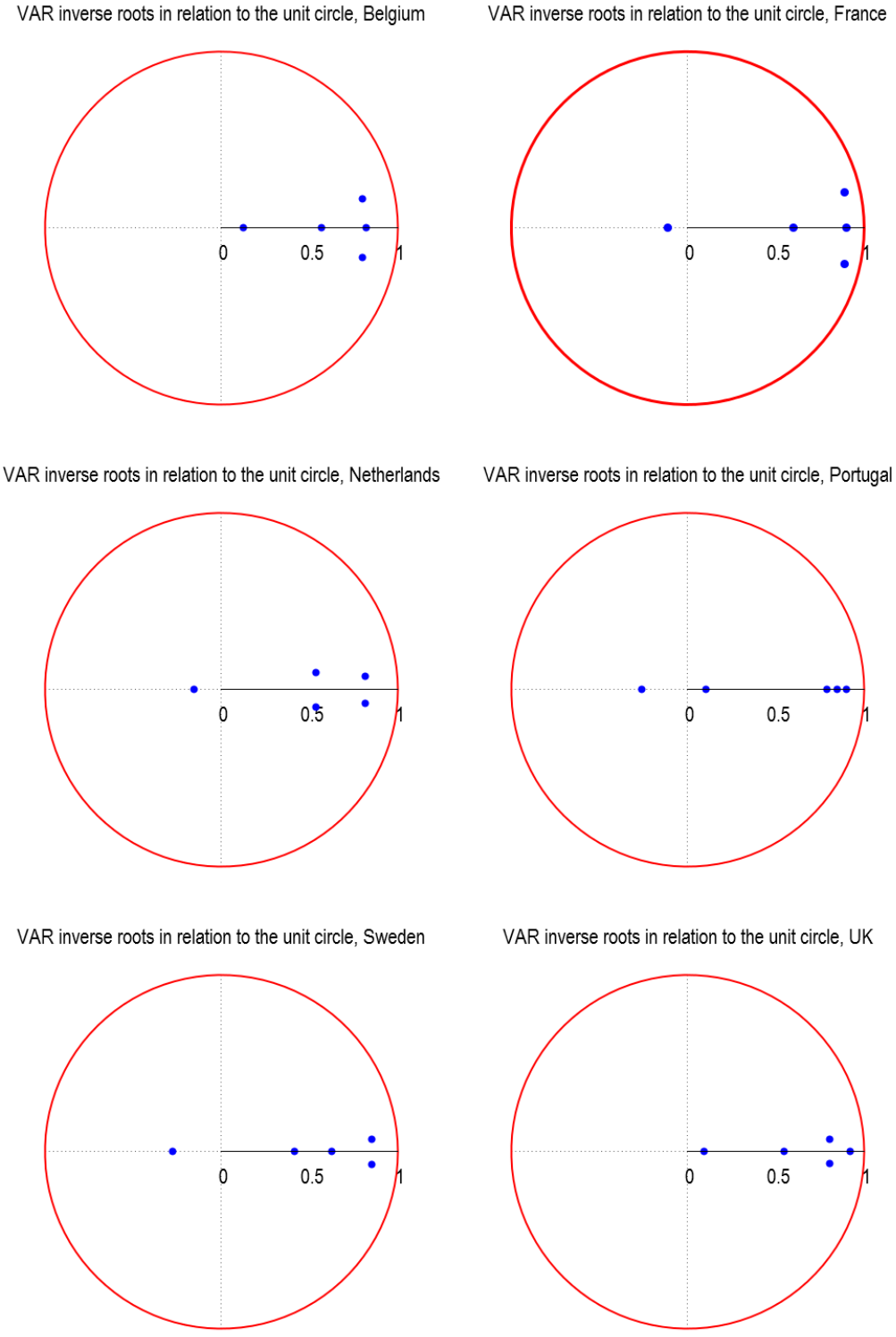
United Kingdom

VAR system, maximum lag order 4

The asterisks below indicate the best (that is, minimized) values
of the respective information criteria, AIC = Akaike criterion,
BIC = Schwarz Bayesian criterion and HQC = Hannan-Quinn criterion.

lags	loglik	p(LR)	AIC	BIC	HQC
1	389.37645		-7.260130	-6.473730*	-6.941952
2	439.65741	0.00000	-7.770857	-6.329124	-7.187529*
3	458.23264	0.05587	-7.641064	-5.543997	-6.792587
4	493.45980	0.00000	-7.847673*	-5.095273	-6.734047

Figure 19. Unit Circle (base model)



B. Extended Model

Table 5. Lag selection (extended model)

Belgium

VAR system, maximum lag order 4

The asterisks below indicate the best (that is, minimized) values
of the respective information criteria, AIC = Akaike criterion,
BIC = Schwarz Bayesian criterion and HQC = Hannan-Quinn criterion.

lags	loglik	p(LR)	AIC	BIC	HQC
1	537.37403		-16.357725	-14.119658*	-15.485953*
2	583.49944	0.00018	-16.258601	-12.279815	-14.708784
3	643.85692	0.00000	-16.650239	-10.930733	-14.422376
4	697.92497	0.00000	-16.824999*	-9.364774	-13.919091

France

VAR system, maximum lag order 4

The asterisks below indicate the best (that is, minimized) values
of the respective information criteria, AIC = Akaike criterion,
BIC = Schwarz Bayesian criterion and HQC = Hannan-Quinn criterion.

lags	loglik	p(LR)	AIC	BIC	HQC
1	678.13613		-22.623132	-20.579302*	-21.832766*
2	731.86711	0.00000	-22.795168	-18.962986	-21.313232
3	787.29213	0.00000	-23.028805	-17.408272	-20.855299
4	857.29496	0.00000	-23.792544*	-16.383660	-20.927468

Netherlands

VAR system, maximum lag order 4

The asterisks below indicate the best (that is, minimized) values
of the respective information criteria, AIC = Akaike criterion,
BIC = Schwarz Bayesian criterion and HQC = Hannan-Quinn criterion.

lags	loglik	p(LR)	AIC	BIC	HQC
1	463.01053		-18.930723	-16.637067*	-18.084893
2	509.89285	0.00012	-18.832225	-14.531621	-17.246295
3	578.89127	0.00000	-19.762385	-13.454831	-17.436354
4	682.87744	0.00000	-22.319881*	-14.005378	-19.253749*

Sweden

VAR system, maximum lag order 4

The asterisks below indicate the best (that is, minimized) values
of the respective information criteria, AIC = Akaike criterion,
BIC = Schwarz Bayesian criterion and HQC = Hannan-Quinn criterion.

lags	loglik	p(LR)	AIC	BIC	HQC
1	436.79089		-11.326997	-9.236872*	-10.501089*
2	496.49009	0.00000	-11.651215	-7.935437	-10.182934
3	555.76406	0.00000	-11.962547	-6.621117	-9.851894
4	616.69226	0.00000	-12.324008*	-5.356924	-9.570982

Portugal

VAR system, maximum lag order 4

The asterisks below indicate the best (that is, minimized) values
of the respective information criteria, AIC = Akaike criterion,
BIC = Schwarz Bayesian criterion and HQC = Hannan-Quinn criterion.

lags	loglik	p(LR)	AIC	BIC	HQC
1	460.96633		-14.726048	-12.682218*	-13.935683*
2	518.70344	0.00000	-15.043761	-11.211580	-13.561826
3	588.19485	0.00000	-15.788904	-10.168371	-13.615398
4	660.50997	0.00000	-16.636726*	-9.227842	-13.771651

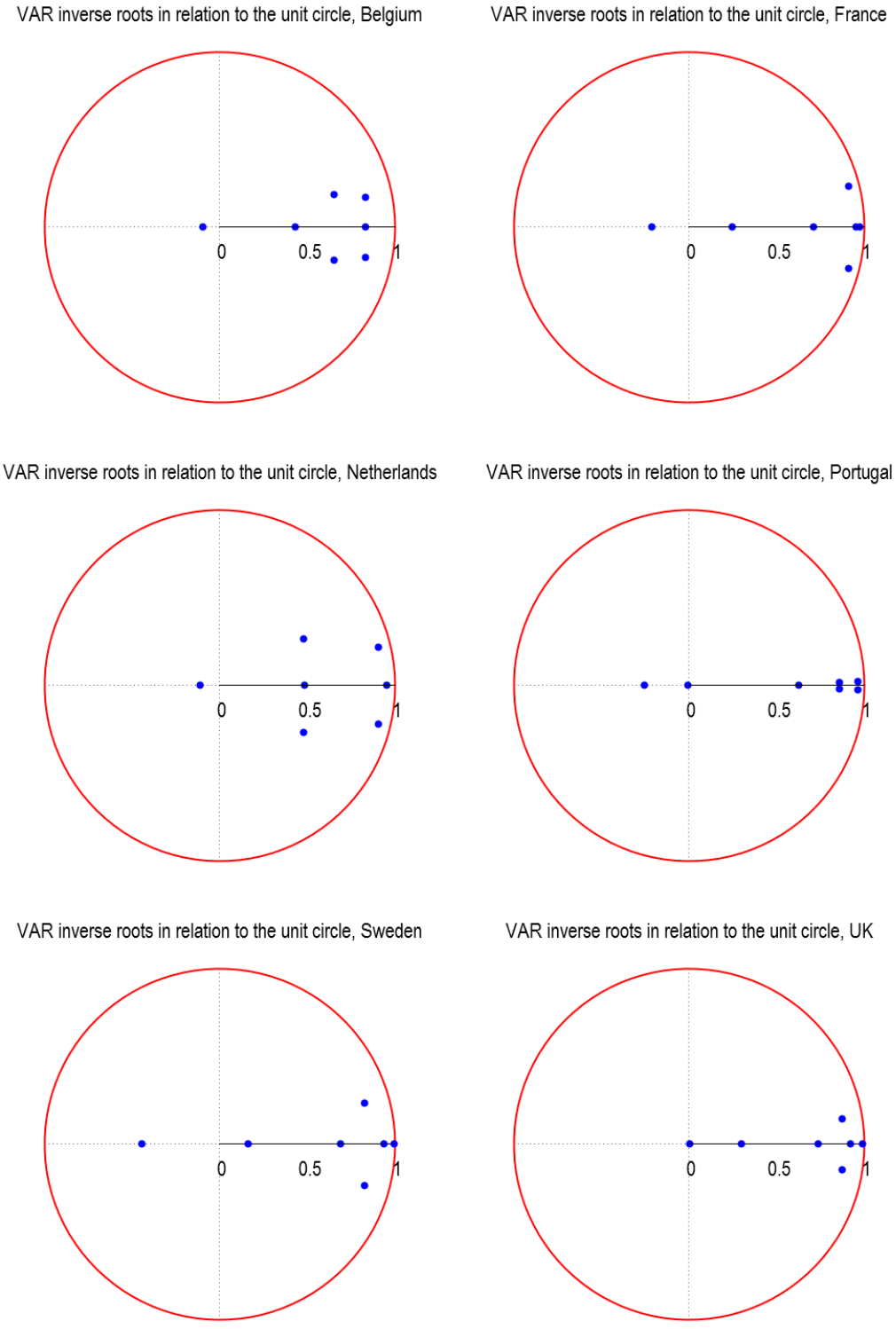
United Kingdom

VAR system, maximum lag order 4

The asterisks below indicate the best (that is, minimized) values
of the respective information criteria, AIC = Akaike criterion,
BIC = Schwarz Bayesian criterion and HQC = Hannan-Quinn criterion.

lags	loglik	p(LR)	AIC	BIC	HQC
1	848.76249		-16.015404	-14.547457*	-15.421470
2	930.06037	0.00000	-16.667886*	-13.915486	-15.554261*
3	962.54640	0.06287	-16.334271	-12.297418	-14.700953
4	1023.86096	0.00000	-16.583050	-11.261743	-14.430041

Figure 20. Unit Circle (extended model)



C. General Results

Table 6. Description of data for the Housing Prices

	Country*	Priced unit	Unit Measure	Coverage
1	**Belgium**	per dwelling	Index, 2000=100	Covers existing ordinary residential houses, villas, pensions, country houses, apartments, flats and studios
2	**France**	per dwelling	Index, 2010 Q1=100	Covers existing buildings
3	**Netherlands**	per dwelling	Index, 2005 = 100	Covers existing all types of dwellings
4	**Sweden**	per dwelling	Index, 1981 = 100	Covers new and existing one or two-dwelling buildings for permanent living
5	**Portugal**	per square meter	Index, 2005 = 100	Covers new and existing owner-occupied and investor dwellings, established and new dwellings, houses and apartments across Portugal (excludes islands)
6	**United Kingdom**	per dwelling	Index, 2002 Q1 = 100	Covers new and existing dwellings on mortgage lending by all lenders

* the data is taken for the whole country including capitals

Table 7. Data Description

	Variable	Abbrev-n	Measure	Source
1	**Gross domestic product - expenditure approach**	**GDP**	GPSA: Growth rate compared to previous quarter, seasonally adjusted	OECD statistics
2		**nom_GDP**	CQRSA: Millions of national currency, current prices, quarterly levels, seasonally adjusted	OECD statistics
3	**Final consumption expenditure of households**	**c**	CQRSA: Millions of national currency, current prices, quarterly levels, seasonally adjusted	OECD statistics
4	**Gross Fixed Capital Formation (proxy for residential investment)**	**GFCF_n**	national currency, billions	IFS
5		**GFCF_euro**	in euro, billions	IFS
6		**inv**	Gross Fixed Capital Formation adjusted (GFCF/deflator)	IFS
7	**Housing Prices**	**hp**		Bank for International Settlement
8	**Short-term interest rate**	**i**	per cent per annum	OECD statistics
9	**Unemployment**	**u**	All persons, Level, rate or quantity series, s.a.	OECD statistics
10	**Consumer Prices- all items (proxy for inflation)**	**inf**	percentage change from previous period	OECD statistics
11	**Deflator**	**def**	DNBSA: Deflator, national base/reference year, seasonally adjusted	OECD statistics

Table 8. Summary Statistics for the Short-Term Interest Rate

Belgium, using the observations 1995:2 - 2011:3
for the variable i (66 valid observations)

Mean	Median	Minimum	Maximum
3.04094	3.23667	0.662167	5.05000
Std. Dev.	C.V.	Skewness	Ex. kurtosis
1.20462	0.396135	-0.276277	-0.735723

France, using the observations 1996:1 - 2011:3
for the variable i (63 valid observations)

Mean	Median	Minimum	Maximum
3.01986	3.35733	0.662167	5.02417
Std. Dev.	C.V.	Skewness	Ex. kurtosis
1.21125	0.401095	-0.300585	-0.817219

Netherlands, using the observations 1995:1 - 2011:3
for the variable i (67 valid observations)

Mean	Median	Minimum	Maximum
3.03083	3.18333	0.662167	5.13000
Std. Dev.	C.V.	Skewness	Ex. kurtosis
1.19884	0.395547	-0.235960	-0.706340

Portugal , using the observations 1996:1 - 2011:3
for the variable i (63 valid observations)

Mean	Median	Minimum	Maximum
3.43009	3.36223	0.662167	8.16667
Std. Dev.	C.V.	Skewness	Ex. kurtosis
1.74326	0.508226	0.500303	-0.105215

Sweden, using the observations 1993:2 - 2011:3
for the variable i (74 valid observations)

Mean	Median	Minimum	Maximum
3.79327	3.81833	0.163333	9.11000
Std. Dev.	C.V.	Skewness	Ex. kurtosis
2.26999	0.598427	0.687478	0.00146552

United Kingdom, using the observations 1985:1 - 2011:3
for the variable i (107 valid observations)

Mean	Median	Minimum	Maximum
6.86112	5.98997	0.589433	15.1856
Std. Dev.	C.V.	Skewness	Ex. kurtosis
3.68163	0.536593	0.494829	-0.321217

Table 9. Summary statistics for the Housing Price Index

Belgium, using the observations 1995:2 - 2011:3
for the variable l_hp (66 valid observations)

Mean	Median	Minimum	Maximum
4.45408	4.40225	3.98379	4.94741
Std. Dev.	C.V.	Skewness	Ex. kurtosis
0.325463	0.0730707	0.0980345	-1.48158

France, using the observations 1996:1 - 2011:3
for the variable l_hp (63 valid observations)

Mean	Median	Minimum	Maximum
4.23975	4.23844	3.72328	4.71761
Std. Dev.	C.V.	Skewness	Ex. kurtosis
0.362055	0.0853952	-0.0916413	-1.62773

Netherlands, using the observations 1995:1 - 2011:3
for the variable l_hp (67 valid observations)

Mean	Median	Minimum	Maximum
4.38515	4.52179	3.66014	4.72798
Std. Dev.	C.V.	Skewness	Ex. Kurtosis
0.332012	0.0757128	-0.845971	-0.716836

Portugal, using the observations 1996:1 - 2011:3
for the variable l_hp (63 valid observations)

Mean	Median	Minimum	Maximum
4.54539	4.57985	4.25750	4.70592
Std. Dev.	C.V.	Skewness	Ex. Kurtosis
0.137402	0.0302288	-0.828655	-0.554950

Sweden, using the observations 1993:2 - 2011:3
for the variable l_hp (74 valid observations)

Mean	Median	Minimum	Maximum
5.71841	5.71522	5.15906	6.30445
Std. Dev.	C.V.	Skewness	Ex. Kurtosis
0.394524	0.0689920	0.0451506	-1.43420

United Kingdom, using the observations 1985:1 - 2011:3
for the variable l_hp (107 valid observations)

Mean	Median	Minimum	Maximum
4.39106	4.23411	3.31419	5.21276
Std. Dev.	C.V.	Skewness	Ex. kurtosis
0.558555	0.127203	0.0500587	-1.19589

Figure 21. History of the short-term Interest Rate

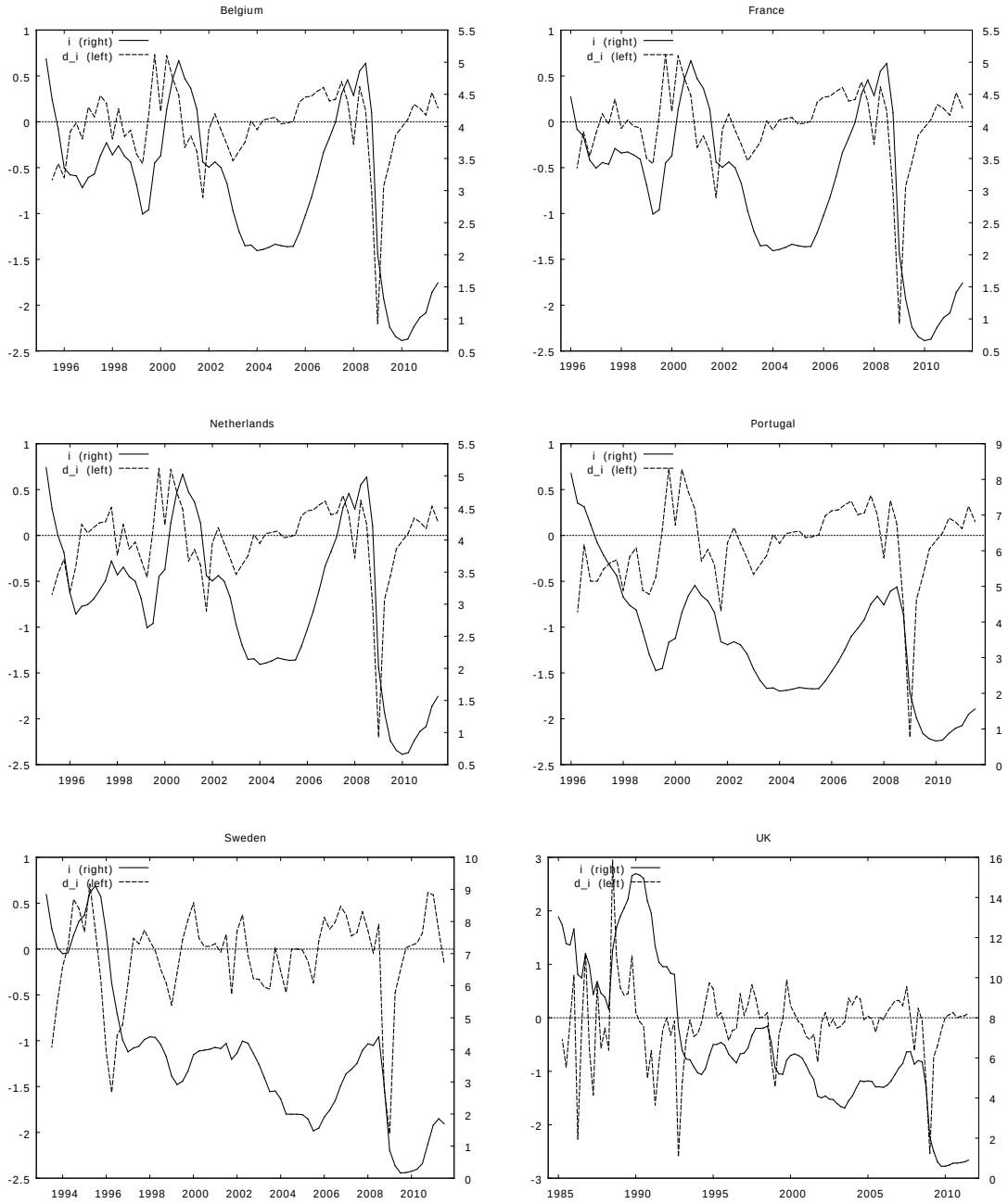
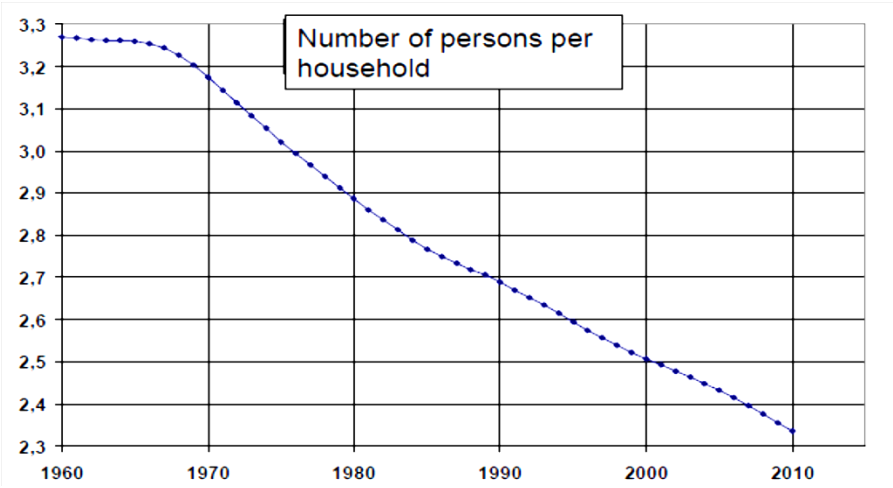
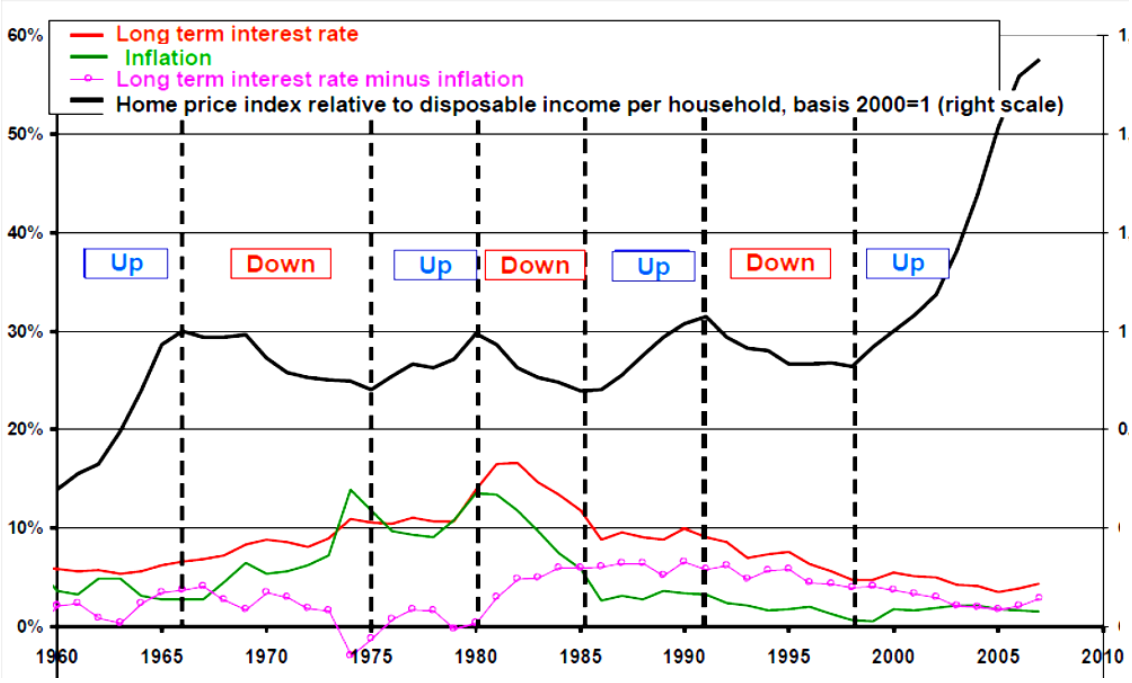


Figure 22. Development of number of persons in household, France



Source: CGEDD (2012)

Figure 23. Interest rate and the HPI, France



Source: Friggit (2009)

Description: evolution of the HPI does not coincide with the evolution of the interest rate

Figure 24. GDP History