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The Influence of Housing Price Development on the Household Balance Sheet
Empirical Analysis for the Czech Republic

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Abstrakt

Tato studie se zabývá vlivem cen nemovitostí na spotřebu domácností. Testuje tzv. hypotézu efektu bohatství, která předpokládá, že změna bohatství plynoucího z vlastnictví nemovitostí nebo z vlastnictví cenných papírů zvyšuje spotřebu domácností. Studie je založena na empirické analýze českých agregátních dat z let 1998 až 2009 získaných z databází České národní banky a Českého statistického úřadu. Obdobná analýza na agregátních datech nebyla doposud v České republice provedena. V rámci studie jsou analyzovány efekty cen nemovitostí na spotřebu zboží dlouhodobé a krátkodobé spotřeby (včetně služeb) pomocí VAR a VEC modelů aplikovaných na čtvrtletní sezónně očištěná data a je zjištěn kladný efekt u obou druhů spotřeby. Pro spotřebu zboží krátkodobé spotřeby je navíc odhadnut kointegrační vektor. Porovnáním složek tohoto vektoru lze navíc zjistit, že elasticita spotřeby zboží krátkodobé spotřeby vzhledem k bohatství plynoucího z vlastnictví nemovitostí (0.18) je více než třikrát větší než vzhledem k bohatství plynoucího z vlastnictví cenných papírů (0.05).

Klíčová slova

Domácnosti, ceny nemovitostí, spotřeba, bohatství plynoucí z vlastnictví nemovitostí, bohatství plynoucí z vlastnictví cenných papírů, model VAR, VECM

Abstract

This study describes the topic of how housing prices influence households' consumption. We test the wealth effect hypothesis which postulates that change in housing or stock market wealth increases consumption. We provide empirical analysis of Czech aggregate data for 1998–2009 by combining the public databases of the Czech National Bank and Czech Statistical Office. To the best of our knowledge, this analysis on aggregate data is the first of its kind in the Czech Republic. We analyse the effect of change in housing prices on the consumption of both durable and non-durable goods employing the VAR and VEC models on quarterly seasonally adjusted data. We find a positive effect of both wealth components on both types of consumption. In case of non-durable goods consumption we estimate the cointegrating vector and conclude that the elasticity of non-durable goods consumption with respect to housing wealth (0.18) is over three times greater than with respect to stock market wealth (0.05).

Keywords

Households, housing prices, consumption, housing wealth, stock market wealth, VAR model, VECM

Declaration of authorship

I hereby declare that I wrote this bachelor thesis on my own under the guidance of my supervisor and that all resources and literature I have used are referenced herein.

I hereby declare that this thesis was not used to obtain another or equal degree.

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Prague, July 29, 2011

Sylvie Dvořáková

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List of Abbreviations

ACF	Autocorrelation function
ADF	Augmented Dickey – Fuller test
AIC	Akaike's Information Criterion
AR	Autoregressive process
ARAD	Public Database of Czech National Bank
BIC	Schwarz Bayesian Criterion
BLUE	Best Linear Unbiased Estimator
CNB	Czech National Bank
CZSO	Czech Statistical Office
DOLS	Dynamic Ordinary Least Squares
GDP	Gross Domestic Product
GDI	Gross Disposable Income
HQ	Hannah-Quinn Criterion
IRF	Impulse Response Function
KPSS	Kwitlowski, Phillips, Schmidt, and Shin test
MAIC	Modified Akaike's Information Criterion
OLS	Ordinary least squares
PACF	Partial Autocorrelation Function
PRIBOR	Prague Interbank Offered Rate
PX index	Prague Stock Exchange Index
RPPI	Residential Property Price Index
SUR	Seemingly Unrelated Regression
VAR	Vector autoregression
VECM	Vector error correction model
2SLS	Two-Stage Least Squares

1. Introduction

This thesis analyses the relationship between housing wealth and consumption expenditure. As consumption represents an important part of aggregate demand and may therefore influence the economic growth, the linkage between housing wealth and consumption expenditure drew the attention of many studies in the past two decades.

Housing wealth (the total value of housing capital) is for most households the primary store of wealth and constitutes an important anchor. On the other hand, stock market wealth (the total value of financial assets, e.g. bonds, stocks, futures, government securities, etc.), is understood as a sort of luxury good which is not distributed as evenly across income levels as housing wealth.[1]

In this study, we assume that change in housing wealth (or stock market wealth) has a positive influence on consumption. This effect is known as the wealth effect (an increase in perceived wealth should lead to higher consumption expenditure). This study tests whether the effect is present in the Czech Republic. According to the studies mentioned in the literature review, the wealth effect in other countries is quite significant. However, there is a strong belief that this effect is not that significant in the Czech Republic, as the level of development of the local real estate and financial markets is smaller and the adjustment of mortgages when housing prices increase is more complicated.[2]

This analysis was performed in various countries[3] both on micro and macro data. Nevertheless, to the best of our knowledge, there has been only one study based on micro data, dealing with this issue in the Czech Republic (Seč and Zemčík, 2007). This implies that the analysis of the impact of housing prices on consumption and the estimation of the magnitude of the housing wealth effect based on aggregate data from the Czech Republic still remains uncovered.

This study analyses the relationship between consumption and the two wealth components (housing and stock market wealth) on aggregate data for the period 1998–2009. We take into account the following variables: consumption, disposable income,

[1] This characterisitcs were summarized for example by Belsky and Prakken (2004)
[2] Increase in house prices means higher value of the owned property and thus one can negotiate higher mortgage by using the property as collateral, enabling increased consumption.
[3] For example Dvornak and Kohler (2003) conducted this analysis for Australia, Case et al. (2001) for the U.S. and OECD countries, Belsky and Prakken (2004) also for the U.S., Campbell and Cocco (2010) for the United Kingdom, and Raymon, Man and Choy (2007) for Hong Kong.

stock market wealth, housing wealth, interest rate, inflation, and unemployment. Due to the use of the aggregate data, we cannot distinguish between the young and old, homeowners and home renters, mortgage payers and non-payers, etc. On the other hand, we are able to distinguish between the consumption of durable and non-durable goods.

In the reviewed literature there is no unanimous conclusion about which effect (housing wealth effect or stock market wealth effect) should be more influential on the consumption of either durable or non-durable goods. We apply the Vector Autoregressive model (VAR) on stationary time-series and in case of cointegration among them we estimate the Vector Error Correction Model (VECM). Due to data limitations, we use price and stock market indices as proxies for the wealth components, thus our results have to be taken with caution.

Our conclusions are as follows: when estimating VAR on the first differences of the consumption of durable goods time-series we find that the growth of both wealth components indirectly Granger causes growth of consumption through changes in the growth of disposable income. In accordance with the concept of Impulse Response Function (IRF) we observe that shocks in both wealth components have positive and approximately equal impact on consumption growth. We compare this IRF with the same model for the consumption of non-durable goods and services and find an approximately two times smaller impact on consumption growth. Moreover, a significant cointegrating vector is found in the VECM for the consumption of non-durable goods and services, which indicates the elasticity of consumption of non-durable goods and services with respect to housing wealth (0.18) is over three times greater than with respect to stock market wealth (0.05). Due to the fact that coefficient estimates by VAR cannot be interpreted as elasticities, and to the absence of cointegration among variables in the former model, we cannot compare this result with the equivalent result for consumption of durable goods. Contrary to prior beliefs, we find a positive relationship between consumption (both of durable and non-durable goods) and the two wealth components.

The study is organized as follows. Chapter 2 contains a detailed literature overview. Chapter 3 provides a description of the development of housing prices and the situation on the real estate market over the period 1997–2010 in the Czech Republic. Chapter 4 discusses households' behaviour with regards to savings and indebtedness over the abovementioned period. Chapters 5 and 6 include an econometric analysis based on

Czech aggregate data from 1998–2009 and goes through the data description, tests for unit root and cointegration, and estimates regression models for the both types of consumption. Moreover, Chapter 6 presents obtained results and the Summary follows.

2. Literature review

In this chapter, the relevant literature connected with the topic of the relationship between consumption and housing wealth (as well as stock market wealth) is presented. Since each of the following studies is based on a different data set and on a different model specification, mutual result comparison is not straightforward.

In the study of Dvornak and Kohler (2003) both stock market wealth and housing wealth are found to have a significant long-run effect on Australian consumption. They estimate that 1 Australian dollar's worth of permanent increase in households' stock market wealth and housing wealth corresponds to an increase in consumption by 6 to 9 cents and 3 cents, respectively. As households' housing assets are, on the average, three times as large as their stock market assets, one per cent increase in housing wealth has an effect on aggregate consumption not smaller than the effect of the same increase in stock market wealth.

The main difference from later research is that Dvornak and Kohler test whether households decide according to the market value of their asset holdings or according to wealth measures net of debt (taking into account households' improper assessment of their net asset position and other behavioural effects). This measure is used also by Bostic, Gabriel and Painter (2007).

Case et al. (2001) find the very opposite – a remarkably higher impact of housing wealth as compared to stock market wealth for a panel of U.S. states and OECD countries. When examining the housing wealth effect on consumption together with the stock market wealth effect, the housing wealth effect is often found insignificant. This occurs in some US studies using aggregate or household–level data. A possible explanation might be the multicollinearity of the two wealth variables. Dvornak and Kohler (2003) control for the multicollinearity by using a panel of Australian states and find both effects to be significant in the long-run.

Case et al. repeat their analysis in 2005 using similar data sets and come to the same conclusions as in their previous study. The stock market wealth effect is estimated to be rather insignificant; meanwhile the housing market wealth effect might cause important changes in consumption. These results are consistent both for US states and for industrial countries and robust to differences in model specification.

Until the study of Ludwig and Slok (2004), Dvornak and Kohler (2003) and Case et al. (2001) were the only ones who were distinguishing between the stock market wealth effect and housing wealth effect. Later, this division began to be commonly applied. The division is highly important, because the two wealth components need not be the same, contrary to what is proposed by the life-cycle hypothesis of saving and consumption, where all sources of an increase in wealth, either in housing or stock market wealth, are supposed to have the same positive effect on household consumption (Ando and Modigliani, 1963). Mishkin (2007) considers the standard objections to this hypothesis. First, the housing wealth effect should be higher than the stock market wealth effect, because housing wealth is spread far more evenly throughout the population. Second, housing prices are far less volatile than stock prices and might be considered longer lasting. Belsky and Prakken (2004) add that home prices are not exposed to frequent and large fluctuations, even though the relevance of this particular observation may be questioned at present time. Moreover, nominal changes in home values are not that common as nominal changes in stock values, and households feel more secure of gains in housing wealth and thus spend more readily and rapidly when they appear. Other objections were added by Catte et al. (2004). If households are liquidity constrained then an increase in housing wealth can make access to credit easier, thus aggregate housing wealth may affect consumption more than an equivalent change in financial wealth.

There are also several challenges to the life-cycle hypothesis which hold the very opposite, that the housing wealth effect should be smaller than wealth effects from other assets. Mishkin (2007) mentions for example the bequest motive, and the fact that if a household is not a homeowner and plans to buy a house in the future, the rise in house prices could even lower its current consumption. The last challenge is mentioned by both Mishkin (2007) and Catte et al. (2004). The effect of housing prices increase on wealth can be expected to be counterbalanced by the higher costs of present and future housing services (implicit costs of living), which is not true for financial assets.

Mishkin (2007) and Catte et al. (2004) both agree that when considering which wealth effect – housing or stock market – is higher, the question is rather empirical and the evidence is too ambiguous to confidently reject the standard life-cycle hypothesis, said ambiguity being caused in no small part by data availability limitations.

Ludwig and Slok (2004) contrast both with Case et al. (2001) and Dvornak and Kohler (2003) when saying that it is doubtful if the two wealth effects are different. However, they find that there is a long-run relationship between consumption and stock market prices and that the housing wealth effect was larger in the 1985–2000 period than in the 1960–1984 period. Further, short-run adjustments of consumption by stock prices, housing prices and income are observed as well for 16 OECD countries. The sample is also split into two different groups of countries, because the authors assume the financial system to play a crucial role in the analysis. Countries with market-based financial systems, which are predominant in Anglo-Saxon countries, form the first group. These countries are characterized by a larger size of stock markets and a higher degree of stock market capitalization. The second type of countries are continental European countries with bank-based financial systems. The analysis reveals that the stock market wealth effect is higher for the first group of countries. Due to data limitations the authors encounter several problems. First, they have to use stock market and housing market indices as proxies for the two wealth components. Second, they do not distinguish between durable and non-durable consumption as only total aggregate consumption is given, and finally they use total income instead of only the income for labour.

The distinction between durable and non-durable goods is discussed in several studies. According to Ludwig and Slok (2004), non-durable consumption is used in most studies, e.g. by Seč and Zemčík (2007), because durable consumption is considered complementary to investment in stock. However, an argument in favour of including durable goods consumption is the fact that during stock market crashes, it is that, not the consumption of non-durables, which is postponed. Moreover, resources from mortgages are mainly spent on the consumption of durable goods. Belsky and Prakken (2004) and Bostic, Gabriel and Painter (2007) also argue that the two consumption components should be modelled separately, and provide such an analysis.

The study of Carroll, Otsuka and Slacalek (2006) also finds evidence for a substantially bigger housing wealth effect compared to the stock market wealth effect, much like Case et al. (2001 and 2005), however the analysis is provided for US aggregate level data instead of micro level data. The authors manage to distinguish between short-run and long-run wealth effects. On US data they estimate the immediate (first quarter) marginal propensity to be relatively small. A one-dollar change in housing wealth means about 2 cents' increase in consumption, however the final long-run effect (several years) is around 4–10 cents, which is consistent with evidence from micro data and experiences across US states. They are, similarly to Ludwig and Slok (2004), quite unsure which wealth effect (housing or stock market) is larger. They, like for instance Belsky and Prakken (2004) stress the importance of monetary policy, but they also warn that a rise in housing prices could have been driven by bubble factors. This means the marginal propensity to consume out of housing wealth should be taken with caution.

A detailed description of the role of housing market in the monetary transmission mechanism was provided by Mishkin (2007, p. 5). "By raising or lowering short-term interest rates, monetary policy affects the housing market, thus the overall economy, directly or indirectly by several channels." He doubts the suitability of micro-level evidence for the estimation of stock market effects, even as micro-level data is used by Case et al. (2005) and Bostic, Gabriel and Painter (2007) and he is critical to cross-country results.

The main contribution of Catte et al. (2004) is the evaluation of the relationship between the business cycle in OECD countries and housing markets, and determining whether the housing market stabilizes the business cycle or not.[4] Some OECD countries are coping with economic downturns better than others and Catte et al. (2004) hypothesize that their resilience may be related to the performance of the housing market. That is why the authors are interested in how housing prices influence consumption and in the factors that determine house price volatility. As regards house price volatility, real house price movements are found not only to be very different among countries but also from one cycle to another and to tend to lag behind the cycle. Catte et al. (2004) propose this is due to macroeconomic and structural factors which differ across countries. The highest influence of house prices on consumption is found in countries with large, efficient and responsive mortgage markets. This conclusion is similar to the one of Ludwig and Slok (2004). Significant housing wealth effects are found in the United States, Canada, the United Kingdom, Australia, and the Netherlands. However in Italy, Germany or France the effect is rather limited.

[4] If there is a strong housing wealth effect, a developed and flexible mortgage market, and a low degree of house price volatility, then the housing market influences the speed and magnitude of monetary policy transmission to the economy (Catte et al., 2004).

The linkage between the housing market and the business cycle is also discussed by Belsky and Prakken (2004). They state that "housing leads the economy into recession as interest rate hikes take steam out of housing demand and job losses further undermine home-building, home sales etc."[5]. As their main result they posit that expansionary monetary policy can stimulate consumer spending provided the right circumstances, on the other hand, monetary tightening can slow down economic growth as it reduces home equity borrowing, which in turn reduces consumption. It is estimated that in the long run, 5 ½ cents out of every dollar increase in housing or stock wealth is spent on consumption. The authors perform the regression on detailed micro data and focus on the consumption of durable goods. They find that the effects on consumer spending of changes in stock wealth and housing wealth are similar in magnitude but different in timing – housing wealth effects are more immediate (one year vs. several years for stock market effects).

There are three possible hypotheses explaining the co-movement of house prices and consumption proposed by Attanasio, Blow, Hamilton and Leicester (2005). First, the wealth effect hypothesis says that an increase in house prices raises households' wealth, especially for those who want to exchange their dwelling for a cheaper one (e.g. pensioners). The second hypothesis could be called the relaxation of borrowing constraints hypothesis. When house prices are growing, collateral available to homeowners increases, reducing credit constraints and making higher consumption possible. Households can then simply borrow more by using the house as collateral and spend the money. The productivity hypothesis is the third one: consumption and house prices tend to be determined by common factors, namely the productivity of labour. Attanasio, Blow, Hamilton and Leicester (2005) test all of them on British individual household level data to assess the importance of each hypothesis. In addition, they, similarly as Campbell and Cocco (2010), distinguish between younger and older households. They find that the linkage between consumption and house prices is surprisingly weaker for older than it is for younger households, who are less likely to own a property. For older households the relationship is not even significant. This contrasts with the wealth hypothesis and with the results of previous studies. Under the wealth explanation, older households are usually those who can freely increase their consumption after an increase in house price since they usually (i) own their home, (ii) do not want to exchange the house for a more expensive dwelling in the future, and (iii) can

[5] Belsky and Prakken (2004), p. 1

expect to have a relatively shorter time for enjoying their wealth increase. On the other hand, a house price increase should lower the consumption of mainly young households who are renting or looking to buy a home, and who after the price increase face higher future dwelling costs than they expected.

This wealth hypothesis is rejected by Attanasio, Blow, Hamilton and Leicester (2005). Instead, the only hypothesis they find support for is the productive hypothesis, under which younger people are supposed to benefit most as their expected future earnings will have shifted upwards with a house price increase and since they have more productive years ahead. Thus the authors conclude that the most important factor in the relationship between house prices and consumption is the common influencing factors (income expectations for example), which is in contrast with all previous studies.

Attanasio, Blow, Hamilton and Leicester (2005) firmly criticize the study of Campbell and Cocco (2010), who admit only the increased households' perceived wealth and relaxation of borrowing constraints hypotheses. Campbell and Cocco (2010), however, are aware of the objections against the direct housing wealth effect. They argue that an increase in house prices augments homeowners' wealth, but that does not imply that real wealth is higher as well. "Higher house price is simply a compensation for a higher implicit rental cost of living in the house."[6] This implies that people who want to remain in their current dwelling are completely hedged against fluctuations in house prices, both up and down.

Nevertheless, a significant wealth effect is observed by Campbell and Cocco (2010). They use UK micro-level data to distinguish between local and national, as well as predictable and unpredictable movements in house prices, and between younger and older cohorts. The effect of house prices on consumption is estimated to be the largest for older homeowners and the smallest (almost zero) for younger renters. They estimate that as people get older, they are more likely to concentrate in the homeowners group, and thus their consumption may respond to house prices more significantly. The elasticity for older homeowners is estimated to be 1.7 versus and at the aggregate level 1.2. Attanasio, Blow, Hamilton and Leicester (2005) find the elasticity to be between 0.21 and 0.04 depending on the age group.

[6] Campbell and Cocco (2010), p. 1

Kishor (2007) conducts a similar analysis on aggregate US data for almost half of a century. He estimates the appropriate elasticities simply by testing for cointegration among consumption, labour income, and the two wealth components. He concludes that consumption elasticity with respect to housing wealth is three times smaller than with respect to financial wealth. Elasticity with respect to housing wealth is 0.19, which is similar to the results of Attanasio, Blow, Hamilton and Leicester (2005). When recalculating the results in order to obtain wealth effects he obtains that a one-dollar increase in housing wealth and stock market wealth increases consumption by seven and six cents, respectively.

Finally, Campbell and Cocco (2010) find that consumption reacts to predictable changes in house prices (consistent with the relaxation of borrowing constraints hypothesis), this effect is weaker for households with unused borrowing capacity, but influences both renters and owners and is present on a national rather than a regional level. This suggests that house prices are correlated with financial market conditions in the economy as a whole.

As we can see, results of Campbell and Cocco (2010) and Attanasio, Blow, Hamilton and Leicester (2005) contrast sharply despite both analyses having been conducted with UK micro data. There were, however, some significant differences in methodology. The econometric evidence does not provide a unanimous solution, across studies different elasticities are measured and different results are obtained when estimating whether the housing wealth effect is bigger than the stock market wealth effect.

However, According to Carroll, Otsuka and Slacalek, (2006) "on balance, most macro- and microeconometric studies provide evidence that the medium-run marginal propensity to consume (after 3 years) out of housing wealth is in the range of 0.04 to 0.10."[7] These results are supported by the research of Bostic, Gabriel and Painter (2007), who estimate housing wealth elasticities in the range of 0.06. Financial wealth elasticities are, according to them, smaller in magnitude, and are in the range of 0.02. The biggest advantage of Bostic, Gabriel and Painter's (2007) study is it having the most detailed micro data set. The data set enables them to control for household demographic, behavioural, and economic characteristics and makes the division between gross and net-of-debt wealth measures, credit-constrained and credit-unconstrained households and

[7] Carroll, Otsuka and Slacalek, (2006), p. 10

between age cohorts possible. They find consumption propensities to diverge between the abovementioned groups.

The study of Raymon, Man and Choy (2007) is significantly different from all the previous studies because the analysis is applied to a relatively coherent and active city of Hong Kong. The estimated effect of housing market wealth on private consumption is found significant; however the estimated effect of stock market wealth is rather weak. Nevertheless, variations in housing markets do not change real consumption dramatically. A 1% increase in housing market wealth augments real consumption by 0.1% – 0.15%, which is close to the results of Case et al. (2001).

Finally, a short study of Seč and Zemčík (2007) is dealing with this topic in the Czech Republic. They combine the Household Consumption and Expenditure Survey of the Czech Statistical Office for 3000 households and the data set of the Institute of Regional Information in Brno (IRI). In their regression model they explicitly distinguish between homeowners and renters, as well as households with and without mortgage, which enables them to assess the difference between the groups. They find that homeowners and renters respond differently to changes in housing prices and rents. A 1% increase in rent lowers a renter's consumption by 0.25% in comparison with a homeowner. Higher housing prices mean increased consumption of homeowners only. Neither renters nor homeowners respond to changes in mortgage payments. Whether a household is or is not paying a mortgage does not make for significant differences in responding to changes in housing prices, rents or mortgage payments.

3. Czech residential property market

In the previous chapter we have described several studies that conducted an analysis of how housing price[8] development influences consumption. Prior to conducting our own analysis for Czech data we describe the Czech residential property market. First of all, we discuss the construction and problems of the Czech residential property price index and then the residential property price development on the Czech real estate market in the 1997–2010 period.

3.1. Residential Property price index

The property price index is crucial for our analysis as we are using it as a proxy for housing wealth. Moreover, it is important for example for the government and the central bank seeking to stabilize the market, and for individuals planning to make an investment into real estate. The more precise the index is, the better and more accurate information it provides. Having an official and correct property price index is therefore important. According to Dubská (2009) it helps to compare the rates of return from different types of assets. It also helps to forecast future economic performance, as housing prices are one of the leading indicators which can signal the changeover in the economic cycle. Nevertheless, in the Czech Republic, there is no official property price index. The problem with its construction stems from Czech legislation. The Czech Statistical Office provides detailed price indices based on data available from declarations of real estate transfer tax. Unfortunately, only natural persons, as opposed to juristic persons, are obliged to provide these declarations. This means that the index lacks information about the sales of new apartments by developers and real estate agencies and even the sales of existing apartments by municipalities, because these are not legally obliged to provide such information. It is estimated that one half of all real estate sales is made through real estate agencies, which could undermine the value of the index (Dubská, 2009).

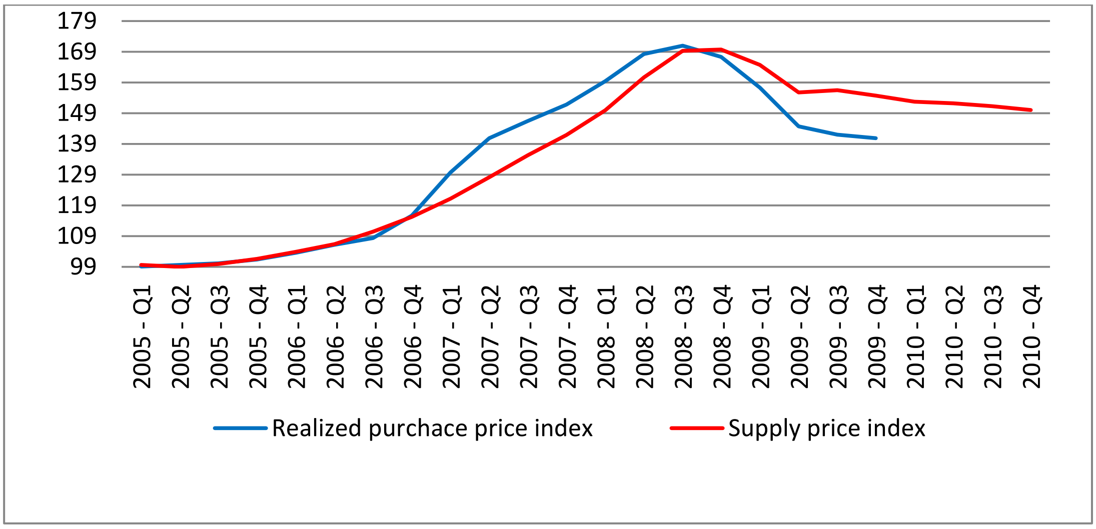
The main source of property prices is the Czech Statistical Office. They compile the realized purchase price index, which comes from the database of the Ministry of Finance of the Czech Republic. The database is created by financial offices on the grounds of the aforementioned declarations of real estate transfer tax. Another property price index is available from the Institute for Regional Information at Brno (IRI). It is a supply price

[8] When referring to housing prices, we understand the residential property prices.

index based on offer price information from real estate agencies and is, unlike the CZSO index, not free of charge.

Due to the fact that households are the subject of this study, the residential property price index is in the centre of our attention. This index is constructed as a weighted average of family house, apartment, apartment block, and building plot price indices for the whole of the Czech Republic. This index is calculated from realized purchase prices rather than from supply prices. The supply prices do not reflect the actual realized demand; their role is only being indicative of the overestimation or underestimation of sellers' expectations (Dubská, 2009). Commercial property is not the focus of this paper, and thus it is not included in the analysis.

Graph 1: Relationship between realized purchase price index and supply price index
(average 2005 = 100)



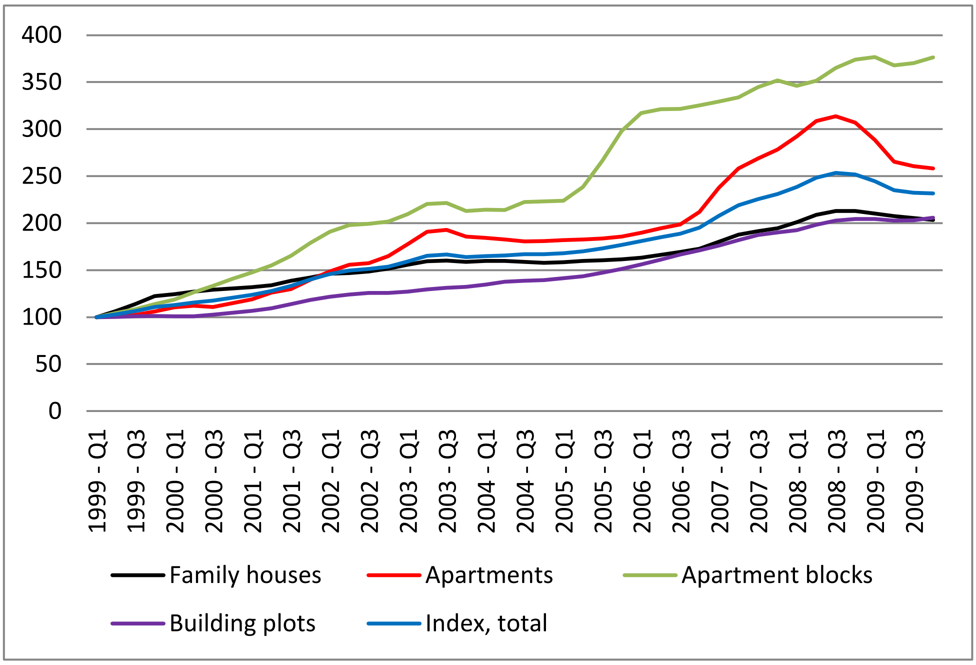
Source: CZSO

3.2. Residential Property price development

In the period 1998–2009 there were two major price increases on the Czech real estate market. The first increase in 2002/2003 was caused by high expectations about future property price development. The Czech Republic was about to join the European Union, which was expected to lead to higher property prices. This confidence wave was carried in marketing by large numbers of developers, economic specialists and banks (Dubská, 2009). As we can see in Graph 2, the decline of property prices in 2004 proved the overestimation of these expectations. Another major increase in housing prices after the period of price stability was observed in 2006 and in 2007/2008. This was caused by significant economic growth in the Czech Republic in this period. Real wages were increasing, the foreign exchange rate was appreciating, and households had positive expectations about future development (see Graph 4).

According to CNB (2006), the rapid housing price growth in 2006 could be viewed as convergence with the "old" EU countries. Furthermore, better availability of mortgages played its role as well. Households' demand was pushing the prices up; see Graph 1, where the realized purchase price index was much higher than the supply price index during the years 2007 and 2008.

Graph 2: Property prices – transfer prices according to tax returns
(absolute index, 1Q 1999 = 100)



Source: CZSO, CNB Financial Stability Report 2010/2011

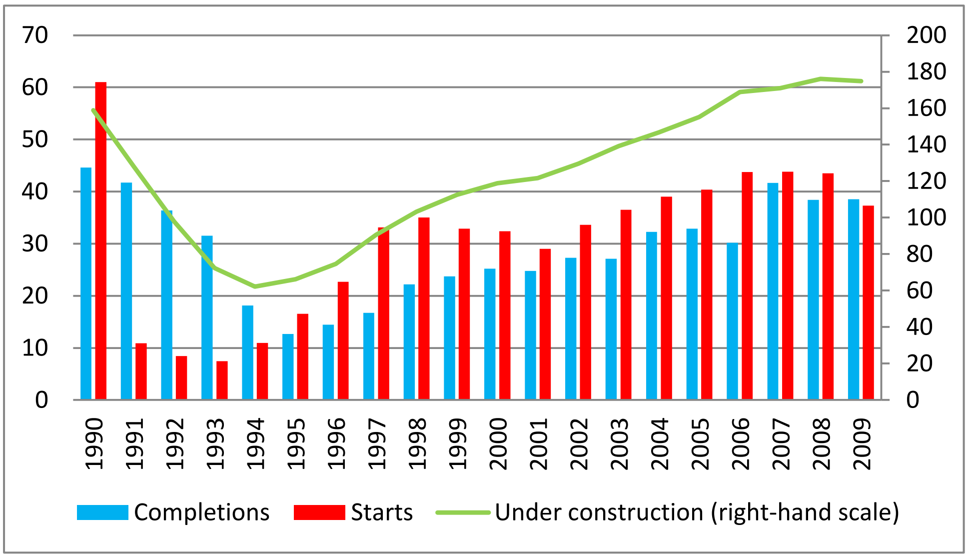
Hlaváček and Komárek (2009) assess and explain the determinants of housing price development in the Czech Republic and identify periods when housing prices diverged from their fundamentals. Based on a complex analysis, both abovementioned periods (2002/2003 and 2007/2008) were identified as property price bubbles. However, the level of overvaluation in the second period was lower, as the price growth was accompanied by the growth of demographic an economic factors.

In spite of the fact that the Czech National Bank classified the development in the year 2006 as risky (CNB, 2006 and 2007) and some developed economies were experiencing serious problems on the real estate market, the prices were rising even in 2007 and 2008. This price boom ended in 2009 due to the worsened economic performance of the country, the worsened situation on the labour market, and more expensive mortgages.

CNB (2010) and also Hlaváček and Komárek (2009) believe that the housing price development was demand-based (wages, rents, unemployment), and especially demographic factors (increased number of migrations and natural population growth) played a role. However, the decline in property prices was smaller than in other countries. Apparently, it is thought that the prices returned to their original values, mainly in the case of apartment prices, which dropped by 14% (CNB, 2010). In those segments of real estate market, where the price increase was gentle, the drop was not that dramatic.

In response to rising housing prices in 2006, 2007 and 2008 the intensity of new construction was the highest since the beginning of the 1990s (see Graph 3). However, since 1994 the constantly rising number of unfinished construction projects has presented a risk and caused problems for developers, as these generate additional expenses together with a longer selling period, which can lead to developer insolvency. In 2009 the drop in housing prices meant a decline in housing construction which started in the last quarter of 2008, but the amount of unfinished construction remained high (CNB, 2010).

Graph 3: Housing construction
(Number of completed, started and under construction dwelling in thousands)



Source: CZSO, CNB Financial Stability Report 2009/2010

We shall mention three characteristics of the Czech real estate market. First, the situation on the real estate market is always different in Prague, the capital and natural economic centre of the country, from other regions. The total residential property price index for Prague has been higher than the total index for the entirety of the Czech Republic since

1999 (Dubská, 2009). Prague is considered the price leader, and prices in other regions respond with a delay. Second, prices on the apartment and apartment block market tend to be much higher than both the total residential property price index and building plot and family housing price indices (see Graph 2), but there is no significant difference between Prague and the whole of the Czech Republic as regards apartment prices. Finally, in Prague there is no bigger difference between family house, apartment, apartment block, and building plot price indices; they all show similar dynamics (Dubská, 2009). Regarding the property price bubbles, Hlaváček and Komárek (2009) conclude that there is an obvious tendency for a higher level of overvaluation in regions with higher property prices.

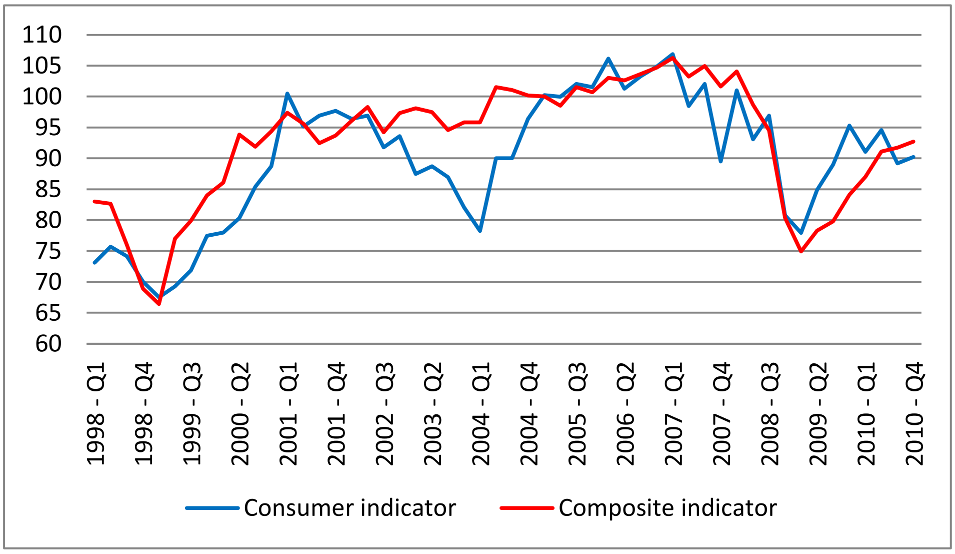
4. Czech households

Similarly to the USA and the UK, housing wealth plays a unique role also in the Czech Republic. For most households it represents an important anchor, a store of value, and is considered as the optimum combination of rate of return and risk. Almost four-fifths of the annual increase in the value of all households' tangible assets is invested into the acquisition of houses or apartments (Dubská, 2009). Moreover, the rising importance of housing wealth can be demonstrated on the fact that by 2006 households' total annual investment in housing had tripled compared to 1995 (in nominal terms). The increase in housing wealth also influenced households' nominal and real profits from the holding of nonfinancial assets. Nominal profits in 2007 were almost double those of 2005; meanwhile real profits in 2007 were declining (Dubská, 2009).

Even though during the second major increase in housing prices in 2007/2008 home loan interest rates rose, demand for own dwelling did not fall till March 2008. At the end of 2008, households perceived an increasing risk of not being able to pay back their home loans and even mortgages, and thus started to demand default insurance. This fact is shown on Graph 4, where we can see a substantial drop in consumers' confidence in 2008.[9]

[9] "The composite confidence indicator (Economic Sentiment Indicator) is a weighted average of seasonally adjusted confidence indicators in industry, construction, trade, in selected services and of the consumer confidence indicator. The consumer confidence indicator is the average of four indicators (expected financial situation of consumers, expected total economic situation, expected total unemployment (with inverted sign) and savings expected in 12 months to come)." Source: http://www.czso.cz/eng/redakce.nsf/i/business_cycle_surveys

Graph 4: Seasonally adjusted confidence indicators
(average 2005 = 100)



Source: CZSO

4.1. Indebtedness

Not all households are able to finance their dwelling and consumption entirely from their income and savings; those must rely upon loans and mortgages. In the past, the volume of Czech household debt in comparison with developed European countries was very low. However, one of the results of contemporary Czech convergence to the level of developed countries is a non-negligible increase of indebtedness. From the CNB database ARAD[10] we can calculate that the total amount of loans from commercial banks increased almost tenfold during the period 1997–2010, in which additionally both the total amount of home loans and total consumer credit to households (including debit balances on current account) increased forty-seven times. The causes of increasing household indebtedness are a strong orientation on consumption (mainly of durable goods), a rising living standard and real wages, a changed perception of debts, better availability of loans and credits, and a strong tendency to own a dwelling. At the end of 2010, home loans represented 70% of the total volume of loans provided to households, which under the right set of circumstances (stability of real estate market, non-increasing interest rates, etc.) does not present a debt trap risk (Dubská, 2008). Consumer loans are also provided by non–banking financial institutions (leasing companies and installment sales companies), which represent almost one half of the sector. In 2008, the volume of

[10]http://www.cnb.cz/cnb/STAT.ARADY_PKG.PARAMETRY_SESTAVY?p_sestuid=9916&p_strid=FE&p_lang=CS
http://www.cnb.cz/cnb/STAT.ARADY_PKG.PARAMETRY_SESTAVY?p_sestuid=9917&p_strid=FE&p_lang=CS

loans was still increasing, but less so than in the previous year, because households' economic expectations had worsened and interest rates were rising. In the following years the total amount of loans continued to rise but with slower dynamics (the amount of new loans was decreasing). In the last quarter of 2010 the total residential loans to households amounted to 1.04 billion Czech crowns. According to Bičáková, Prelcová and Pašaličová (2010) the total amount of households with at least one loan remained stable and below 40% over the period 2000–2008, however, the amount of debt outstanding increased, which indicates possible future risks for Czech households.

4.2. Savings

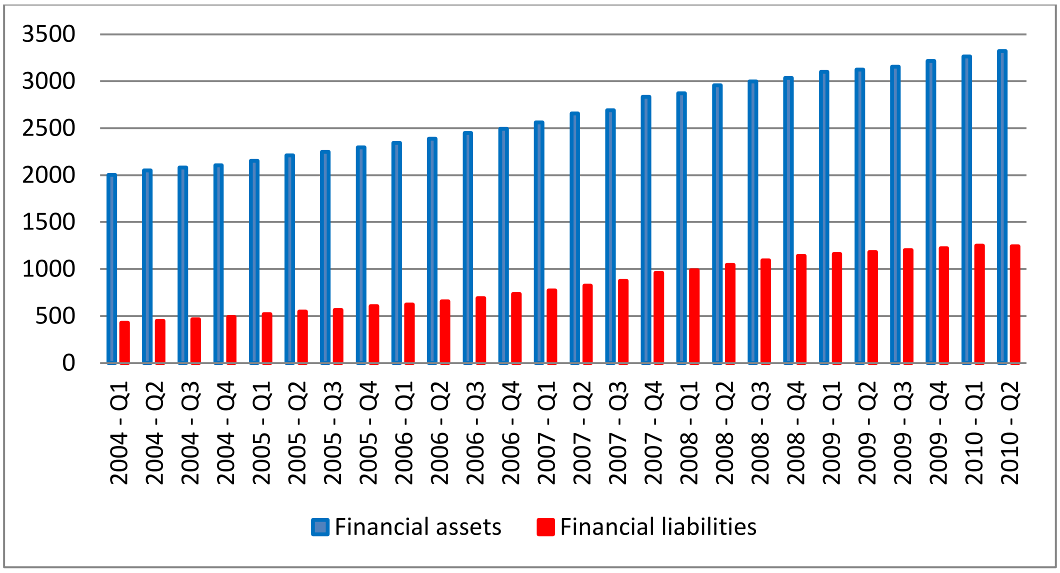
Until the beginning of the new century savings dominated consumption, supported by the high interest rates offered by small and medium-sized banks (these banks later suffered liquidity problems, and some even went bankrupt). For the last decade it is characteristic that income growth is absorbed by higher consumption. In comparison with the Czech Republic the propensity to consume from gross disposable income is twice as high (and rising) in some developed EU countries (Dubská, 2008).

Although savings are still higher than debts, the gap has narrowed a lot in the past decade. The total amount of households' loans in 2007 represented almost two thirds of the total amount of their savings; meanwhile in 1997 it was only 8.3% (Dubská, 2008). However, we should keep in mind that some households' liabilities are backed by fixed assets (houses, flats, etc.). Future possible risks of household sector are described in the following subchapter.

4.3. Future risks

According to CNB (2010), the economic recession in 2009 affected households' balance sheets. The decline in GDP resulted in higher unemployment (first, companies were dismissing workers from positions with lower qualification, later this affected all professions) and slower increase in nominal incomes, which has had a negative impact on aggregate consumption and thus on the economy as a whole. The biggest risks for households remain the labour market and the evolution of nominal wages. Households will probably have problems paying off their debts as their incomes are smaller and unemployment is higher. In addition, costs of debt service are increasing (rising average interest rates on bank credit for both consumption and property investment uses), which might cause other serious trouble for households' solvency. The rate of indebtedness lowered, because households are insecure about their future incomes. On the aggregate level, households still have more financial assets than liabilities (see Graph 5), but total aggregate financial liabilities represented in 2004 21% of households' financial assets, while in 2010 it was 37%. Moreover, net returns declined as the difference between interest rates from credits and deposits increased. The possible future insolvency of some Czech households is supported by a dramatic increase in the number of filings for personal bankruptcy (the institution of discharge from debts).[11] It is expected that the credit risk of Czech households will continue to rise. (CNB, 2010)

Graph 5: Financial assets and liabilities of Czech households
(In thousands of Czech crowns)



Source: CNB

[11] The institution of distraints is closely related to this subject, as households which are not able to service their debt lose their property. It originated in 2001 and the number of exercised distraints has been rising every year. In 2007 the total amount reached 427,800 cases, where three-fourths were against natural persons, which implies that people are less able to pay off their debts. (Dubská, 2008)

5. Data description

In the studies mentioned in the Chapter 2 the authors mainly use the following variables: consumption (aggregate, durable, and non-durable), income (labour or total), housing wealth, and stock market wealth. However among studies the list of variables used may vary. Catte et al. (2004) add unemployment rate, real short term interest rate and inflation rate. Raymon, Man and Choy (2007) also consider interest rate and money supply in its broadest form (M3), which is found to be a significant and important factor determining consumption in their analysis.

The data set used in this study consists of quarterly observations during the period 1998–2009 and was collected from various sources (the database of the Czech Statistical Office, the ARAD – a public database of Czech National Bank, and the Prague Stock Exchange[12]). We intended to investigate data up to and including 2010; however the residential property price index for the year 2010 was not available as of July 2011. As it was already mentioned this index is constructed as a weighted average from family house, apartment, apartment block, and building plot price indices. The Czech Statistical Office had updated only the apartment price index, not the whole index, which is more complex and more useful for our analysis. As housing wealth or its approximation is the most important variable in this study, we omit the year 2010 for lack of data and instead we have added the years 1998 and 1999.

Our study provides a regression model on selected aggregate data, as this has not been done yet in the Czech Republic. However, we are not able to distinguish between the young and old, homeowners and renters, or mortgage payers and non-payers, and also a description of the behavioural aspects of the transmission mechanism is beyond the scope of this analysis. When trying to evaluate the impact of changes in housing wealth on consumption, one may posit that the effect is different for homeowners and renters. However, according to CZSO, the ratio of renters has been fluctuating around 1/5 of all households. In 2009 for example, it was 22.4%. That is why we consider all households as homeowners, which simplifies the interpretation of our results.

In our analysis, we distinguish between housing wealth and stock market wealth. However, due to data limitations, we use the stock market price index PX, which is an

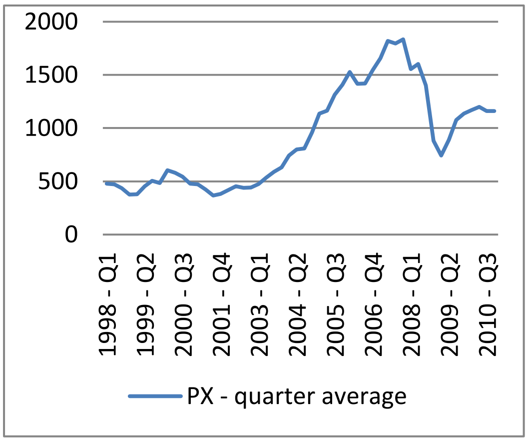
[12] http://www.bcpp.cz/dokument.aspx?k=Burzovni-Indexy

official index of the Prague Stock Exchange, as a proxy variable for stock market wealth. We consider this index in its average value for one quarter.

For housing wealth, we use the Residential Property Price Index (RPPI) as a proxy variable. Several difficulties with this index have appeared. This index has been estimated in two ways. One is a year-on-year index, and the other employs a base year. Until the last quarter of 2006, the year 2000 was used as the base, but later on this was modified to the year 2005. Each year, the CZSO updates the indices retroactively; however in this case it was only the base-2005 series which was recomputed. In order to create a single series we recalculate the latter series using the former one. Due to the updating of only one dataset, there is a slight difference between original and recalculated data. Nevertheless, we use the recalculated time series starting in 2003, before that we use the official data obtained from the CZSO.

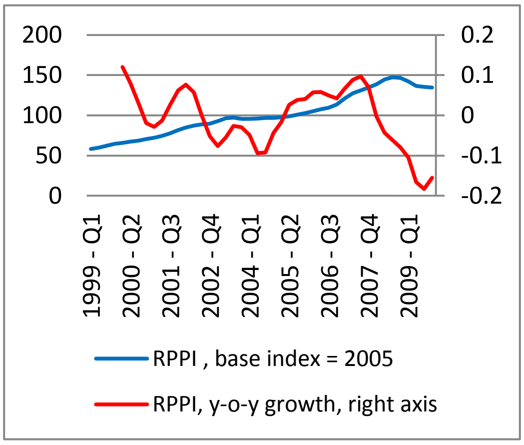
Dynamics of both indices is displayed in Graph 6 and Graph 7. Use of indices as proxies for the wealth variables is quite common in other studies as well, for example in the study of Ludwig and Slok (2004) and Case et al. (2005).

Graph 6: Evolution of PX index



Source: Prague Stock Exchange

Graph 7: Evolution of RPPI



Source: CZSO

Consumption is available with quarterly frequency both in current and previous-year average prices, by the domestic and national concepts, either in millions of Czech crowns or in the form of indices. For the domestic concept we are able to divide Household Final Consumption Expenditure by Durability into durable, non-durable, and semi-durable goods and services. For our regression, we use current price indices with base year 2000 in the domestic concept, which enables us to distinguish between durable and non-durable consumption.

The last important variable is households' income. The gross disposable income (GDI) is used as a proxy for households' total income.

These are the basic variables, however we also include several other variables, e.g. unemployment, inflation, interest rates (PRIBOR – Prague Interbank Offered Rate), and yields on government bonds.

6. Model specifications

In the aforementioned literature, various model specifications were applied. Almost all studies contained Ordinary Least Squares (OLS) analysis. Dvornak and Kohler (2003) further used panel-data estimation techniques with fixed effects, instrumental variables, and panel Dynamic Ordinary Least Squares (DOLS) estimators. An analysis based on error-correction models was proposed, for example, by Ludwig and Slok (2004), Belsky and Prakken (2004), Case et al. (2005) and Kishor (2007). However, this cointegration approach was firmly criticised by Carroll, Otsuka, and Slacalek (2006).

As regards the analysis in the Czech Republic, Seč and Zemčík (2007) constructed an unbalanced panel and applied several versions of the pooled OLS model on first differences. They propose a better solution by using a fixed-effect model with an autocorrelated error structure and a Two-Stage Least Squares (2SLS) approach to account for the potential endogeneity in the model, but this has been left for future research.

In our analysis, we estimate the Vector Autoregression Model (VAR), and in the case of a non-stationary and cointegrated time series we apply the Vector Error Correction Model (VECM).

6.1. Introduction to VAR

The VAR model has been frequently used by econometricians as it is one of the most flexible, successful, and simple ways for the analysis of multivariate time series. It is a natural extension of the univariate autoregressive model. Among other advantages, in this model we do not have to specify which variables are endogenous or exogenous; all variables are considered endogenous. Each variable depends not only on its own lagged values and white noise, but also on the lagged values of all the other variables included in the model.

The basic p-lag vector autoregressive VAR(p) model has the following form (see e.g. Hamilton, 1994):

$$Y_t = c + \Phi_1 Y_{t-1} + \Phi_2 Y_{t-2} + \cdots + \Phi_p Y_{t-p} + \varepsilon_t$$
$$\varepsilon_t \sim WN(0, \Sigma)$$

Where the $(n \times 1)$ vector ε_t is a vector generalization of white noise, Σ is an $(n \times n)$ symmetric positive definite matrix, c is an n-dimensional vector of constants, and Y_t denotes a time series of $(n \times 1)$vectors. $Y_t = (y_{1t}, y_{2t}, \dots, y_{nt})'$, where $\{y_{1t}\}, \dots, \{y_{nt}\}$ are n time series variables and Φ_j is an $(n \times n)$ matrix of autoregressive coefficients for $j = 1,2, \dots, p$.

The VAR model requires no serial correlation in the error term ε_t and all the variables to be stationary, which does not have to hold in empirical time series data. If each equation has the same explanatory variables, then the model is in the form of Seemingly Unrelated Regression (SUR), which can be efficiently and consistently estimated by Ordinary Least Squares (OLS) (Cipra, 2008).

6.2. Data analysis

In this section basic analysis of data employed in the final VAR model is performed. Time series are described in the following table.

Table 1: Description of time series

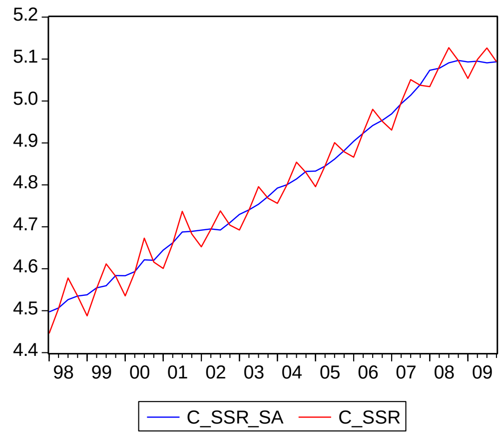
Time series	Denotation	Data span	Note
Consumption of durable goods	C_LR	1998 Q4–2009 Q4	Seasonally adjusted
Consumption of non-durable goods and services	C_SSR	1998 Q1–2009 Q4	Seasonally adjusted
Gross disposable income	GDI	1998 Q1–2009 Q4	Seasonally adjusted
Housing wealth	HW	1998 Q1–2009 Q4	
Stock market wealth	SW	1998 Q1–2009 Q4	
Inflation	INFLATION	1998 Q1–2009 Q4	
Unemployment	U	1998 Q1–2009 Q4	
3M PRIBOR	PRIBOR3	1998 Q1–2009 Q4	
Yields from 3M PRIBOR	YIELDS3	1998 Q1–2009 Q4	$1 + \frac{real\ PRIBOR3}{100}$
12M PRIBOR	PRIBOR12	1998 Q1–2009 Q4	
Yields from 12M PRIBOR	YIELDS12	1998 Q1–2009 Q4	$1 + \frac{real\ PRIBOR12}{100}$
Yields on five-year government bonds	BONDS	2001 Q1–2009 Q4	

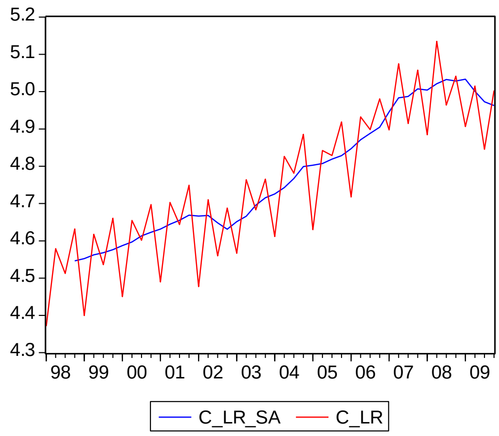
Source: ARAD, CZSO, Prague Stock Exchange

All variables are indexed so that the average of the year 2000 is equal to 100. Moreover, they are transformed to natural logarithms, which allows us to adjust for possible scale effects and cointegrating relation.

Further, we deal with seasonality in both consumption and disposable income. These series are corrected for seasonality using simple additive decomposition. We apply the Census X11 methodology elaborated in American US Bureau of Census.[13] This methodology applies several special moving averages (Cipra, 2008). The adjustment is made for disposable income and for consumption of durable and non-durable goods. However, this methodology does not perform well for the consumption of durable goods, thus we use a one-year moving average instead (and thus we start three quarters later from the first quarter of 1998). We can demonstrate the seasonal adjustment on the following graphs.

Graph 8: Seasonal adjustment for consumption
(index _SA means Seasonally Adjsuted)



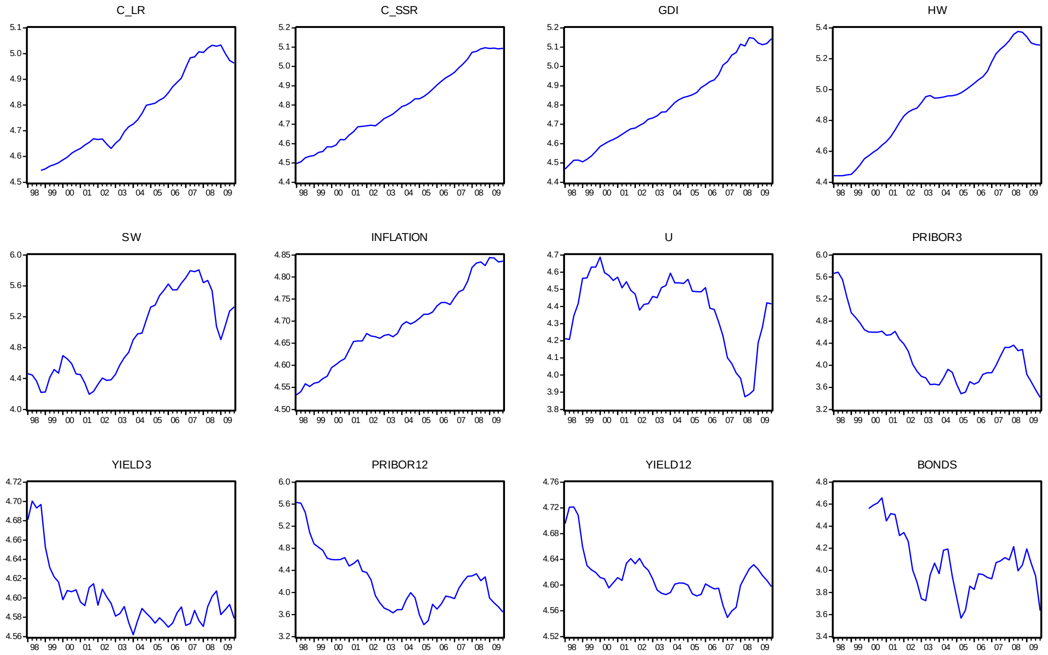


Source: CZSO, author's calculations

On the following graph, we can see the development of each time series we use for the analysis. All the time series have the same scale since they are converted to natural logarithms. Non-stationarity of some time-series is evident on simple visual examination (Graph 9). There are multiple sources of non-stationarity; however the most common one is a root of the series' characteristic polynomial being unity (unit root). Therefore the next sub-chapter provides the relevant tests.

[13] This methodology is included in the statistical package EViews.

Graph 9: All time-series used in the analysis



Source: ARAD, CZSO, Prague Stock Exchange

6.2.1. Unit root tests

As was already mentioned, most time series are non-stationary (they do not have time-invariant mean, variance, and autocorrelation structure). We perform stationarity tests in order not to use non-stationary time series leading to spurious regression and false relationships between series. Non-stationary time series have infinitely long memory and any shock is permanent, whereas a shock in stationary series is only temporary. There is one more problem with non-stationary time series: the distribution of t-tests is no longer asymptotically normal and it follows the Dickey-Fuller distribution, which is a function of Brownian motion. Under the null hypothesis of unit root, Y_t is no longer stationary and ergodic and sample moments do not converge to fixed constants but to random functions of Brownian motion (Hayashi, 2000).

According to Cipra (2008) we distinguish between two types of non-stationarity. Trend stationarity can be eliminated by detrending the series. A difference stationary time series is made stationary by applying differences. The process that can be made stationary by first-differencing is called an I(1) process (the process is integrated of order 1). Similarly, if the time series is stationary then it is called an I(0) process.

For the unit root testing, we apply the Augmented Dickey-Fuller test, which allows for the residuals to be serially correlated and it can be applied on more complicated dynamic structures (compared to the Dickey-Fuller Test). The ADF test tests the null hypothesis that Y_t is an I(1) process (i.e., has a unit root) against the alternative that Y_t is an I(0) process, assuming that the data has an ARMA structure. This test is influenced by the presence (not the value) of deterministic terms in the regression. Different critical values are applied if a constant, a trend, or both are present.

This test can be formally written in the following way (e.g. Cipra, 2008):

$$y_t = \beta' D_t + \phi y_{t-1} + \sum_{j=1}^{p} \psi_j \Delta y_{t-j} + \varepsilon_t$$
$$H_0 \colon \phi = 1, \beta = 0$$
$$H_1 : \phi \neq 1, \beta \neq 0$$

Or alternatively[14]:

$$\Delta y_t = \beta' D_t + \Pi \Delta y_{t-1} + \sum_{j=1}^{p} \psi_j \Delta y_{t-j} + \varepsilon_t$$
$$H_0 \colon \Pi = 0, \beta = 0$$
$$H_1 : \Pi \neq 0, \beta \neq 0$$

Where D_t contains deterministic terms and Δy_{t-j} captures the remaining serial correlation in residuals.

There are, of course, other tests for testing the unit root. We mention one more. The KPSS test is testing the opposite hypothesis; the null of stationarity is tested against the alternative of non-stationarity. It is recommended to use both ADF and KPSS tests. (Cipra, 2008)

Now, we test the stationarity of our twelve time series. In Graph 9, we can see that all the time series have a non-zero intercept and a trend. In specifying the test, we include these deterministic terms. Moreover, we specify the lag length (p). There has been a long discussion in the literature about how to select a lag length properly. There are basically two ways how to choose it. The first is to look at the shape of the autocorrelation function (ACF) and the partial autocorrelation function (PACF). The second one is using

[14] This form is integrated and tested in statistical packages and thus is also widely used in the literature.

the lag length selection criteria (AIC, MAIC, BIC, etc.). Both ways have their drawbacks; the former depends on the judgment of the econometrician and the latter strongly depends on the chosen criterion. An AIC (Akaike's Information Criterion) estimate is efficient but not consistent, whereas a BIC (Schwarz Bayesian Criterion) estimate is consistent but not efficient, and both criteria produce better estimates with a larger sample size.

We apply the lag length selection criteria (the BIC and Modified Akaike criterion – MAIC). They sometimes yield a different lag length; however the conclusions are mostly the same. In case of ambiguity, we look at the ACF and PACF functions to decide the lag length, and then apply the test again (the graphs indicate mostly AR(1) processes). The results of ADF test based on MAIC criterion may be seen in Table 2 in the Appendix.

Based on the results of the ADF Unit Root tests, where all p-values are larger than 0.05, we do not reject the null hypothesis of non-stationarity and thus we conclude that all the time series are non-stationary. We also conduct the KPSS test[15], which supports our conclusions, and we therefore reject the null hypothesis of stationarity on the 5% level of significance. We then test the first differences for unit root (see Table 3 in the Appendix). Based on the ADF test we reject the null hypothesis of unit root on the 5% level of significance. Thus we conclude that our original time series are difference stationary (I(1)) processes, and that the VAR model can be applied on the stationary first differences.

This transition is statistically correct, however, it does not reveal the long-run relationships between the original (undifferenced) series. Thus, it is recommended to test for cointegration and, in the case of positive results, estimate the Vector Error Correction Model (VECM). We are going to provide this estimation later in the study.

6.3. VAR model

The VAR model is estimated for the two types of consumption: consumption of durable goods (C_LR) and for consumption of non-durable goods and services (C_SSR). We have already mentioned that studies published so far do not present unanimous conclusions on whether the changes in housing wealth and stock market wealth should

[15] Test results are not included in this study, but are available upon request.

influence the consumption of durable goods or non-durable goods. That is why we conduct the analysis on both and answer the question in the following subchapters.

We consider that both consumptions depend on disposable income, housing wealth, stock market wealth, inflation, and unemployment. We also assume that interest rate might have some influence on the variables. For example, if interest rates rise, households might tend to save more and consume less. Therefore, we include the three-month PRIBOR in the model of non-durable consumption, and yields on government bonds and twelve-month PRIBOR in the durable consumption model. Since these variables turn out to be insignificant, we also compute real interest rates by subtracting inflation from nominal interest rates (this easy calculation holds for low levels of inflation per the Fisher theorem). Since the real interest rates also take on negative values, we construct yields from these rates (see Table 1).

6.3.1. VAR model for consumption of durable goods

Several different specifications of the model were estimated with different combinations of variables and lag lengths. We exclude models which are not stationary (where inverse roots of the AR characteristic polynomial lie outside the complex unit circle) and models with serially correlated residuals. In case of the presence of serial correlation in residuals, the OLS estimate is no longer BLUE and hypothesis tests are invalid. Thus we are not able to discuss the significance of the variables. In case of positive serial correlation; the model seems to perform better than it actually does.

Into our final model we include only four variables, apart from consumption of durable goods (C_LR), there is gross disposable income (GDI), housing wealth (HW) and stock market wealth (SW).

Even though VAR models are usually constructed with small numbers of variables, we are aware of the fact that either inflation, or unemployment, or the interest rate should be included in the model as for example in the model of Catte et al. (2004). Nevertheless, these variables do not turn out significant, or if they do, the model does not satisfy its assumptions. As has been mentioned before, for example Dvornak and Kohler (2003) or Ludwig and Slok (2004) do not take these variables into account, either.

The construction of a VAR model requires the variables to be stationary, which is, in this case, achieved by first-differencing the data. However, as we intend to examine the long-run relationship between variables, which would be lost by the transition to first differences, we apply the cointegrated VAR model (VECM) if the variables are cointegrated. This Vector Error Correction Model works for non-stationary and cointegrated variables only. Cointegration means that variables share a common trend or that there exists their non-trivial linear combination which is stationary.

In order to correctly test for cointegration, first we estimate the VAR for the levels and choose the lag length. Lag length selection criteria indicate 4, 3 and 2 lags (see Table 4 in the Appendix). The models with 4 and 3 lags are not stationary, thus we work with VAR(2). We then test the levels of the variables for the cointegration using the Johansen cointegration test with 1 lag. When specifying the lag length for the VECM we apply one lag less than are the lags of the VAR, since VECM is specified for first differences. Since no cointegrating relation is found (see Table 5 in the Appendix), we do not deal with the VECM further in this subchapter.

We can conclude that constructing a VAR model for first differences does not lead to any information loss and that this is the correct model to apply.

In order to set the right lag length we apply the lag length selection criteria on the first-differenced data. All lag length selection criteria choose only 1 lag (see Table 6 in the Appendix). We are thus going to estimate a VAR(1) model.

The estimated equation of the VAR(1) model of consumption is of the following form:

$$\Delta C_{LR(t)} = c_1 + \phi_{11}\Delta C_{LR(t-1)} + \phi_{12}\Delta \mathrm{GDI}_{\mathrm{t-1}} + \phi_{13}\Delta HW_{t-1} + \phi_{14}\Delta SW_{t-1} + \varepsilon_1$$

Equations for the three other variables can be expressed analogously. The results of our regression are presented in Table 7 in the Appendix.

Before making any further conclusions we test the model for stationarity and the residuals for serial correlation, heteroskedasticity, and normality. The model is stationary, because all the inverse roots of the characteristic polynomial lie inside the complex unit circle (see Graph 13 in the Appendix). Based on the LM test for serial correlation and the Portmanteau test for autocorrelation (see Table 8 and Table 9 in the Appendix) we do not reject the null hypothesis of no serial correlation on the 5% level of significance. We also conduct tests for heteroskedasticity and normality (see Table 10 and Table 11 in the Appendix) and we conclude that the residuals are homoskedastic and asymptotically normal on the 5% level of significance. A plot of the residuals is displayed in

Graph 14 in the Appendix. Model assumptions are satisfied; therefore we can proceed to the model interpretation.

In order to determine which variables are significant, it is necessary to compare t-statistics from the regression with the critical values of Student's t-distribution. If we have more than thirty observations it is possible to approximate the critical values of the t-distribution by those of the normal distribution. We are going to work with the 5% significance level, thus we denote a variable as significant if its t-statistic is in absolute terms greater than 1.96.

In Table 7 in the Appendix, we can see that the quarterly growth of consumption depends on its lagged value and on the quarterly growth of disposable income. It seems it does not depend at all on changes in the growth of housing and stock market wealth. However, these two variables are significant for explaining the growth of disposable income. In order to estimate whether the change in the two wealth components has an impact on changes in consumption, we use the concept of Granger causality and the Impulse Response Functions (IRF).

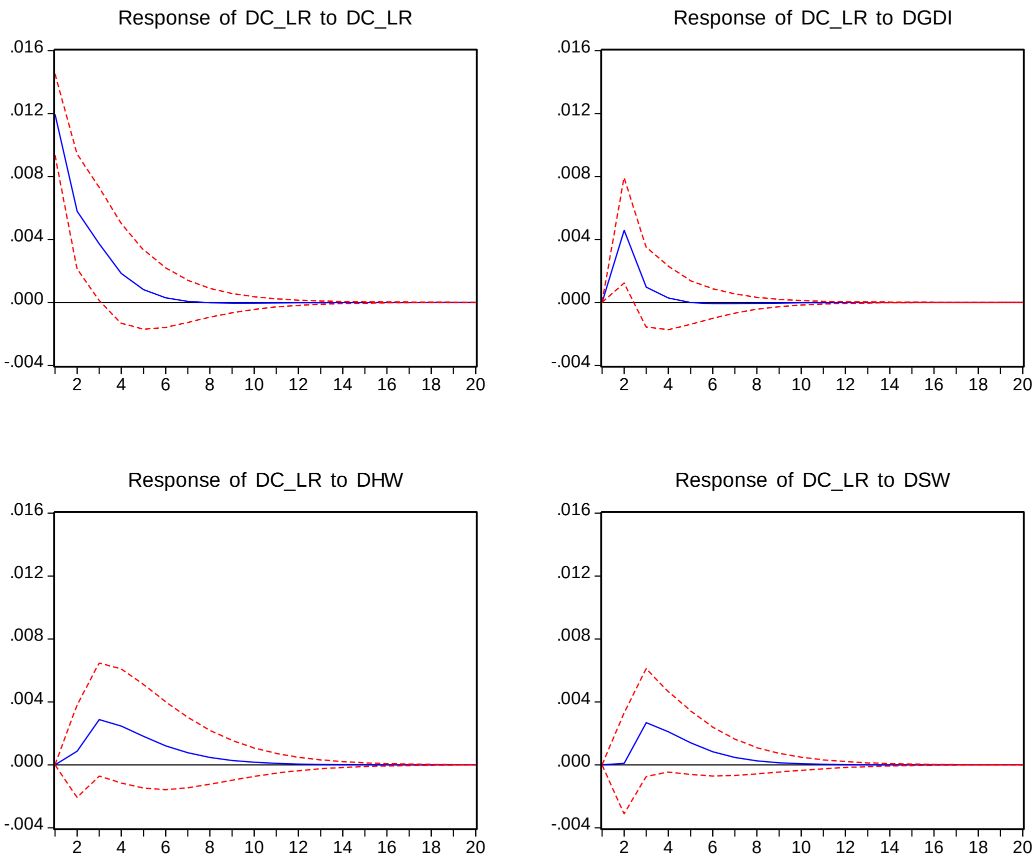
The concept of Granger causality investigates whether one variable or a group of variables is found to be helpful for predicting another variable, if so, we say that the variable Granger causes the other variable. The notion of Granger causality, however, does not imply true causality, rather, it only implies forecasting ability, and thus, we have to be careful when interpreting the results.

In Table 12 in the Appendix we can see that on the 5% level of significance changes in both wealth components Granger cause changes in disposable income, which Granger cause changes in consumption. Changes of the growths of housing wealth and stock market wealth have a positive impact on the growth of disposable income (see Graph 11). Moreover, changes in gross disposable income have a positive impact on changes in consumption (see Graph 10). Thus we can see an indirect effect on consumption trough the wealth channel.

The interpretation of each estimated coefficient (and its sign) in the VAR framework is not easy, as a coefficient cannot be explained as elasticity. However, according to Sims (1980) the best way to interpret the results is by using the responses of the system to a given shock (impulse).

Impulse Response Functions are displayed on the following graphs. In this framework, the impulse is one standard deviation to the error term. We can see that the growth of consumptions responds positively to shocks in all variables and the shocks eventually dissipate, which confirms the stability of the model. An increase in the growth of disposable income causes a gradual increase in the growth of consumption for two quarters, when it reaches its peak. Then the growth of consumption slows down, and the effect of the shock disappears after one year. The reaction to changes in growth of the two wealth components is lower in magnitude and also it takes more time for the shock to fully manifest itself and to die out. The highest impact can be seen after three quarters and the shock wears off after approximately two and a half years. Thus we conclude that changes in housing wealth and stock market wealth have a positive impact on changes in consumption.

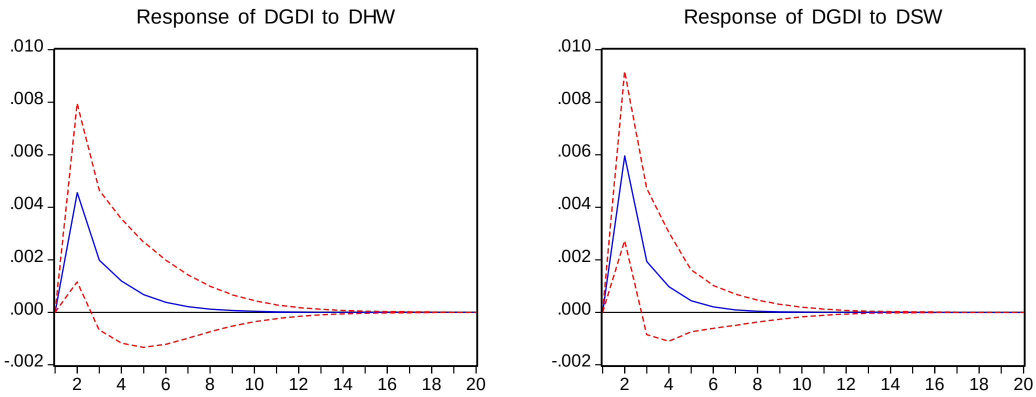
Graph 10: Response to Cholesky One S.D. Innovations ± 2 S.E.
(Consumption of durable goods)



Source: ARAD, CZSO, Prague Stock Exchange, Author's calculations

In Graph 11, the growth of stock market wealth has a bigger impact on the growth of disposable income than the growth of housing wealth (by almost 50%). Both effects manifest themselves quite quickly and reach the peak after two quarters. The effect of housing wealth is slightly longer lasting, however both impulses dies out after two years.

Graph 11: Response to Cholesky One S.D. Innovations ± 2 S.E.
(Gross Disposable Income)



Source: ARAD, CZSO, Prague Stock Exchange, Author's calculations

6.3.2. VAR model for consumption of non-durable goods

In this section we estimate the relations between the consumption of non-durable goods and services and other variables. It is assumed that the relations should be slightly different for the two types of consumption.

We estimate several different specifications of the model with various combinations of variables and lag lengths; however we again end up with the basic model with four variables: consumption of non-durable goods and services (C_SSR), gross disposable income (GDI), housing wealth (HW), and stock market wealth (SW).

Since we are again dealing with non-stationary series we test for cointegration. The procedure is as follows. First, we estimate VAR model for the levels, and estimate the lag length. Then we perform the Johansen cointegration test with one lag less. If this test reveals some cointegration, we do not estimate the VAR model but the Cointegrated VAR (VECM) instead.

All lag length selection criteria chose 2 lags for the variables in levels (see Table 13 in the Appendix), thus we apply the Johansen cointegration test on 1 lag (since it works on first differences). The test for cointegration strongly depends on deterministic trend assumptions. According to Juselius (2006) there are five cases to consider. The first two cases do not allow for a deterministic trend in the data, another two allow for a linear trend, and the last one allows for a quadratic trend in data. We choose case number three[16], which assumes a linear trend (and an intercept) in the data and an intercept and no linear trend in VAR. This means that in the cointegrating equation there is only intercept and no trend. The results of the test are presented in Table 14 in the Appendix. Both Trace statistics and Maximum Eigenvalue statistics indicate one cointegrating vector.

In this case, applying the VAR model on stationary first differences means a loss of long-run equilibrium information. Nevertheless, since the estimated coefficients from the VAR regression cannot be interpreted as elasticities and the following VECM with the cointegrating vector provides such interpretations, we will not be able to compare the effects on different types of consumption. Only for the purpose of comparison we present the VAR model for first differences, being aware of the fact that this model is not the most suitable one.

VAR model for first differences

In this section, we present a very brief description of the model and focus on the concept of IRF. Lag length selection criteria choose 1 lag for the first differences (see Table 15 in the appendix).

We estimate the model in the following form:

$$\Delta C_{SR\,(t)} = c_1 + \gamma_{11}\Delta C_{SR(t-1)} + \gamma_{12}\Delta \mathrm{GDI}_{\mathrm{t-1}} + \gamma_{13}\Delta HW_{t-1} + \gamma_{14}\Delta SW_{t-1} + \varepsilon_1$$

We may express three remaining equations analogously.

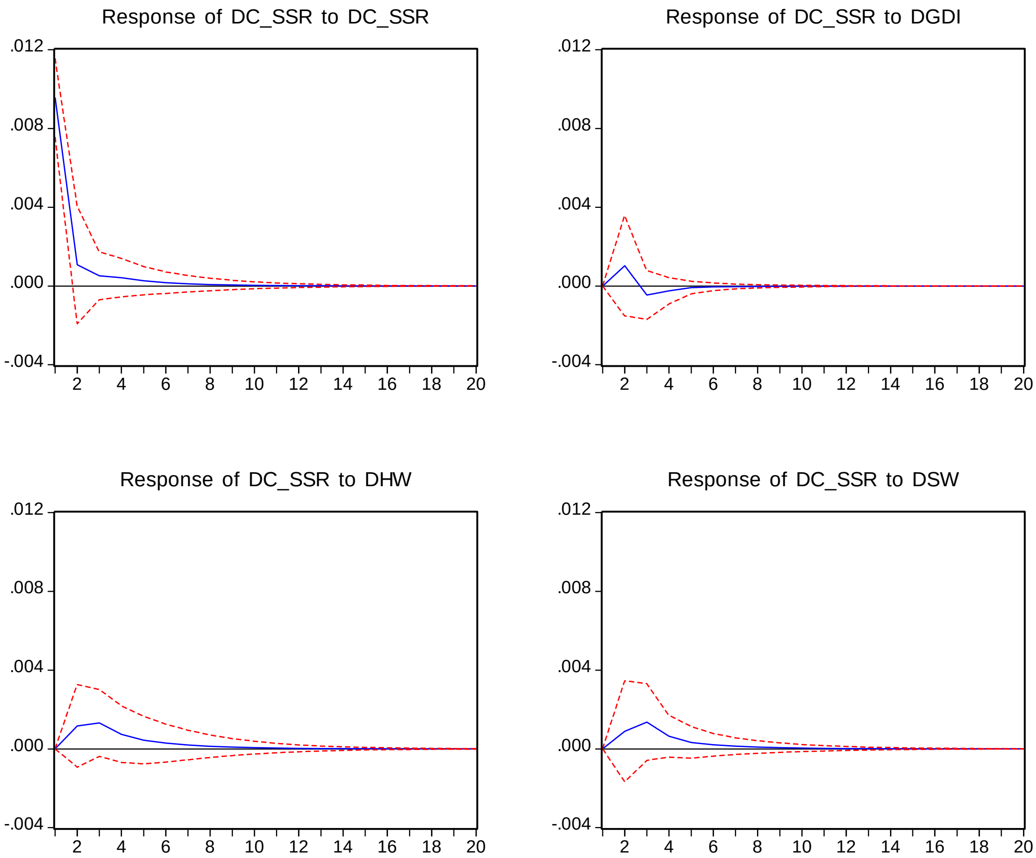
All model assumptions are satisfied (see Table 17, Table 18, Table 19, Table 20, and Graph 15 and Graph 16 in the Appendix) and the results of the VAR(1) model are presented in Table 16 in the Appendix. We can see that this model does not explain very well the variations in consumption which are in the centre of our attention. Even though this model is present only to showcase the implications of the impulse response function concept, we have to take these results with caution.

In this case, neither the growth of disposable income nor of the two wealth components Granger causes the growth of consumption. But growth of both wealth components

[16] We applied this case also in the previous subchapter, where we tested for cointegration.

Granger causes the growth of disposable income (see Table 21). Next, we investigate the concept of IRF.

Graph 12: Response to Cholesky One S.D. Innovations ± 2 S.E.
(Consumption of non-durable goods and services)



Source: ARAD, CZSO, Prague Stock Exchange, Author's calculations

On the previous graph, we can see that the reactions of the consumption of non-durable goods and services are very similar to those of durable goods; however they are smaller in magnitude.

Response to a shock in the growth of disposable income is the smallest and compared to the response in durable goods it is almost four times smaller, however, the dynamics are similar. The maximum is reached after one quarter and the shock wears off after five quarters. Responses to shocks in the growth of the two wealth components are similar for both components. The biggest reaction is observed after three quarters, and after two and a half years the shock disappears. This evolution is comparable to the reactions of durables consumption; however the response is approximately two times smaller in magnitude. The IRF for the growth of disposable income is very similar to Graph 11, thus there is no need to present it again. In the following subchapter, we focus on the most correct and suitable model for the data – the VEC model.

Defining VECM

In this case, the original equation for consumption does not account for cointegration:

$$\Delta C_{SR\,(t)} = c_1 + \gamma_{11}\Delta C_{SR(t-1)} + \gamma_{12}\Delta \mathrm{GDI}_{\mathrm{t-1}} + \gamma_{13}\Delta HW_{t-1} + \gamma_{14}\Delta SW_{t-1} + \varepsilon_1$$

Instead, we estimate the long-term relationship among variables after stabilization in a steady state, where the growth of variables per given time units is close to zero (Cipra, 2008).

The estimated corrected model is in the following form:

$$\Delta C_{SR\,(t)} = c_1 + \gamma_{11}\Delta C_{SR(t-1)} + \gamma_{12}\Delta \mathrm{GDI}_{\mathrm{t-1}} + \gamma_{13}\Delta HW_{t-1} + \gamma_{14}\Delta SW_{t-1} + \alpha_1\left(C_{SR(t-1)} - \delta - \beta_1 \mathrm{GDI}_{\mathrm{t-1}} - \beta_2 HW_{t-1} - \beta_3\, SW_{t-1}\right) + \varepsilon_1$$

The vector $\gamma_1 = (\gamma_{11}, \gamma_{12}, \gamma_{13}, \gamma_{14})$ of coefficients describes the short-term relationships among variables, the vector $\beta = (1, \beta_1, \beta_2, \beta_3)$ describes long-term cointegration relationship, and finally coefficient α_1 stands for the speed of adjustment and δ for the intercept in the cointegration relation. The other three equations can be expressed analogously.

Into the model we add the error-correction term:

$$\alpha_1\left(C_{SR(t-1)} - \delta - \beta_1 \mathrm{GDI}_{\mathrm{t-1}} - \beta_2 HW_{t-1} - \beta_3\, SW_{t-1}\right)$$

It is constructed from the lagged values of the variables in levels (as opposed to first differences). This model describes short-term relationships between the growth components (for example between $\Delta C_{SR\,(t)}$ and $\Delta \mathrm{GDI}_{\mathrm{t-1}}$), but also provides correction for the case when short-term changes make the levels of the variables deviate from their long-run equilibrium. If the correction term is the cointegrating relation, then all variables in the model are stationary and the regression can be consistently estimated using OLS.

The estimated model is displayed in Table 22 in the Appendix. Before making any further conclusions we test whether the model fulfills its assumptions. The model is stable, because exactly one inverse root of the characteristic polynomial lies on the complex unit circle and the others lie inside (see Graph 17 in the Appendix). After running additional tests on residuals, we find that the residuals are homoskedastic, asymptotically normally distributed, and are not serially correlated on the 5% level of significance (see Table 23, Table 24, Table 25, Table 26, and Graph 18 in the Appendix). Since the assumptions are fulfilled, we can proceed to interpret the model.

We find a significant cointegrating vector whose unique identification is achieved by applying a normalizing assumption (setting the first component equal to one). The cointegrating relation is displayed in Graph 19 in the Appendix. According to Juselius (2006) this equilibrium error should look stationary. Considering our very short period, we can say that it is fairly stationary.

The estimated cointegrating vector

$$\hat{\beta} = (1, -0.55, -0.18, -0.05)$$

is then the result of the first step of the Johansen procedure. Since the dependent and the explanatory variables are in natural logarithms, the interpretation of the cointegrating vector is in terms of elasticities (Kishor, 2007). We can conclude that the long-run elasticity of consumption of non-durable goods and services with respect to housing wealth (0.18) is over three times greater than the elasticity with respect to financial wealth (0.05). These results do not stand out among results obtained by other studies. In particular the elasticity with respect to housing wealth lies in the interval proposed by Attanasio, Blow, Hamilton and Leicester (2005).

Comparison of results across studies, even if they apply VECM and are testing for cointegration, is not simple, as different types of data and model specifications are set. The most similar choice and type of variables and estimation procedure is presented in the study of Kishor (2007). We now compare our results with his. He assesses whether the housing wealth effect or the stock market wealth effect influence consumption in the USA. After some simplification he assumes that consumption of nondurable goods and services (c_t) is influenced by labour income (y_t), housing wealth (h_t) and financial market wealth (f_t).

$$c_t = \beta_0 + \beta_1 y_t + \beta_2 h_t + \beta_3 f_t + \varepsilon_t$$

For estimating the cointegrating vector, Dynamic Ordinary Least Squares (DOLS) and Newey-West heteroskedastic autocorrelation-consistent standard errors are used. This method of estimating the cointegrating vector was provided by Stock and Watson (1988) and it produces consistent, asymptotically normally distributed, and efficient estimates.

The procedure is based on regressing c_t on all the other variables with appropriate deterministic terms and p lags and leads of their differences. Kishor (2007) has around 200 quarterly observations, and thus he chooses 6 lags and 6 leads and gets the following significant estimate of the cointegrating vector:

$$\hat{\beta}_{Kishor} = (1, -0.62, -0.194, -0.372)$$

He concludes the very opposite than we did. The elasticity of consumption with respect to financial wealth is approximately three times greater than with respect to housing wealth. These opposite results, mainly due to a considerably small stock market wealth effect in the Czech Republic, might be caused by the different characteristics of the American and Czech stock markets. Elasticities with respect to labour income are roughly similar; however theory suggests they should be close to one. It means we have found that the consumption of non-durable goods and services in the Czech Republic responds less to changes in labour income than it does in the USA.

We apply the same DOLS method with 2 lags and 2 leads for estimating the cointegrating vector (the choice of more lags and leads is not possible due to the short period covered by our data), however we find only the influence of disposable income significant; the two wealth components do not seem significant for consumption. This might be caused by the shorter period examined (almost less than one fifth of Kishor's).

Results of VECM in Table 22 indicate that in the regression of consumption the short-term relationships are not significant, but the long-term relationships expressed by the cointegrating vector are. The consumption of non-durable goods and services responds positively in the long run to disposable income and to both wealth components. Based on the values of the elements of the cointegrating vector, the elasticity of consumption with respect to housing wealth is over three times greater than with respect to stock market wealth. It means households are more sensitive to changes in housing prices. On the other hand, changes in disposable income are in the short run strongly and positively influenced by changes in housing and stock market wealth. In models for both types of consumption the housing wealth and stock market wealth have positive and significant impact on gross disposable income and on consumption as well.

7. Summary

In this study we present an analysis of how housing prices influence the consumption of households. To the best of our knowledge, this analysis on aggregate data has never been conducted in the Czech Republic and thus it is the first of its kind in this country.

We assume that an increase in housing prices or an equivalent increase in housing wealth should significantly influence consumption. We divide total household wealth into two components: housing wealth and stock market wealth. We also distinguish between the consumption of durable goods and of non-durable goods and services, as in literature there is an ambiguity about which consumption should be used; thus we use both of them. On the other hand, since we are working with aggregate data, we are not able to divide households according to age, mortgage payments, or dwelling ownership.

We apply the VAR model on Czech quarterly data from the period 1998–2009, and in case of cointegration we use the VECM. We include several variables though relevant into our analysis: consumption, disposable income, housing wealth, stock market wealth, interest rate, unemployment, inflation, and yields on government bonds. The final models, however, include only the first four variables mentioned.

Due to the lack of other data we use the Residential Property Price Index as a proxy for housing wealth and the Prague stock market index as a proxy for stock market wealth. The Residential Property Price Index has its drawbacks, as it is not up-to date, does not include all relevant information, and is subject to frequent recalculations. This should be considered while interpreting the results.

The VAR model is applied on the first differences of the data and for the consumption of durable goods we find a positive indirect wealth effect stemming from changes in housing wealth and stock market wealth (supported by the Granger causality test and IRF). Based on the IRF concept, this effect is two times bigger than for the consumption of non-durable goods and services. However, the indirect wealth effect is not found when using the concept of Granger causality.

This may be caused by the fact that in the model of consumption of non-durable goods and services the variables are cointegrated, thus the VAR model specified in first differences is omitting the long-run relationship and is explaining only the short-term adjustments. Therefore we estimate the cointegrating vector for the consumption of non-durable goods and conclude that the elasticity of consumption of non-durable goods and services with respect to housing wealth (0.18) is over three times greater than with respect to stock market wealth (0.05).

Even though, there was a belief that no significant relationship between consumption and housing and stock market wealth would be found for the Czech Republic, we find significant both housing and stock market wealth effect on both types of consumption. Thus we can conclude that there is a positive linkage between property prices and consumption.

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9. Appendix:

A. Unit root tests

Table 2: ADF Unit Root tests on levels

Null Hypothesis: Unit root (individual unit root process)
Sample: 1998Q1 2009Q4
Exogenous variables: Individual effects, individual linear trends
Automatic selection of lags based on MAIC: 0 to 4
Intermediate ADF test results UNTITLED

Series	Prob.	Lag	Max Lag	Obs
C_LR	0.6979	1	4	43
C_SSR	0.8039	0	4	47
GDI	0.6453	0	4	47
HW	0.5752	2	4	45
SW	0.7923	2	4	45
INFLATION	0.5620	0	4	47
U	0.3346	3	4	44
PRIBOR3	0.2067	1	4	46
YIELD3	0.0941	2	4	45
PRIBOR12	0.4935	0	4	47
YIELD12	0.5678	4	4	43
BONDS	0.6409	0	4	39

Table 3: ADF Unit Root tests on first differences

Null Hypothesis: Unit root (individual unit root process)
Sample: 1998Q1 2009Q4
Exogenous variables: Individual effects
User specified maximum lags
Automatic selection of lags based on MAIC: 0 to 1
Intermediate ADF test results UNTITLED

Series	Prob.	Lag	Max Lag	Obs
DC_LR(no intercept)	0.0352	1	1	42
DC_SSR	0.0297	1	1	45
DGDI	0.0047	1	1	45
DHW(1 fixed lag)	0.0137	1	1	46
DSW	0.0008	0	1	46
DINFLATION	0.0000	0	1	46
DU(no intercept)	0.0173	1	1	45
DPRIBOR3	0.0252	1	1	45
DVYNOS3	0.0000	0	1	46
DPRIBOR12	0.0003	0	1	46
DVYNOS12	0.0007	0	1	46
DBONDS	0.0003	0	1	38

B. Consumption of durable goods

1. Testing for cointegration

Table 4: VAR Lag Order Selection Criteria for levels

Endogenous variables: C_LR GDI HW SW
Exogenous variables: C
Sample: 1998Q1 2009Q4
Included observations: 41

Lag	LogL	LR	FPE	AIC	SC	HQ
0	169.5263	NA	3.66e-09	-8.074451	-7.907274	-8.013574
1	393.0373	392.5072	1.48e-13	-18.19694	-17.36105	-17.89256
2	434.3198	64.44091	4.41e-14	-19.43023	-17.92563*	-18.88234
3	455.7845	29.31770*	3.59e-14	-19.69681	-17.52350	-18.90541*
4	474.5071	21.91912	3.55e-14*	-19.82962*	-16.98759	-18.79471

* indicates lag order selected by the criterion

Table 5: Johansen test for cointegration

Sample (adjusted): 1999Q2 2009Q4
Included observations: 43 after adjustments
Trend assumption: Linear deterministic trend
Series: C_LR GDI HW SW
Lags interval (in first differences): 1 to 1
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.447124	45.71478	47.85613	0.0784
At most 1	0.203249	20.23208	29.79707	0.4073
At most 2	0.195998	10.46191	15.49471	0.2469
At most 3	0.024833	1.081294	3.841466	0.2984

Trace test indicates no cointegration at the 0.05 level
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.447124	25.48269	27.58434	0.0907
At most 1	0.203249	9.770179	21.13162	0.7659
At most 2	0.195998	9.380612	14.26460	0.2558
At most 3	0.024833	1.081294	3.841466	0.2984

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

2. Estimating VAR

Table 6: VAR Lag Order Selection Criteria for first differences

Endogenous variables: DC_LR DGDI DHW DSW
Exogenous variables: C
Sample: 1998Q1 2009Q4
Included observations: 40

Lag	LogL	LR	FPE	AIC	SC	HQ
0	358.8989	NA	2.31e-13	-17.74495	-17.57606	-17.68388
1	401.8657	75.19183*	6.03e-14*	-19.09328*	-18.24884*	-18.78796*
2	413.5670	18.13703	7.67e-14	-18.87835	-17.35836	-18.32877
3	423.9898	14.07078	1.08e-13	-18.59949	-16.40395	-17.80565
4	443.4239	22.34926	1.04e-13	-18.77120	-15.90010	-17.73310

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Table 7: VAR(1) for consumption of durable goods

Vector Autoregression Estimates
Sample (adjusted): 1999Q2 2009Q4
Included observations: 43 after adjustments
Standard errors in ( ) & t-statistics in [ ]

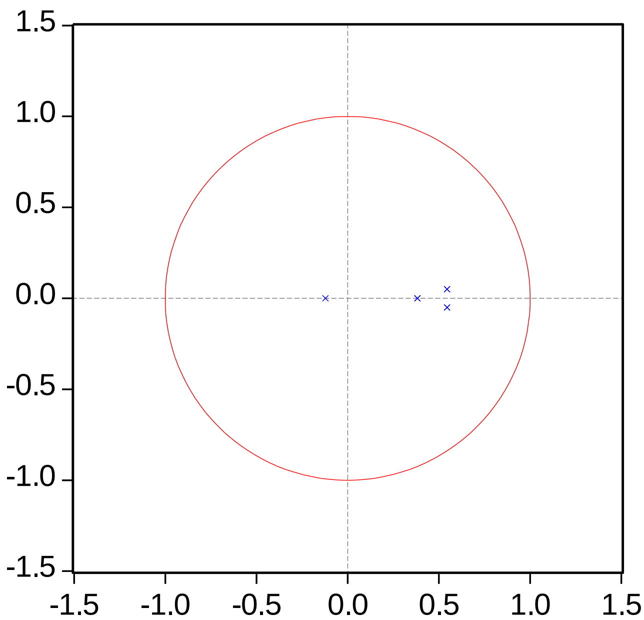
	DC_LR	DGDI	DHW	DSW
DC_LR(-1)	0.388909*	0.044551	-0.197276	0.350725
	(0.14017)	(0.12961)	(0.16109)	(1.39448)
	[2.77454]	[0.34374]	[-1.22465]	[0.25151]
DGDI(-1)	0.403712*	-0.198013	0.100790	-2.076778
	(0.15403)	(0.14242)	(0.17701)	(1.53235)
	[2.62100]	[-1.39033]	[0.56939]	[-1.35529]
DHW(-1)	0.067783	0.286980*	0.783822*	-0.706578
	(0.11287)	(0.10436)	(0.12971)	(1.12288)
	[0.60054]	[2.74980]	[6.04274]	[-0.62925]
DSW(-1)	0.000870	0.054025*	0.027822	0.373935*
	(0.01451)	(0.01342)	(0.01667)	(0.14434)
	[0.05993]	[4.02697]	[1.66857]	[2.59058]
C	-0.001336	0.010187*	0.003945	0.056028*

	(0.00281)	(0.00259)	(0.00322)	(0.02791)
	[-0.47612]	[3.92766]	[1.22372]	[2.00767]
R-squared	0.439364	0.403998	0.603947	0.216518
Adj. R-squared	0.380350	0.341261	0.562257	0.134046
Sum sq. resids	0.005420	0.004634	0.007158	0.536387
S.E. equation	0.011942	0.011042	0.013724	0.118808
F-statistic	7.445041	6.439540	14.48670	2.625362
Log likelihood	132.0326	135.4018	126.0520	33.24380
Akaike AIC	-5.908492	-6.065201	-5.630326	-1.313665
Schwarz SC	-5.703701	-5.860411	-5.425536	-1.108875
Mean dependent	0.009542	0.014809	0.019475	0.025642
S.D. dependent	0.015171	0.013605	0.020744	0.127673
Determinant resid covariance (dof adj.)		3.24E-14		
Determinant resid covariance		1.98E-14		
Log likelihood		434.3492		
Akaike information criterion		-19.27206		
Schwarz criterion		-18.45289		

3. Model testing

3.1. Stationarity

Graph 13: Inverse Roots of AR Characteristic Polynomial



3.2. Serial correlation

Table 8: VAR Residual Portmanteau Tests for Autocorrelations

H0: no residual autocorrelations up to lag h
Date: 07/09/11 Time: 16:58
Sample: 1998Q1 2009Q4
Included observations: 43

Lags	Q-Stat	Prob.	Adj Q-Stat	Prob.	df
1	8.003043	NA*	8.193592	NA*	NA*
2	16.48039	0.4200	17.08447	0.3802	16
3	30.27161	0.5542	31.91003	0.4712	32
4	51.35011	0.3438	55.15042	0.2225	48
5	70.92732	0.2579	77.30359	0.1228	64
6	78.08034	0.5399	85.61656	0.3133	80
7	91.43020	0.6129	101.5622	0.3293	96
8	101.4693	0.7524	113.8960	0.4323	112
9	107.4268	0.9065	121.4305	0.6465	128
10	113.5879	0.9710	129.4586	0.8018	144
11	120.2685	0.9918	138.4356	0.8900	160
12	129.8326	0.9963	151.7020	0.9073	176

*The test is valid only for lags larger than the VAR lag order.
df is degrees of freedom for (approximate) chi-square distribution

Table 9: VAR Residual Serial Correlation LM Tests

H0: no serial correlation at lag order h
Date: 07/09/11 Time: 16:59
Sample: 1998Q1 2009Q4
Included observations: 43

Lags	LM-Stat	Prob
1	18.30667	0.3062
2	12.57656	0.7034
3	13.99964	0.5987
4	24.52542	0.0786
5	24.68002	0.0757
6	9.376282	0.8971
7	17.28446	0.3674
8	17.10063	0.3791
9	9.008185	0.9131
10	10.09371	0.8617
11	10.37397	0.8464
12	14.63575	0.5515

Probs from chi-square with 16 df.

3.3. Normality

Table 10: VAR Residual Normality Tests

Orthogonalization: Cholesky (Lutkepohl)
H0: residuals are multivariate normal
Sample: 1998Q1 2009Q4
Included observations: 43

Component	Skewness	Chi-sq	df	Prob.
1	-0.462337	1.531916	1	0.2158
2	0.661981	3.140572	1	0.0764
3	-0.450863	1.456820	1	0.2274
4	0.034158	0.008362	1	0.9271
Joint		6.137670	4	0.1891

Component	Kurtosis	Chi-sq	df	Prob.
1	2.448629	0.544685	1	0.4605
2	2.840835	0.045389	1	0.8313
3	2.124825	1.372293	1	0.2414
4	3.308953	0.171018	1	0.6792
Joint		2.133385	4	0.7112

Component	Jarque-Bera	df	Prob.
1	2.076601	2	0.3541
2	3.185962	2	0.2033
3	2.829113	2	0.2430
4	0.179380	2	0.9142
Joint	8.271056	8	0.4075

3.4. Heteroskedasticity

Table 11: VAR Residual Heteroskedasticity Tests: Includes Cross Terms

Sample: 1998Q1 2009Q4
Included observations: 43

Joint test:

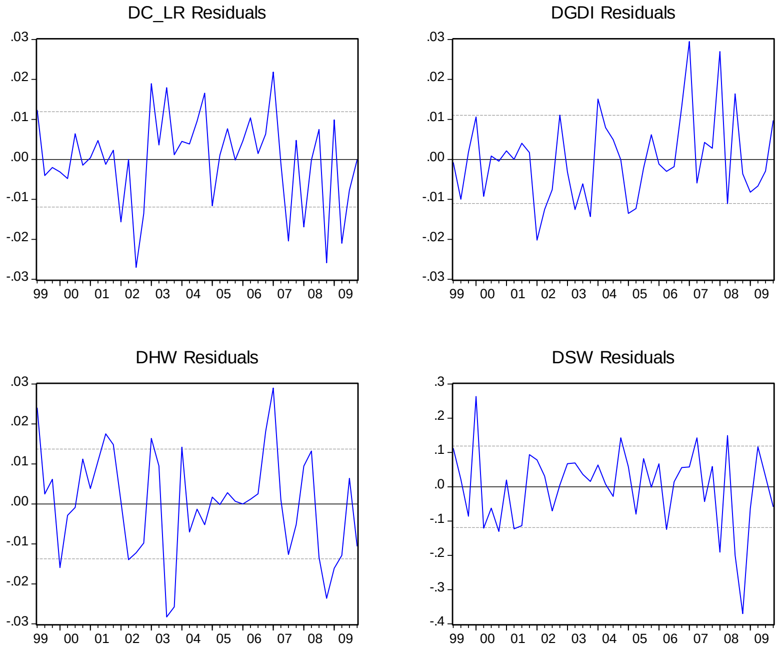
Chi-sq	df	Prob.
156.0126	140	0.1680

Individual components:

Dependent	R-squared	F(14,28)	Prob.	Chi-sq(14)	Prob.
res1*res1	0.312857	0.910600	0.5584	13.45283	0.4912
res2*res2	0.082700	0.180312	0.9992	3.556109	0.9976
res3*res3	0.088445	0.194053	0.9988	3.803136	0.9965
res4*res4	0.535147	2.302437	0.0293*	23.01133	0.0601
res2*res1	0.169406	0.407915	0.9598	7.284451	0.9232
res3*res1	0.222809	0.573370	0.8629	9.580781	0.7921
res3*res2	0.230664	0.599644	0.8425	9.918550	0.7681
res4*res1	0.559640	2.541738	0.0173*	24.06452	0.0450*
res4*res2	0.275267	0.759638	0.7003	11.83649	0.6194
res4*res3	0.551517	2.459480	0.0207*	23.71524	0.0496*

*these p-values are smaller than 0.05 thus we should reject the null hypothesis of homoskedasticity, however the joint test shows the residuals are homoskedastic.

Graph 14: Plot of residuals



These residuals mostly look like a white noise, however we would need higher frequency (e.g. monthly data), which would be more precise.

4. Granger Causality

Table 12 : VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1998Q1 2009Q4 Included observations: 43			
Dependent variable: DC_LR			
Excluded	Chi-sq	df	Prob.
DGDI	6.869646	1	0.0088
DHW	0.360649	1	0.5481
DSW	0.003592	1	0.9522
All	10.86819	3	0.0125
Dependent variable: DGDI			
Excluded	Chi-sq	df	Prob.
DC_LR	0.118157	1	0.7310
DHW	7.561378	1	0.0060
DSW	16.21651	1	0.0001
All	25.53558	3	0.0000

C. Consumption of non-durable goods and services

1. Testing for cointegration

Table 13: VAR Lag Order Selection Criteria for the levels

Endogenous variables: C_SSR GDI HW SW
Exogenous variables: C
Sample: 1998Q1 2009Q4
Included observations: 44

Lag	LogL	LR	FPE	AIC	SC	HQ
0	205.7391	NA	1.22e-09	-9.169961	-9.007762	-9.109810
1	447.0748	427.8223	4.38e-14	-19.41249	-18.60149	-19.11173
2	480.4110	53.03486*	2.03e-14*	-20.2005*	-18.74071*	-19.65914*
3	487.6828	10.24669	3.17e-14	-19.80376	-17.69518	-19.02180
4	504.6755	20.85467	3.34e-14	-19.84889	-17.09150	-18.82632

* indicates lag order selected by the criterion

Table 14: Johansen test for cointegration

Sample (adjusted): 1998Q3 2009Q4
Included observations: 46 after adjustments
Trend assumption: Linear deterministic trend
Series: C_SSR GDI HW SW
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.480076	48.88638	47.85613	0.0399
At most 1	0.192312	18.79903	29.79707	0.5074
At most 2	0.135433	8.974362	15.49471	0.3678
At most 3	0.048359	2.280123	3.841466	0.1310

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.480076	30.08735	27.58434	0.0233
At most 1	0.192312	9.824668	21.13162	0.7609
At most 2	0.135433	6.694239	14.26460	0.5259
At most 3	0.048359	2.280123	3.841466	0.1310

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

2. Estimating VAR

Table 15: VAR Lag Order Selection Criteria

Endogenous variables: DC_SSR DGDI DHW
DSW
Exogenous variables: C
Sample: 1998Q1 2009Q4
Included observations: 43

Lag	LogL	LR	FPE	AIC	SC	HQ
0	407.8752	NA	8.16e-14	-18.78489	-18.62106	-18.72448
1	444.1794	64.16561*	3.19e-14*	-19.72927*	-18.91011*	-19.42719*
2	455.9223	18.57024	3.97e-14	-19.53127	-18.05678	-18.98752
3	464.5705	12.06716	5.89e-14	-19.18932	-17.05950	-18.40391
4	479.1055	17.57726	7.00e-14	-19.12119	-16.33603	-18.09411

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Table 16: VAR for the first differences of consumption of non-durable goods

Sample (adjusted): 1998Q3 2009Q4
Included observations: 46 after adjustments
Standard errors in ( ) & t-statistics in [ ]

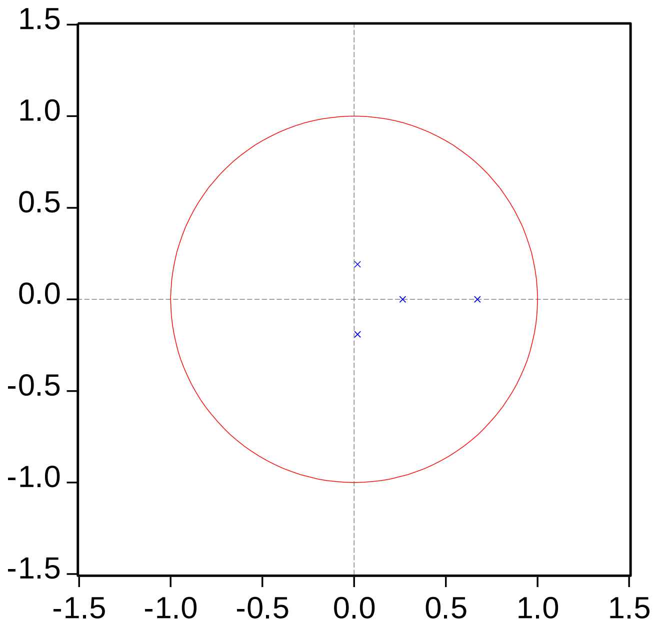
	DC_SSR	DGDI	DHW	DSW
DC_SSR(-1)	0.054075	0.212935	0.436152	1.825640
	(0.17342)	(0.19975)	(0.23495)	(2.09207)
	[0.31180]	[1.06598]	[1.85635]	[0.87265]
DGDI(-1)	0.101471	-0.202783	-0.046861	-3.070589
	(0.12830)	(0.14778)	(0.17382)	(1.54775)
	[0.79087]	[-1.37217]	[-0.26959]	[-1.98390]
DHW(-1)	0.078763	0.262311	0.703924	-0.350874
	(0.08016)	(0.09233)	(0.10860)	(0.96702)
	[0.98254]	[2.84092]	[6.48167]	[-0.36284]
DSW(-1)	0.008042	0.058643	0.031297	0.418514
	(0.01145)	(0.01319)	(0.01551)	(0.13813)
	[0.70236]	[4.44647]	[2.01750]	[3.02990]
C	0.009035	0.008420	-0.000128	0.038102

	(0.00255)	(0.00293)	(0.00345)	(0.03073)
	[3.54643]	[2.86919]	[-0.03715]	[1.23974]
R-squared	0.100970	0.419770	0.635050	0.245053
Adj. R-squared	0.013260	0.363162	0.599445	0.171399
Sum sq. resids	0.003752	0.004978	0.006887	0.546027
S.E. equation	0.009566	0.011019	0.012960	0.115402
F-statistic	1.151178	7.415415	17.83606	3.327107
Log likelihood	151.2522	144.7503	137.2850	36.70458
Akaike AIC	-6.358791	-6.076099	-5.751522	-1.378460
Schwarz SC	-6.160026	-5.877333	-5.552757	-1.179695
Mean dependent	0.012762	0.014177	0.018383	0.019168
S.D. dependent	0.009630	0.013808	0.020478	0.126778
Determinant resid covariance (dof adj.)		1.77E-14		
Determinant resid covariance		1.12E-14		
Log likelihood		477.7451		
Akaike information criterion		-19.90196		
Schwarz criterion		-19.10690		

2.1. Model testing

2.1.1. Stationarity

Graph 15: Inverse Roots of AR Characteristic Polynomial



2.1.2. Serial correlation

Table 17: VAR Residual Portmanteau Tests for Autocorrelations

H0: no residual autocorrelations up to lag h
Sample: 1998Q1 2009Q4
Included observations: 46

Lags	Q-Stat	Prob.	Adj Q-Stat	Prob.	df
1	7.729088	NA*	7.900846	NA*	NA*
2	18.94415	0.2716	19.62569	0.2376	16
3	35.03212	0.3262	36.83607	0.2550	32
4	48.80658	0.4404	51.92238	0.3236	48
5	61.89142	0.5515	66.60294	0.3875	64
6	74.71513	0.6459	81.35021	0.4369	80
7	89.76497	0.6597	99.10129	0.3938	96
8	97.59593	0.8320	108.5809	0.5738	112
9	106.4388	0.9176	119.5747	0.6903	128
10	117.2032	0.9505	133.3292	0.7276	144
11	125.6531	0.9793	144.4348	0.8058	160
12	137.3524	0.9860	160.2632	0.7965	176

*The test is valid only for lags larger than the VAR lag order.
df is degrees of freedom for (approximate) chi-square distribution

Table 18: VAR Residual Serial Correlation LM Tests

H0: no serial correlation at lag order h
Sample: 1998Q1 2009Q4
Included observations: 46

Lags	LM-Stat	Prob
1	19.46303	0.2454
2	14.79433	0.5398
3	18.96883	0.2703
4	13.17324	0.6601
5	14.58664	0.5551
6	14.14062	0.5882
7	18.50682	0.2951
8	11.12920	0.8014
9	11.08171	0.8044
10	15.01573	0.5235
11	12.83655	0.6847
12	14.00498	0.5983

Probs from chi-square with 16 df.

2.1.3. Normality

Table 19: VAR Residual Normality Tests

Orthogonalization: Cholesky (Lutkepohl)				
H0: residuals are multivariate normal				
Sample: 1998Q1 2009Q4				
Included observations: 46				
Component	Skewness	Chi-sq	df	Prob.
1	-0.015785	0.001910	1	0.9651
2	0.823063	5.193652	1	0.0227*
3	-0.159323	0.194610	1	0.6591
4	-0.228191	0.399213	1	0.5275
Joint		5.789385	4	0.2154
Component	Kurtosis	Chi-sq	df	Prob.
1	1.670942	3.385588	1	0.0658
2	3.065369	0.008190	1	0.9279
3	2.332729	0.853396	1	0.3556
4	3.078227	0.011729	1	0.9138
Joint		4.258904	4	0.3721
Component	Jarque-Bera	df	Prob.	
1	3.387499	2	0.1838	
2	5.201842	2	0.0742	
3	1.048006	2	0.5921	
4	0.410942	2	0.8143	
Joint	10.04829	8	0.2617	

*this p-value is smaller than 0.05 thus we should reject the null hypothesis of normality in skewness, however the joint test shows the residuals are normal in skewness.

2.1.4. Heteroskedasticity

Table 20: VAR Residual Heteroskedasticity Tests: Includes Cross Terms

Sample: 1998Q1 2009Q4
Included observations: 46

Joint test:

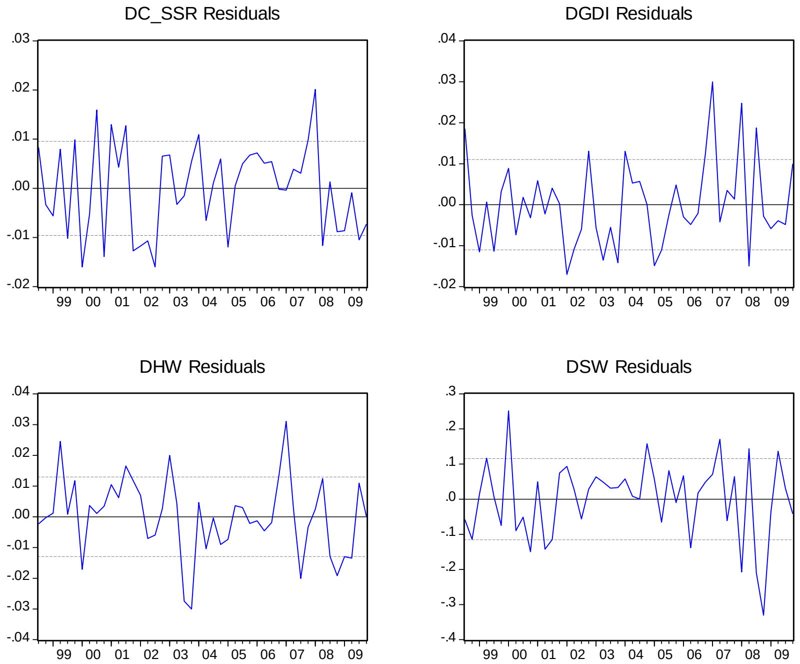
Chi-sq	df	Prob.
148.8200	140	0.2891

Individual components:

Dependent	R-squared	F(14,31)	Prob.	Chi-sq(14)	Prob.
res1*res1	0.327169	1.076714	0.4134	15.04979	0.3748
res2*res2	0.067972	0.161485	0.9996	3.126694	0.9988
res3*res3	0.145176	0.376056	0.9722	6.678108	0.9464
res4*res4	0.573880	2.982104	0.0055*	26.39848	0.0230*
res2*res1	0.296469	0.933105	0.5366	13.63759	0.4770
res3*res1	0.252344	0.747350	0.7129	11.60781	0.6378
res3*res2	0.199547	0.552004	0.8807	9.179149	0.8194
res4*res1	0.361784	1.255207	0.2885	16.64207	0.2758
res4*res2	0.284760	0.881580	0.5846	13.09898	0.5187
res4*res3	0.562711	2.849376	0.0074*	25.88469	0.0268*

*these p-values are smaller than 0.05 thus we should reject the null hypothesis of homoskedasticity, however the joint test shows the residuals are homoskedastic.

Graph 16: Plot of residuals



These graphs seems like white noise, however it might not be persuasive enough due to the small sample.

3. Granger Causality

Table 21: VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1998Q1 2009Q4 Included observations: 46			
Dependent variable: DC_SSR			
Excluded	Chi-sq	df	Prob.
DGDI	0.625481	1	0.4290
DHW	0.965378	1	0.3258
DSW	0.493305	1	0.4825
All	3.417161	3	0.3317
Dependent variable: DGDI			
Excluded	Chi-sq	df	Prob.
DC_SSR	1.136320	1	0.2864
DHW	8.070813	1	0.0045
DSW	19.77113	1	0.0000
All	29.14892	3	0.0000

4. Estimating VECM

Table 22: VECM for consumption of non-durable goods

Vector Error Correction Estimates
Sample (adjusted): 1998Q3 2009Q4
Included observations: 46 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
C_SSR(-1)	1.000000
GDI(-1)	-0.552294
	(0.10718)
	[-5.15272]
HW(-1)	-0.179079
	(0.06372)
	[-2.81039]
SW(-1)	-0.053481
	(0.01212)
	[-4.41106]
C	-1.000818

Error Correction:	D(C_SSR)	D(GDI)	D(HW)	D(SW)
CointEq1	-0.331314	-0.094652	0.265703	1.519020
	(0.08160)	(0.11068)	(0.12447)	(1.14483)
	[-4.06021]	[-0.85516]	[2.13465]	[1.32685]
D(C_SSR(-1))	0.057229	0.213836	0.433622	1.811176
	(0.14775)	(0.20041)	(0.22538)	(2.07296)
	[0.38733]	[1.06697]	[1.92394]	[0.87372]
D(GDI(-1))	-0.132493	-0.269623	0.140770	-1.997902
	(0.12357)	(0.16761)	(0.18849)	(1.73364)
	[-1.07222]	[-1.60864]	[0.74683]	[-1.15243]
D(HW(-1))	0.032862	0.249198	0.740734	-0.140427
	(0.06923)	(0.09390)	(0.10560)	(0.97122)
	[0.47471]	[2.65393]	[7.01486]	[-0.14459]
D(SW(-1))	-0.001676	0.055867	0.039090	0.463071
	(0.01004)	(0.01362)	(0.01532)	(0.14092)
	[-0.16687]	[4.10044]	[2.55127]	[3.28597]
C	0.013319	0.009643	-0.003564	0.018462
	(0.00241)	(0.00327)	(0.00368)	(0.03386)
	[5.51873]	[2.94588]	[-0.96799]	[0.54527]

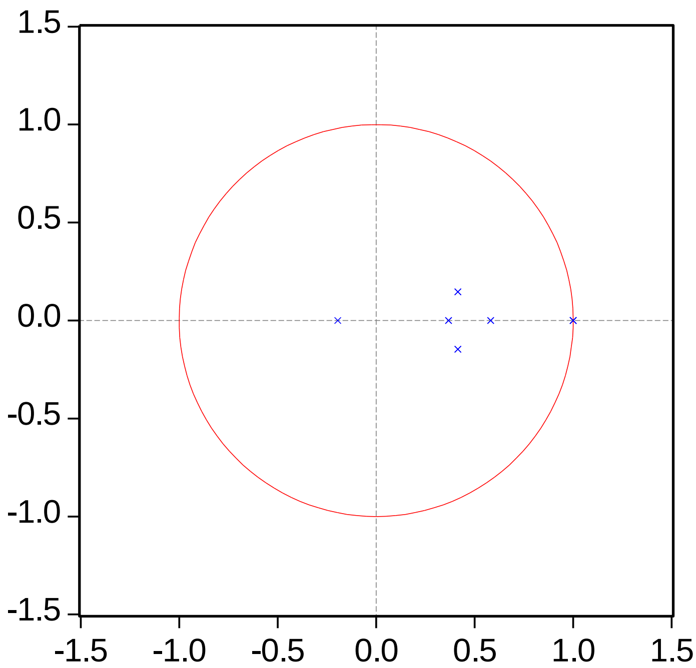
R-squared	0.363353	0.430188	0.672373	0.276880
Adj. R-squared	0.283772	0.358961	0.631420	0.186490
Sum sq. resids	0.002657	0.004889	0.006182	0.523008
S.E. equation	0.008150	0.011055	0.012432	0.114347
F-statistic	4.565826	6.039714	16.41801	3.063164
Log likelihood	159.1895	145.1670	139.7663	37.69524
Akaike AIC	-6.660413	-6.050738	-5.815927	-1.378054
Schwarz SC	-6.421895	-5.812219	-5.577409	-1.139536
Mean dependent	0.012762	0.014177	0.018383	0.019168
S.D. dependent	0.009630	0.013808	0.020478	0.126778

Determinant resid covariance (dof adj.)	1.02E-14
Determinant resid covariance	5.82E-15
Log likelihood	492.7888
Akaike information criterion	-20.20821
Schwarz criterion	-19.09512

4.1. Model testing

4.1.1. Stationarity

Graph 17: Inverse Roots of AR Characteristic Polynomial



4.1.2. Serial correlation

Table 23: VEC Residual Portmanteau Tests for Autocorrelations

H0: no residual autocorrelations up to lag h
Sample: 1998Q1 2009Q4
Included observations: 46

Lags	Q-Stat	Prob.	Adj Q-Stat	Prob.	df
1	3.280193	NA*	3.353087	NA*	NA*
2	11.75842	0.7604	12.21669	0.7289	16
3	29.78021	0.5793	31.49581	0.4919	32
4	44.70898	0.6085	47.84637	0.4791	48
5	57.16296	0.7149	61.81913	0.5540	64
6	73.11737	0.6941	80.16670	0.4737	80
7	92.06708	0.5946	102.5176	0.3057	96
8	101.3352	0.7554	113.7370	0.4365	112
9	108.4323	0.8942	122.5603	0.6191	128
10	115.1654	0.9631	131.1638	0.7705	144
11	121.4771	0.9898	139.4592	0.8777	160
12	133.9519	0.9921	156.3368	0.8540	176

*The test is valid only for lags larger than the VAR lag order.
df is degrees of freedom for (approximate) chi-square distribution

Table 24: VEC Residual Serial Correlation LM test

H0: no serial correlation at lag order h
Sample: 1998Q1 2009Q4
Included observations: 46

Lags	LM-Stat	Prob
1	7.480666	0.9628
2	11.42500	0.7825
3	21.59070	0.1569
4	14.78614	0.5404
5	13.86094	0.6091
6	16.94856	0.3889
7	24.68492	0.0756
8	12.51311	0.7080
9	8.839488	0.9199
10	7.924265	0.9511
11	8.542574	0.9311
12	16.02264	0.4514

Probs from chi-square with 16 df.

4.1.3. Normality

Table 25: VEC Residual Normality Tests

Orthogonalization: Cholesky (Lutkepohl)
H0: residuals are multivariate normal
Sample: 1998Q1 2009Q4
Included observations: 46

Component	Skewness	Chi-sq	df	Prob.
1	0.059987	0.027588	1	0.8681
2	0.785099	4.725588	1	0.0297*
3	-0.135049	0.139826	1	0.7085
4	-0.281928	0.609371	1	0.4350
Joint		5.502372	4	0.2395

Component	Kurtosis	Chi-sq	df	Prob.
1	2.164257	1.338728	1	0.2473
2	2.796261	0.079560	1	0.7779
3	2.366648	0.768843	1	0.3806
4	2.908170	0.016163	1	0.8988
Joint		2.203294	4	0.6984

Component	Jarque-Bera	df	Prob.
1	1.366316	2	0.5050
2	4.805148	2	0.0905
3	0.908668	2	0.6349
4	0.625534	2	0.7314
Joint	7.705665	8	0.4627

*this p-value is smaller than 0.05 thus we should reject the null hypothesis of normality in skewness, however the joint test shows the residuals are normal in skewness.

4.1.4. Heteroskedasticity

Table 26: VEC Residual Heteroskedasticity Tests: Includes Cross Terms

Sample: 1998Q1 2009Q4
Included observations: 46

Joint test:

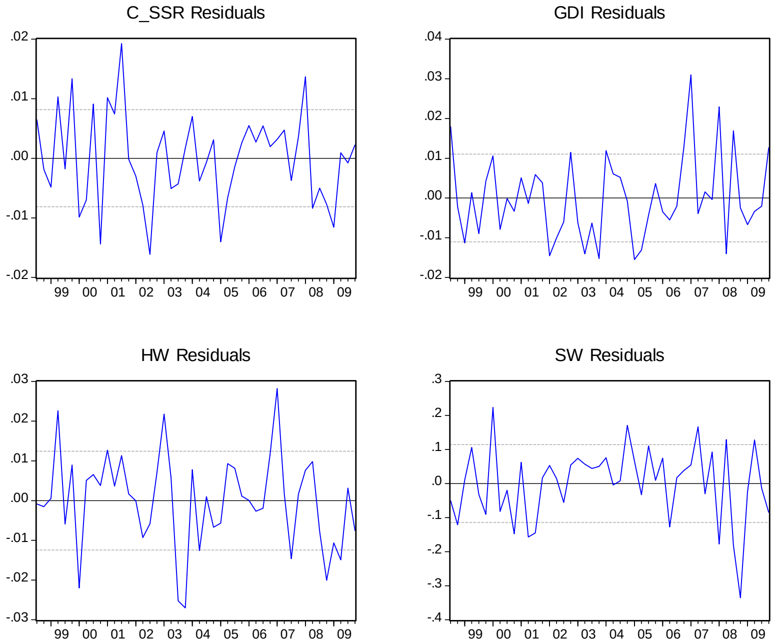
Chi-sq	df	Prob.
201.6742	200	0.4535

Individual components:

Dependent	R-squared	F(20,25)	Prob.	Chi-sq(20)	Prob.
res1*res1	0.343063	0.652769	0.8332	15.78089	0.7301
res2*res2	0.227209	0.367514	0.9872	10.45162	0.9592
res3*res3	0.222708	0.358148	0.9889	10.24459	0.9635
res4*res4	0.672310	2.564584	0.0136*	30.92627	0.0562
res2*res1	0.363670	0.714389	0.7768	16.72881	0.6705
res3*res1	0.417018	0.894150	0.5965	19.18285	0.5100
res3*res2	0.189666	0.292574	0.9966	8.724640	0.9859
res4*res1	0.415793	0.889654	0.6010	19.12650	0.5136
res4*res2	0.471993	1.117394	0.3917	21.71169	0.3564
res4*res3	0.680161	2.658217	0.0110*	31.28741	0.0515

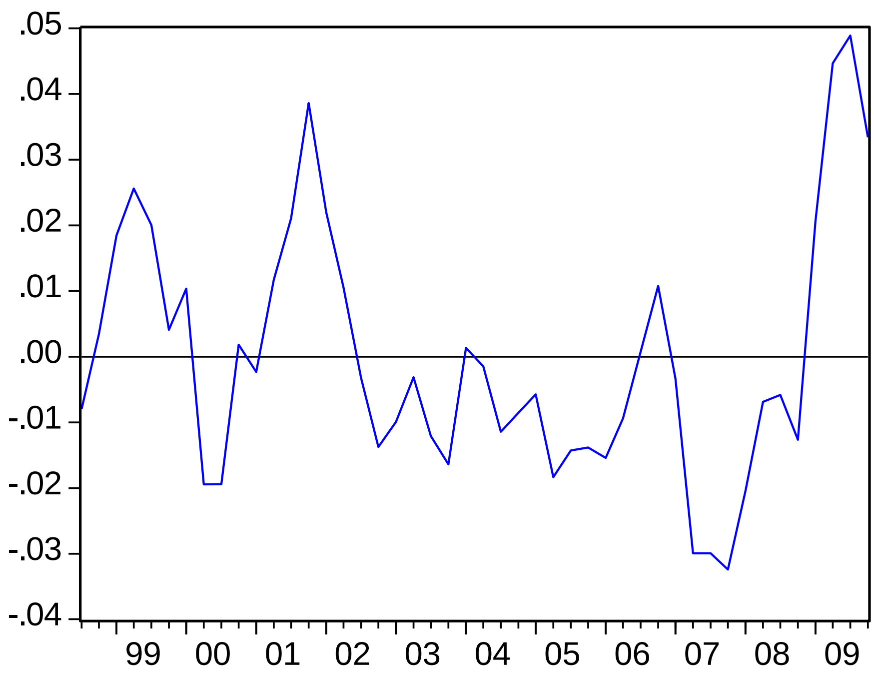
*these p-values are smaller than 0.05 thus we should reject the null hypothesis of homoskedasticity, however the joint test shows the residuals are homoskedastic.

Graph 18: Plot of residuals



Despite the small data set, the residuals look like a white noise.

Graph 19: Cointegration relation



Bachelor Thesis Proposal

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Akademický rok 2009/2010

TEZE BAKALÁŘSKÉ PRÁCE[17]

Student:	Sylvie Dvořáková
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Konzultant:	PhDr. Jakub Seidler

Garant studijního programu Vám dle zákona č. 111/1998 Sb. o vysokých školách a Studijního a zkušebního řádu UK v Praze určuje následující bakalářskou práci

Předpokládaný název BP:

The Influence of Housing Price Development on Household Balance Sheet - Empirical Analysis for the Czech Republic

Charakteristika tématu, současný stav poznání, případné zvláštní metody zpracování tématu:

The objective of this thesis is to describe the influences of house price development on the balance sheet of households and possible wealth effect. The thesis will be particularly focused on the consumption of households as it comprises the largest part of GDP. Firstly, we will describe some fundamental issues about the housing market in relation to the current crisis, secondly, illustrate the changes in households' consumption, and finally create a model which will explain possible relations between house prices and consumption.

Struktura BP:

Abstrakt

Housing is a risky asset with high price volatility. Part of its importance for economics lies in the fact that housing price changes influence aggregate consumption. The correlation between house prices and consumption is widely attributed to direct wealth

[17] In this thesis, mistakes concerning spelling, grammar and vocabulary were corrected.

effect. When house prices increase, the owners perceive it as an increase to their house wealth and thus increase their consumption. However, some objections to the wealth hypothesis mentioned above may be found. Some owners are hedged against fluctuations on the housing market, as they know that higher prices reflect higher implicit costs of living. Another reason might be that houses are used as collateral for loans. When prices increase the collateral available to households increases and it reduces the credit constraint of house owners, thus facilitating consumption. According to the Modigliani Life Cycle Hypothesis, this would lead to homeowners smoothing their consumption over time. The final objection is that house prices and consumption tend to be influenced by the same common factors.

Not all households react in the same way, depending on their risk awareness, expectations, house price elasticities, and expected future income, which could be different across generations or regions. It is thought that the relationship between house prices and consumption is stronger for younger than older households, and that the consumption of homeowners and renters are equally aligned with the house price cycle.

We should keep in mind that an increase in house prices can be expected to lead to a reduction in the expected net future wealth of non-homeowners.

Different consequences could arise when changes in house prices are predictable versus unpredictable, and when the changes are perceived as either permanent or temporary.

In this thesis we will study the empirical relationship between house prices and consumption on Czech data in the period 2000 – 2010 based on the Vector Error Correction model which models the long-run relationship between variables and characterizes possible short-run deviations from the long-term trend.

Osnova

1. Introduction
2. Real estate market and housing market
    2.1. Comparison with stock market
3. Impact of financial crisis on real estate market in the Czech Republic
    3.1. Comparison with other countries
4. Consumption and wealth effect
5. Impact of house price changes on consumption
    5.1. Transmission mechanism of the impact
        5.1.1 Different types of correlation
    5.2. Impact on the young and the old
    5.3. Impact on owners and renters
    5.4. Expectations
6. Analysis of the Czech data based on the Vector Error Correction Model
7. Conclusion

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Podpisy konzultanta a studenta:

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PhDr. Jakub Seidler Sylvie Dvořáková

V Praze dne 21. 5. 2010.