On the macroeconomic determinants of the housing market in Greece: A VECM approach

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ABSTRACT

This study examines the role of the housing market in the Greek economy. We review the literature and assess the interdependence between the housing price index and its macroeconomic determinants within a VECM framework. An equilibrium relationship exists and in the long run the retail sector and mortgage loans emerge as the most important variables for housing. The dynamic analysis shows that the mortgage loans followed by retail trade are the variables with the most explanatory power for the variation of the houses price index.

Keywords: Housing Market · Greece · VECM · impulse response function · Granger causality

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1. Introduction

Housing is considered to be the most valuable asset of a household and a fundamental part of its portfolio. It provides positive externalities in terms of social environment, public health and economic development. The literature discounted for a long time the interaction between the housing market and the macroeconomy by putting housing next to other consumption goods (Leung, 2004). The recent US subprime crisis and the subsequent collapse of the housing market revived the focus on the housing market.

The recession and the collapse of the Greek housing market created chain reaction effects on most sectors of the Greek economy raising the question whether house prices reflected fundamentals. We examine the key macroeconomic determinants by employing a two stage Vector Error Correction Model (VECM) that takes into account exogenous variables to gauge the short and the long run dynamics. The direction of causality and the long-term relation between housing prices and the other macroeconomic factors will be investigated.

The paper is organized as follows: Sections 2 discusses homeownership, housing wealth and the financial crisis. Section 3 reviews the main macroeconomic determinants of the housing market. Section 4 focuses on the Greek housing market while chapter 5 presents the empirical results. The last section draws conclusions and provides suggestions for further research.

2. Background

2.1. Homeownership

The encouragement of homeownership has been a key government policy. Its benefits and costs are still of interest to researchers (Phang, 2010). Atterhog (2005) depicts three main advantages of owning a house: (i) private dwellings are usually of bigger size and better quality than these of non-private property, (ii) due to the role of long-term investment it could lead to wealth accumulation, (iii) it cultivates self-esteem and it creates positive social externalities. Regarding the disadvantages, the most important factor is the immobility (which could lead to higher unemployment, Oswald 1999) and the user cost of housing (Hickman, 2010). Glaeser and Shapiro (2002) argues that owners desire for keeping their property value up, causing cartel and artificial inflation actions in order to control the housing supply. Figure 1 depicts the homeownership indices for the EU-15 countries. Greece, Spain and Ireland emerge as champions on the one side of the scale whereas Germany and Switzerland appear on the other.

(Please see Appendix for Figure 1)

2.2. Housing Wealth

The term housing wealth refers to the market value of all the assets or capital stock of the residential sector in a country, rented or owned (Iacoviello, 2011a, b). Housing wealth is connected with a household's income (Mirrlees et al, 2010). At the end of 2008 housing wealth in the USA represented half of the total household wealth (Iacoviello, 2011a).

The same time in the Eurozone the net housing wealth represented the 60% of total wealth (ECB, 2009). Housing wealth is linked to consumption and (non) housing investment (Case et al, 2013).

2.3. Housing market and the financial crisis

In addition to the key macroeconomic and financial factors responsible for the crisis, fundamental was the role of housing in the change of the consumption behavior given that is used as a collateral in most of the cases. In some countries (for example USA and Spain) the role of the housing sector was more active, multiplying the weight of the other macroeconomic determinants while in others, as Greece, the housing market wasn't one of the main causes of the financial crisis (Hardouvelis, 2009). Ireland, Spain and Greece were the EU countries with the highest homeownership ratio and the highest increase in house prices. *(Please see Appendix for Figure 1)*

3. Housing Market and the Macroeconomic Determinants

The double role of the housing market, as a consumption good and as an investment, has been acknowledged in the literature (Leung, 2004). Hilbers et al (2008) classifies policies in four types; fiscal (for rents and income), monetary (for interest rates), structural (supply and demand for housing) and prudential (for the financing of the housing market).

3.1 GDP Income

The strong relationship between GDP, income and the housing market has been examined in the literature. Iacoviello and Neri (2008) examine

the response of GDP to housing market fluctuations and Mikhed and Zemcik (2009) concluded that in USA a decline in home prices affected negatively the consumption and GDP. Adams and Füss (2010) noticed that the GDP growth has an increasing impact on the housing market. Tsatsaronis and Zhu (2004) using data from 17 industrialized countries and through variance decomposition concluded that the long-term contribution of GDP doesn't exceed the 10% of the total variation of housing price. Many studies (Davis and Heathcote, 2003; Goodhart and Hofmann, 2008; Madsen, 2012) agree that a strong short-term relationship exist between housing market and GDP. However Madsen (2012) indicates that in the long term this nexus becomes weak. Turning on the Greek economy, Merikas et al (2010) found a bidirectional causality with a strong impact of housing investment on the economy growth.

3.2 Taxation

There are two main reasons why government taxes residential property. Firstly, it taxes it because of the high market value of the housing stock and secondly because of the immobility and durability of housing that makes it difficult to avoid taxation (Leung, 2004). However, the taxation policy in many countries used to be favorable for homeowners. Most Eurozone governments encourage housing investments either by subsidizing or through tax deductions (ECB, 2009; Andrews, 2010). Poterba (1992) following a user cost approach underlines the importance of imputed rent taxation and of other residential taxes which may lead to distortions in the housing market. Other studies (Skinner, 1996; Gervais, 2002; Feldstein, 1982; Bellettini and Taddei,

2009; Van den Noord, 2003; Berkovec and Fullerton, 1992) argue that the preferential tax treatment lead to social welfare loss and the crowding-out phenomenon for investments in other sectors. In the long-term this course will end up with higher housing stock and increased price levels (Turnovsky and Okuyama, 1994; Order Van, 2007).

3.3 Loans

An important part of the bank credit portfolio is the mortgages loans. In 2008 these loans were almost 50% (40%) of GDP for the EU-27 (Greece). According to Case et al (2000), any decrease in the house price level reduces the bank capital, limits lending and finally it confines the investments in the housing sector. Adams and Füss (2010) argue that any increase in the house prices raises the bank lending as high as greater is the ratio of loan to the value of the collateral (Loan to Value Ratio). Further related literature includes Leung, 2004; Goodhart and Hofmann, 2008; Panagiotidis et al, 2008; Iacoviello and Pavan, 2011.

3.4 Interest

When the interest rate is rising, the cost of borrowing is also rising and the potential buyers are getting discouraged. As a result housing demand is falling. On the contrary, when the interest rates are on the decrease, e.g. because of money supply growth, then the user cost of housing is going down and the demand for housing is rising (Apergis and Rezitis, 2003; Igan et al, 2011). Andrews (2010) argues that the correlation between house prices and the loan interest rate is negative and depends on the degree of competition in the banking sector.

Frederic (2007) detects six direct and indirect ways in which the rate is affecting the housing market: directly on the user cost of capital, on the expectations for the future movements of prices and on the housing supply; indirectly through housing wealth changes and credit-channel effects on consumption and on demand. Jud and Winkler (2002) and Painter and Redfearn (2002) argue that the influence of houses prices on interest rates is of minor importance while others that the interest rate is one of the most crucial macroeconomic factors of housing (Tsatsaronis and Zhu, 2004; Assenmacher-Wesche and Gerlach, 2008; Iacoviello, 2005; Iacoviello and Pavan, 2011; Goodhart and Hofmann, 2008; Zan and Wang, 2012).

3.5 Inflation

Kearl (1979) examined the inflationary environment and concluded that in the case of false anticipation relative housing prices are affected. Similarly, Follain (1981) and Feldstein (1992) infer this negative effect of inflation on demand and on housing investments while Andrews (2010) detect upward trends of housing prices after change of inflation in both directions. On the other hand, Nielsen and Sorensen (1994) find that an increasing inflation generates housing investment motives because of the decreasing real user cost after taxes. All in all, there are discordant views concerning the actual effect of inflation on housing market (Manchester, 1987; Berkovec and Fullerton, 1989; Madsen, 2012; Apergis and Rezitis, 2003; Tsatsaronis and Zhu, 2004; Bork and Muller, 2012).

3.6 Employment

Employment and household income are important factors (see Lerbs 2011; Giussani et al, 1992; Baffoe-Bonnie, 1998). Smith and Tesarek (1991) examined the effect of a real estate activity decrease and found that the latter leads to a decreased employment growth rate. Schnure (2005) concludes that an unemployment rate percentage increase of one unit leads to housing price decrease of 1%. Blanchflower and Oswald (2013) and Oswald (1999) connect the labour mobility and the home ownership rate and find evidence of negative externalities of the housing market on the labour market. They argue that a home-ownership rate increase affects labour mobility and leads to an unemployment rise.

3.7 Demographics

Mankiw and Weil (1989) were the first to study the relationship between demographics and the housing market. An increase in the number of newborns (baby booms) has a small short-term effect on the housing market but it increases demand for new houses twenty years later. A decrease in the number of births or an increase in the average age of population has a strong influence on demand and on the housing prices.

4. The Greek Housing Market

There is an old dictum in Greece saying "*No one lost his money buying land"*. The construction sector (specially housing) had been a pillar of the Greek economy, strongly connected with many other sectors (up to

2009). Hardouvelis (2009) argues that investing in the housing market was for the Greek household a form of saving. Homeownership rate reaches 73.2% (Fig.1) while 81.5% of the Greek household assets are related to housing. The housing investments reached their peak in 2006 representing 11.8% of GDP (Sampaniotis and Hardouvelis, 2012).

Davrakakis and Hardouvelis (2006) draw the following conclusions for the Greek household behavior before 2009: (i) in the urban areas two out of three dwellings are home owned, (ii) two thirds of the new buyers were ex-renters while half of them had already a private property, (iii) in the years 2004 & 2005 the mortgage interest rates were on a decrease while the rents were rising. From 2006 to 2010 homeownership was rising by 3.5% per year, (iv) eight out of ten households expected house prices to increase for the next year as well as for the next four years, (v) the Greek households were filled with optimism about the housing market future and the 78% of the sample rated it as a secure investment, (vi) housing supply was inelastic since 90% of the respondents weren't intended to sell their home, although the prices were continuously rising.

4.1 Macroeconomic Determinants of the Housing Market in Greece

The main reasons for the price rise of the period 1997-2002 were the deregulation of the bank sector, the convergence of the Greek economy with the rest of the eurozone, the prosperous macroeconomic environment, the inflation decline and finally the loan interest rates decrease (Simigiannis and Hondroyiannis, 2009).

Simigiannis and Hondroyiannis (2009) examine whether a bubble was present by applying the user cost model. No evidence emerged of an increased price to rent ratio or that the housing prices were overestimated. The same holds when using the McQuinn and O'Reilly (2006, 2007) model.

Apergis and Rezitis (2003) analyzed the dynamic effects of the macroeconomic variables on the housing prices in Greece. Their findings suggest that the housing prices respond to the examined macroeconomic variables (interest, inflation, employment, money supply). Interest rates followed by inflation and the employment rate were found to be the most important while money supply were not found to be significant. Brissimis and Vlassopoulos (2007) examined the connection between mortgages and housing prices in Greece and couldn’t find a long term causal relationship from mortgages to prices, although in the short-run evidence of a bi-directional relationship was found. Merikas et al (2010) developed an equilibrium model for the Greek housing market and concluded that construction and the labour cost have a positive effect on the house prices while interest rates and the non-construction investments negative. The latter is accordant with the crowding-out effect when the rest of the economy is deprived of investment funds. Finally, Katrakilidis and Trachanas (2012) using a non-linear cointegration model for the period 1999-2011 found asymmetric long-term effects of CPI and industrial production on the housing prices.

4.2 The causes of the crisis in the Greek Housing Market

According to Alpha Bank (2012, 2013) the main causes of the crisis are: (i) the excessive demand of dwellings and houses, the increasing stock and the fall of the demand, (ii) lack of liquidity in the Greek economy, (iii) lack of positive prospects for the future of the housing market, (iv) the high unemployment rate, (v) the general adverse economic environment in Greece and (vi) the excessive tax burdens of the private property.

Table 2 summarises the literature on the Greek housing market. *Please see Appendix for Table 2*

5. Empirical Analysis

5.1 Variables and Data

The empirical analysis of the Greek Housing Market employs monthly data for the period 1997:M1 to 2013:M12. Following the literature we have focused on the following variables: House Price Index (HPI), Consumer Price Index (CPI), Industrial Production Index (IP), volume of Retail trade (RETAIL), loan interest rate (INTEREST), annual growth rate of mortgages (MORTGAGE), money supply growth rate M1 (M1) and the Unemployment rate (UNEMPL)1.

The quarterly data set for the HPI is provided by the Bank of Greece (BoG) and refers to the urban areas and covers the time period 1997-2013 (the frequency conversion was done in EViews). The interest rate is

[1] All logged unless they are growth rates.

the bank interest rate on loans from the domestic credit institutions to non- financial corporations (BoG, 2012). This is used as a proxy for the mortgage interest rates (the availability of this series is limited) and their correlation coefficient for the overlapping period is r=0.922. The interest rate is the nominal one to take into account the money illusion effect. The other factors, CPI, RETAIL and IP (excluding the construction sector), were obtained from the OECD and the mortgage flows and the money supply M1 growth rate were obtained from the BoG. All the variables were seasonally adjusted nominal values (original or using U.S. Census Bureau's X12 seasonal adjustment method). Table 3 presents the descriptive statistics.

Please see Appendix for Table 3

5.2 VECM Model

We start the analysis with the unit root tests. Table 4 presents the Phillips-Perron test, (Phillips and Perron, 1988) and the Unit Root Test with Structural Break (Saikkonen and Lutkepohl, 2002; Lanne et al, 2002) and all the variables appear to be I(1). The cointegration test is based on Johansen (1995). The Akaike information criteria (AIC) determines the lag order. The results are presented in Table 5. The trace test indicates the presence of one cointegration vector at the 5% level of significance.

We employ a two stage estimation procedure discussed in Lütkepohl and Krätzig (2004) that allows us to account for the exogenous variables[2]. This approach requires estimation in two stages. In the first stage, the cointegration matrix has to be estimated. All exogenous variables are eliminated from the model for performing this step (S2S estimator). In the second stage the exogenous variables can be accounted for and OLS for each individual equation is used. The error correction model includes a linear deterministic part. Money supply M1, the unemployment rate and the interest rate are treated as exogenous and enter in the short-term relationship but not in the long-run. The estimated equation can be written as:

$$\Delta y_t = \alpha\beta^{*'}\begin{bmatrix} y_{t-1} \\ D_{t-1}^{co} \end{bmatrix} + \sum_{i=1}^{p} \Gamma_i \Delta y_{t-i} + \sum_{i=0}^{q} \Theta_i x_{t-i} + CD_t + u_t \quad t = 1, \dots, T \qquad (1)$$

where: y_t is the vector of (1) endogenous variables: $y_t = \begin{bmatrix} HPI \\ IP \\ MORTGAGE \\ RETAIL \\ CPI \end{bmatrix}$, x_t the vector of exogenous variables: $x_t = \begin{bmatrix} M1 \\ UNEMPL \\ INTEREST \end{bmatrix}$, D_t the vector of the deterministic terms: $D_t = [SHIFT]$, Γ_i the matrix of endogenous variables coefficients, Θ_i the matrix of exogenous variables coefficients, C the matrix of deterministic terms coefficients, D_{t-1}^{co} the vector of the

[2] Interest rates are set by the ECB and most likely do not reflect the economic conditions of a small peripheral economy. Together with M1 and the unemployment rate will be treated as exogenous.

deterministic terms included in the cointegration relations, β^* the coefficients vector $\beta^* = \begin{bmatrix} \beta \\ \eta \end{bmatrix}$, β the cointegration vector, η the coefficient matrix of the deterministic terms, α the adjustment (loading) coefficients vector and u_t the disturbance terms vector

The VECM estimates for the cointegration equation are presented in Table 6. The long-run relationship is expressed by the following equation (standard errors in brackets):

$$HPI = \underset{(0.094)}{0.352}IP + \underset{(0.001)}{0.005}MORTGAGE + \underset{(0.055)}{0.784}RETAIL + \underset{(0.320)}{2.582}CPI - \underset{(1.312)}{11.346} - \underset{(0.001)}{0.003}t \quad (2)$$

The results reveal that all the cointegration vector coefficients of the model and the adjustment factor of HPI (α=-0.031) are statistically significant. The latter implies that the error correction mechanism is rather slow. The signs of the coefficients are in line with the literature. All the determinants have a positive effect on housing prices. However the IP coefficient doesn't confirm a crowding-out effect.

The cointegration relation is plotted in Figure 2:

$$\hat{z_t} = \beta^{*'} \begin{bmatrix} y_{t-1} \\ D_{t-1}^{co} \end{bmatrix}$$

$$\hat{z}_t = HPI - \underset{(0.094)}{0.352}IP - \underset{(0.001)}{0.005}MORTGAGE - \underset{(0.055)}{0.784}RETAIL - \underset{(0.320)}{2.582}CPI + \underset{(1.312)}{11.346} + \underset{(0.001)}{0.003}t \quad (3)$$

This $z\hat{}$ graph expresses the error correction term in the reference period. In the period 2007-2013 the prices were above the level which is defined by the market fundamentals used in the model, while in the

period 1997-2006 were slightly below. There is no indication of an overestimated Greek housing market and for the first years of the crisis (2007-2010) the housing prices show a sign of rigidity, as they fail to adjust to the new market conditions.

Regarding the causal relationship in the long-run, Table 6 presents the loading factors and shows that for mortgages and CPI the coefficients are statistically insignificant, implying that a change of the housing price index will not affect these variable, therefore the causal relationship doesn't have a direction from the HPI to mortgages and CPI. As a result these variables could be treated as weakly exogenous. The same doesn't apply for IP and RETAIL. In the other direction any variable change has an effect on HPI. The instantaneous and Granger causality tests are reported in Table 7. In the short run MORTGAGE, CPI and RETAIL Granger-cause HPI.

(Please see Appendix for Figure 2 and Tables 4, 5, 6, 7)

5.3 Dynamic Analysis

Table 8 present the results of the variance decomposition (Cholesky decomposition). The total variance of HPI is decomposed in each period of the forecast horizon and we measure the percentage of this variance that each variable can explain. For the first quarters the highest

explanatory power is attributed to own shocks but three years after the shock mortgages and RETAIL account for more variation (29% for both) in houses prices than the variation which is produced by shocks to IP or CPI (9% combined). One could argue that (i) house prices are rigid especially in short horizons and (ii) mortgage flows and RETAIL are the variables that can explain 29% of the HPI variation three years after the shock.

The impulse response functions assess the dynamic behavior of the model by examining the response of a variable after shocks to the other variables. Generalized Impulse responses (GIRF) are employed and bootstrapped standard errors are reported. Figure 3 reveals similar results with the variance decomposition method. The housing price index responds to mortgage, CPI and RETAIL shocks leveling off after 36 months from the initial shock, while shocks to IP do not cause a statistically significant response of HPI.

Please see Appendix Figure 3 & Table 8

6. Conclusions

This study examines the long-run determinants of the housing market in Greece by employing a two stage VECM estimation approach that allows us to consider exogenous variables as well. First we find that an equilibrium relationship exists. In the long-run the direction of causality is from the mortgages and the retail trade to housing prices. In the short run mortgages, CPI and retail Granger-cause HPI. Retail trade emerges as the most important variable in the long-run. This is followed by mortgage loans. Dynamic analysis (variance decomposition and GIRF)

reveals that the housing price index responds to mortgage, CPI and retail trade shocks, while shocks to IP do not affect HPI in a significant way. House prices are not affected by movements in Industrial Production. The banking sector plays the dominant role for house prices and increase in house prices will not be observed without an increase in mortgage loans. Overall, mortgage loans and retail trade are the variables to watch if you want to forecast house prices in Greece.

Appendix 1- Tables and Figures

Table 1: Literature Review

Title	Authors	Data	Methodology	Conclusions
House Price Developments in Europe : A Comparison	Hilbers et al (2008)	Indices: HPI, Income, Taxation, Demographics, Rents. EU Countries	User cost approach (P/R)	The model fits most of the EU countries well, capturing the housing market developments.
Do house prices reflect fundamentals? Aggregate and panel data evidence	Mikhed and Zemcik (2009)	Housing Prices, Income, Population, Rents, Interest rates, Construction Cost, Stock market. U.S 1980:Q2-2008:Q2 22 U.S. Metropolitan Statistical Areas for 1978–2007	Present value model	The housing prices do not reflect fundamentals prior to 1996 and from 1997 to 2006. They deviate from their fundamental value and it may take decades to adjust.
Does Housing Really Lead the Business Cycle?	Älvarez and Cabrero (2010)	Spanish Housing Market, GDP components 1980:Q1 – 2008:Q4	Cross correlation Butterworth and Epanechnikov filters	Residential investment leads GDP. Its lead is larger in expansions than in contractions. There is a positive linkage between fluctuation in housing prices and residential construction.
Macroeconomic determinants of international housing markets	Adams and Füss (2010)	Real money supply, real consumption, real industrial production, real GDP, employment, long-term interest rates, construction costs. 1975Q1 to 2007Q2 for 15 countries	Panel cointegration analysis και ECM	House prices increase by 0.6% for a 1% increase in economic activity. The divergence from the long-term equilibrium fully adjusts after 14 years.
Housing market spillovers: Evidence from an estimated DSGE model	Iacoviello and Neri (2008)	USA Quarterly Data 1965:I-2006:IV	Bayesian likelihood approach Dynamic stochastic general equilibrium model	The slow technological progress of the construction sector account for a large share in the housing price upward trend. The residential investments and the housing prices are sensitive to demand shock and to the monetary policy. Housing wealth affects positively and significantly the consumption.
What drives housing price dynamics : cross-country evidence	Tsatsaronis and Zhu (2004)	GDP, Interest rates, Spreads, Inflation, Loans 17 Industrial countries 1970-2003	SVAR (structural vector autoregression) framework	Housing prices depend on inflation and credit and they are strongly linked with the short term interest rates.
House prices, money, credit, and the macroeconomy	Goodhart and Hofmann (2008)	Quarterly data for 17 Industrial countries 1970-2006 (money, credit, prices, economic activity)	Fixed-effects panel vector autoregression	There is a multidirectional causality between house prices, monetary variables, and the macroeconomy. The monetary variables are strongly linked with housing prices from 1985 to 2006. In periods of price booms the effects of shocks to money and credit are stronger.
Housing and the Business Cycle	Davis and Heathcote (2003)	USA Data (Tax rate, GDP, depreciation rate, land's share, population growth, etc.). Model period of one year	Cobb-Douglas Equilibrium multi-sector growth model	The volatility of the residential investment is more than twice the volatility of business investment. There is a positive correlation between consumption, residential and non-residential investment. The residential investment leads the business cycle in contrast with the non-residential which lags.
A behavioral model of house prices	Madsen (2012)	18 OECD countries 1995-2007	Repayment model of houses price – equilibrium model	House prices are independent of the rents. The income elasticity of house prices reaches one. In the long run the house prices are driven by the acquisition costs.

Title	Authors	Data	Methodology	Conclusions
Real House Prices in OECD Countries: The Role of Demand Shocks, Structural and Policy Factors	Andrews (2010)	Interest rates, disposable income, CPI, housing prices for 29 OECD countries 1980-2005	VECM (Vector Error Correction Model)	The housing prices rise in proportion with the household income and with declines in the unemployment and real interest rates. Countries with a significant tax relief on mortgage debt financing cost show a tendency for demand shocks.
Taxation and Housing Old Questions, New Answers	Poterba (1992)	USA Data 1980 -1990	User cost approach (P/R)	The housing tax policy is associated with distortions in the user cost of housing and in the housing market
Housing taxation and capital accumulation	Gervais (2002)	USA data, Model period of one year	General equilibrium life-cycle economy populated by heterogeneous agents	The favorable tax treatment of home ownership leads to wealth loss and to crowding-out effects. Taxation of imputed rents or no deductible mortgage interest rates are suggested.
Housing and the Economy : After the Short Run	Order Van (2007)	Theoretical approach	Growth model Long Run Equilibrium	Reductions of taxes on the business capital increase the housing stock and the non-housing consumption. Not taxing the imputed rents increases the housing stock and decreases the business capital which later returns to its initial level.
Money and housing – evidence for the euro area and the US	Greiber and Setzer (2007)	Euro area 1981-2006 USA 1986-2006 Quarterly data for M3, GDP, housing prices, interest rates.	VECM (Vector Error Correction Model)	Loose monetary policy is related with the rise of housing prices. There is a bi-directional connection between the money and the housing market.
Housing, credit, and real activity cycles: Characteristics and comovement	Igan et al (2011)	Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Spain, Switzerland, the United Kingdom, and the United States 1981:Q1 to 2006:Q4	Generalized dynamic factor model (GDFM)	In the long run the housing price cycles lead the credit and the real activity while in the short run it depends on the country.
Housing and Debt Over the Life Cycle and Over the Business Cycle	Iacoviello and Pavan (2011)	U.S Economy, 1952-2010	Quantitative general equilibrium model	In high leverage conditions the housing market responds more and it is more vulnerable to negative shocks than positive. (Nonlinearity)
On the Relationship between Credit and Asset Prices	Panagiotidis et al (2008)	UK & US 1964Q4-2004Q1. Data: GDP, mortgages, housing prices, stock market	VECM (Vector Error Correction Model)	Existence of a stable house price model in the UK and of a stable stock prices model in US. Both countries are characterized by a larger effect of housing prices compared to the effect of stock prices.
The Role of Interest Rates in Influencing Long-Run Homeownership Rates	Painter and Redfearn (2002)	Quarterly data for USA 1965-1999. (interests, prices, income, demographics etc)	VECM (Vector Error Correction Model)	Short term changes in income or interest rates do not affect the home ownership rate, Interest rates show short run impacts on housing starts. In the long run the highest explanatory power over home ownership rate belongs to the demographics and to the rising income.
Financial Structure and the Impact of Monetary Policy on Asset Prices	Assenmacher-Wesche and Gerlach (2008)	CPI, GDP, interest rates, prices, stock market index for 17 countries 1986 - 2006	VAR models for individual countries & panel VAR	There is a large influence of the monetary policy over the residential property prices. An interest rate increase of 2,5% decreases GDP by 1,25% and the property prices by 3,75% .
House Prices and Interest Rates: A Theoretical Analysis	Guler, and Arslan (2010)	Real Interest rates & Housing prices	Two-period overlapping-generations model populated	High or low housing stock in different periods (effective housing supply) has an ambiguous effect on the housing price behavior in response to fluctuations in interest rates.

Title	Authors	Data	Methodology	Conclusions
Empirical evidence on the reaction speeds of housing prices and sales to demand shocks	Oikarinen (2012)	Housing price, Sales volume, Aggregate income, Loan-to-income ratio, User cost %, Housing stock for Finland 1988-2008	VECM (Vector Error Correction Model)	The prices respond slower to demand shocks than the sales do. The sales volume can be used as an indicator of demand's change and as a predictor of house prices movements.
Money Illusion and Housing Frenzies	Brunnermeier and Julliard (2008)	U.K. housing market (1966:Q2–2004:Q4)	Vector Autoregression (VAR) approach	It's the nominal interest rate and not the real which affects the housing price to rent ratio. A large share of the variation of the mispricing is due to movements in inflation.
The Long-Run Relationship between House Prices and Rents	Gallin (2008)	USA 1970:Q -2003:Q4 1970:Q1 - 2001:Q4	P/R ratio Campbell and Shiller's (2001) Mark's (1995)	The P/R ratio is a measure of valuation of the housing market and high values indicate a sign of a "bubble". However it can't predict precisely the direction, the time and the value of the housing prices.
The Dynamic Impact of Macroeconomic Aggregates on Housing Prices and Stock of Houses : A National and Regional Analysis (1998)	Baffoe-Bonnie (1998)	USA 1973:1-1994:4 (housing stock, prices, interest rates, CPI, employment, money supply)	Vector Autoregression (VAR)	The housing market is sensitive to fluctuations in the employment growth rates and interest rates at national and regional levels.
Does housing drive state-level job growth? Building permits and consumer expectations forecast a state's economic activity (2012)	Strauss (2012)	USA 1969:1-2010:4	ARDL model	The number of building permits can predict the growth of the construction activity, is a sign of future employment growth and it leads housing prices and wealth.
Housing price volatility and its determinants	Lee (2009)	Quarterly data (prices, CPI, income, population, interests, unemployment) for Australia 1987:Q4 - 2007:Q4.	Exponential-generalized autoregressive conditional Heteroskedasticity (EGARCH) model	Volatility clustering effects and asymmetric shocks were found in many cities. Inflation is the main determinant of housing price volatility.
The baby boom, the baby bust, and the housing market	Mankiw and Weil (1989)	Στοιχεία ΗΠΑ 1947-1987	User cost approach (P/R)	There are no immediate effects on the housing market after an increase in the number of births, but after 20 years the demand increases. The number of births is a leading indicator of future changes in the housing demand.
How Long Do Housing Cycles Last ? A Duration Analysis for 19 OECD Countries	Bracke (2011)	Quarterly data 1970:1-2010:1 for 19 OECD countries	Linear Probability Model (LPM)	Upturns last longer than downturns. An increasing duration of the upturns makes them more likely to end Thus an overheated economy faces the potential to enter a downturn.
Wealth Effects Revisited 1975-2012	Case, Karl E., Quigley, John M. and Shiller, Robert J. (2013)	Quarterly data from 1795 to 2012 for a panel of U.S State	OLS and ECM models	There is a large effect of housing wealth on housing consumption, larger than the effect of stock market. When housing prices increase the household spending increases, when they decrease they affect negatively the household consumption.

Table 2: Literature Review of the Greek Housing Market

Title	Authors	Data	Methodology	Conclusions
Housing prices and macroeconomic factors in Greece: prospects within the EMU	Apergis and Rezitis (2003)	Quarterly data of interest, inflation, employment, money supply, housing prices for Greece 1981-1999.	VECM (Vector Error Correction Model)	The prices respond to the macroeconomic variables. The highest explanatory power belongs to the interest rates followed by inflation and employment whereas lower is the contribution of the money supply.
Τιμές κατοικιών: Η πρόσφατη ελληνική εμπειρία	Simigiannis and Hondroyiannis (2009)	Quarterly data for Greece 1994:Q1-2007:Q4	User Cost Fully Modified Ordinary Least Squares ECM (Error Correction Model)	There are no signs of housing overpricing in the recent past. The elasticity of housing price to mortgage value comes to 0,78. The causal relationship between loans and housing prices appear to be bidirectional.
The interaction between mortgage financing and housing prices in Greece	Brissimis and Vlassopoulos (2007)	Quarterly data of GDP, interests, mortgages, for Greece 1993:Q4-2005:Q2	VECM (Vector Error Correction Model)	There are no results of a long term causal relationship from mortgages to the housing prices while in the short run these is evidence of a bidirectional relation between the two variables.
Explaining house price changes in Greece	Merikas et al (2010)	Quarterly data for Greece 1985:Q1-2008:Q1	FDW model VECM (Vector Error Correction Model)	The construction and the labor cost are affecting positively the prices whereas the interest rates and the non-construction production negatively (crowding out). There is evidence of substitution between the stock market and the housing market in Greece.
What drives housing price dynamics in Greece: New evidence from asymmetric ARDL cointegration	Katrakilidis and Trachanas (2012)	Monthly data of prices, CPI, industrial production for Greece 1999:M1-2011:M5	Asymmetric ARDL cointegration methodology	Asymmetric long-term effects of CPI and IPI on housing prices. In the short run the asymmetric effects on the prices are statistically significant.

Table 3: Descriptive Statistics

	HPI	IP	MORTGAGE	RETAIL	CPI	M1	UNEMPL	INTEREST
Mean	5.218237	4.687843	19.11426	4.534164	4.484666	5.860784	12.53573	9.254345
Median	5.253439	4.735396	23.57232	4.541165	4.491741	5.900000	10.60000	7.496467
Maximum	5.570781	4.822417	40.84383	4.848116	4.706811	38.40000	27.70000	19.70000
Minimum	4.561120	4.431090	-3.721505	4.252772	4.201898	-17.30000	7.400000	5.722567
Std. Dev.	0.289692	0.111782	13.53631	0.165307	0.152706	10.90306	5.376480	3.902506
Skewness	-0.682336	-0.910458	-0.534905	0.060629	-0.133081	0.093267	1.845845	1.479799
Kurtosis	2.360679	2.524601	1.931786	1.844874	1.754847	3.025883	5.091084	3.669649
Jarque-bera	19.30400	30.10477	19.42740	11.46667	13.78061	0.301455	153.0103	78.26500
Probability	0.000064	0.000000	0.000060	0.003236	0.001018	0.860082	0.000000	0.000000
Sum	1064.520	956.3199	3899.308	924.9694	914.8718	1195.600	2557.289	1887.886
Sum Sq. Dev.	17.03602	2.536542	37196.03	5.547262	4.733797	24131.97	5868.028	3091.599
Observation	204	204	204	204	204	204	204	204

Table 4: Unit Roots and Stationarity Tests

Variable	Phillips-Perron		UR Test with Str. Break		Structural Breaks	
	Levels	Difference	Levels	Difference	Levels	Difference
HPI	-3.00**	-3.16**	-1.34	-3.35**	2009M1	2009M1
IP	-0.143	-26.62***	-1.35	-6.03***	2008M2	2011M8
MORTGAGE	-0.04	-12.05***	-1.66	-5.89***	2001M3	2002M1
RETAIL	-0.87	-18.86***	-0.87	-6.12***	2010M4	2008M11
CPI	-2.75	-13.43***	-1.05	-5.28***	2011M9	2011M9
M1	-2.30	-15.87***	-2.09	-4.18***	2000M3	1999M12
UNEMPL	2.01	-10.46***	-1.68	-2.83*	2004M1	2004M2
INTEREST	-3.64***	-13.33***	-0.43	-5.95***	1997M11	1997M11
Critical Value 1%	-3.46	-3.46	-3.55	-3.55		
Critical Value 5%	-2.88	-2.88	-3.03	-3.03		
Critical Value 10%	-2.57	-2.57	-2.76	-2.76		

Note: The UR Test with Structural Break is proposed by Saikkonen and Lutkepohl (2002); Lanne et al (2002) (Ho: unit root), Phillips-Perron test (Ho: unit root), *** (**, *) rejects the null hypothesis at the 1% (5% and 10%) level, Phillips-Perron test includes a constant term and the Structural Break test a constant term, a time trend and seasonal dummies.

Table 5: Johansen Cointegration Test

Ho: Rank	Trace Value	*p*-Value	90%	95%	99%
0	96.56	0.0109	84.27	88.55	96.97
1	59.55	0.1083	60.00	63.66	70.91
2	35.63	0.2230	39.73	42.77	48.87
3	21.14	0.1761	23.32	25.73	30.67
4	9.05	0.1821	10.68	12.45	16.22

Note: 1. 5 included lags (levels) based on Akaike Information Criterion, 2. Trend and intercept included 3. Sample range: [1997 M6, 2013 M12], T = 199, 4. Critical values from Johansen (1995) and the *p*-values are from Doornik (1998).

Table 6: VECM Long run coefficients - Diagnostic Tests

Cointegrating Eq:	HPIt-1	IPt-1	MORTGAGEt-1	RETAILt-1	CPIt-1	CONSTANT	TRENDt-1
	1.000	-0.352	-0.005	-0.784	-2.582	11.346	0.003
	(0.000)	(0.094)	(0.001)	(0.055)	(0.320)	(1.312)	(0.001)
	{0.000}	{0.000}	{0.000}	{0.000}	{0.000}	{0.000}	{0.000}
	[0.000]	[-3.744]	[-7.811]	[-14.273]	[-8.070]	[8.650]	[3.973]
Loading factors:							
	-0.031	0.205	-4.342	0.532	-0.007		
	(0.014)	(0.093)	(3.479)	(0.103)	(0.012)		
	{0.032}	{0.027}	{0.212}	{0.000}	{0.537}		
	[-2.147]	[2.209]	[-1.248]	[5.156]	[-0.617]		
ARCH-LM test (32 lags):	{0.1876}	{0.8572}	{0.0000}	{0.9604}	{0.0613}		
Multivariate ARCH-LM test (5 lags):	{0.4747}						
LM-Type test for autocorrelation (5 lags):	{0.0551}						

Note: Standard errors in ( ), p-values in { } and t-statistics in [ ]

Table 7: Causality Tests from the VECM Model

Cause Variables:	Δ(HPI)	Δ(IP)	Δ(MORTGAGE)	Δ(RETAIL)	Δ(CPI)
Effect Variables:	Δ(IP)	Δ(HPI)	Δ(HPI)	Δ(HPI)	Δ(HPI)
	Δ(MORTGAGE) Δ(RETAIL) Δ(CPI)	Δ(MORTGAGE) Δ(RETAIL) Δ(CPI)	Δ(IP) Δ(RETAIL) Δ(CPI)	Δ(IP) Δ(MORTGAGE) Δ(CPI)	Δ(IP) Δ(MORTGAGE) Δ(RETAIL)
Granger Causality	0.0002*	0.1722	0.0051*	0.0122*	0.0469*
Instantaneous Causality	0.0035*	0.0658	0.0505	0.8277	0.8526

Note: only p-values are reported, Granger Test, H0: doesn't Granger cause, Instantaneous Test, H0: No instantaneous causality, * rejects the null hypothesis at the 5% level

Table 8: Forecast Error Variance Decomposition of HPI

FORECAST HORIZON	HPI	IP	MORTGAGE	RETAIL	CPI
3	0.97	0.00	0.01	0.00	0.01
6	0.92	0,00	0.04	0.01	0.02
9	0.85	0.01	0.08	0.03	0.03
12	0.79	0.01	0.11	0.05	0.04
15	0.75	0.01	0.13	0.06	0.05
18	0.71	0.01	0.15	0.07	0.06
21	0.69	0.01	0.16	0.08	0.07
24	0.67	0.01	0.17	0.09	0.07
27	0.65	0.01	0.17	0.09	0.07
30	0.64	0.01	0.18	0.09	0.08
33	0.63	0.01	0.18	0.09	0.08
36	0.62	0.01	0.19	0.10	0.08

Note: The columns give the proportion of forecast error in HPI accounted for by each endogenous variable

Fig. 1: Home Ownership Ratio

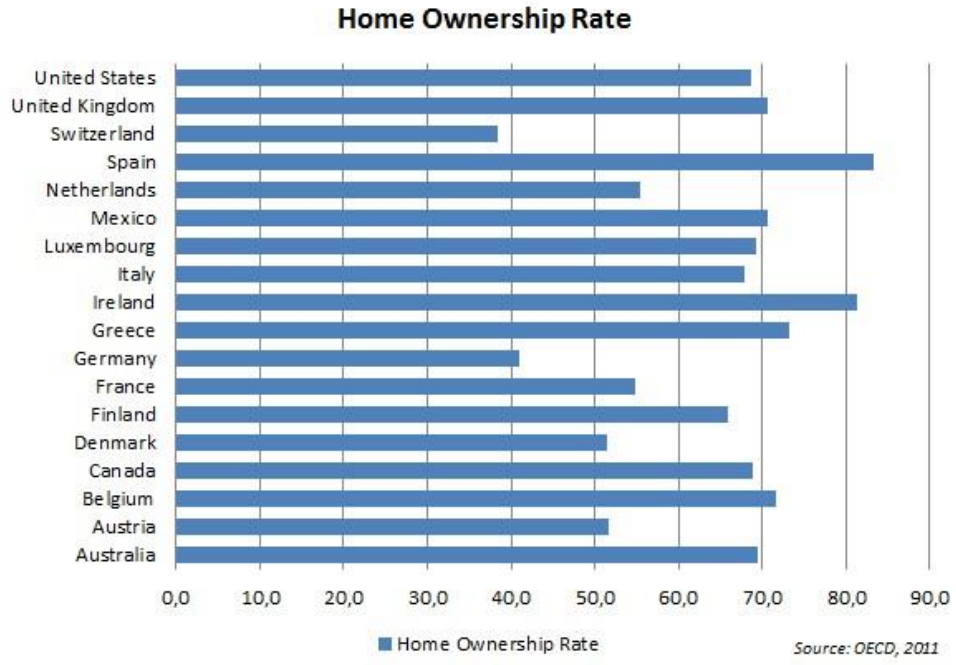


Figure 2: Cointegration Graph

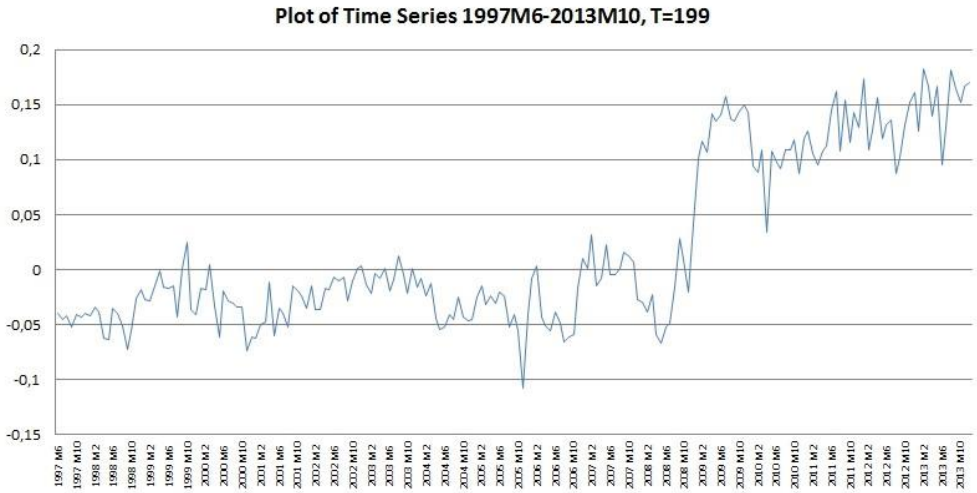
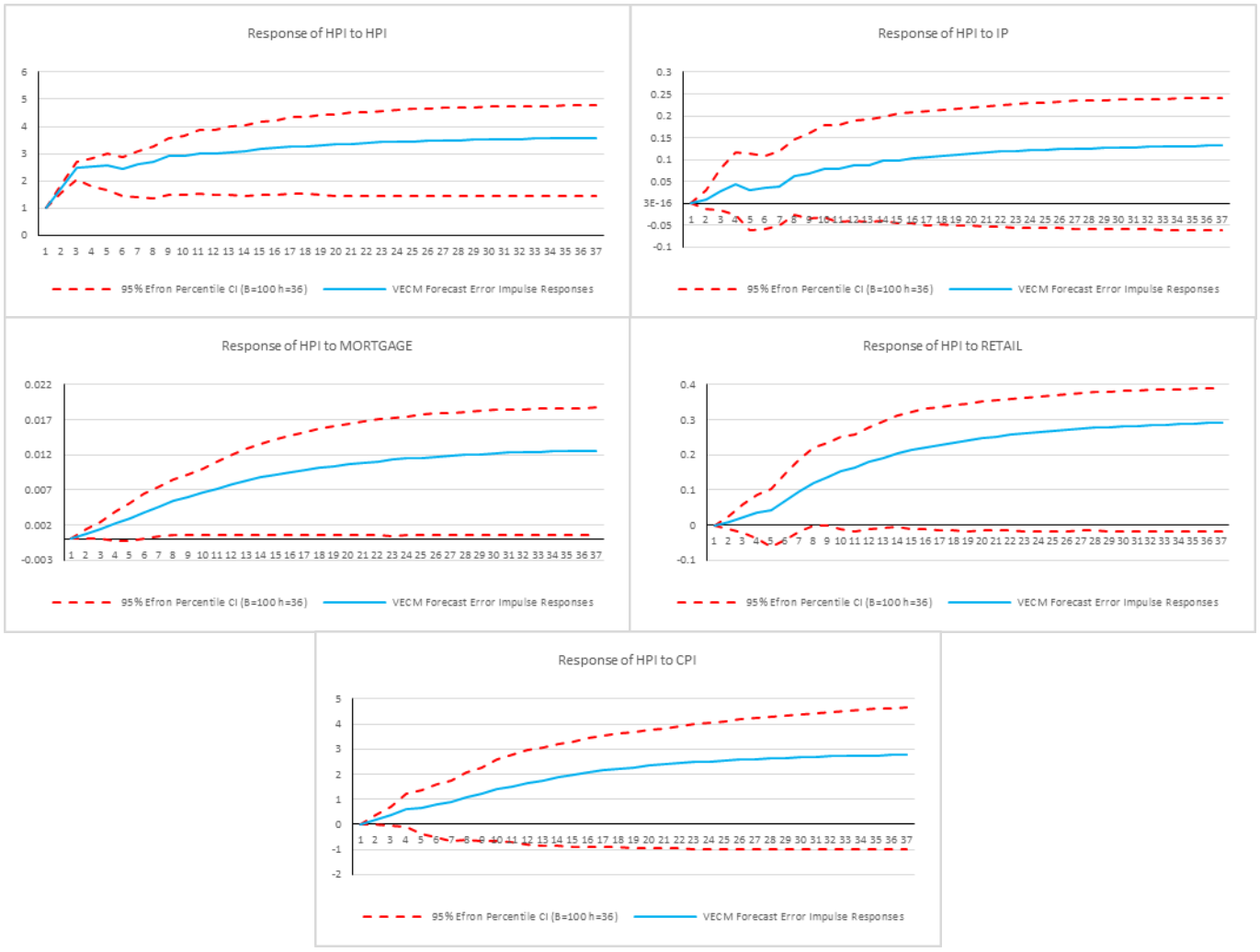


Figure 3: Impulse Responses



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