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An Empirical Investigation on the European Housing Market Prices

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Abstract: Although the housing market prices and trends have been the object of a great deal of studies in the last decade, since the 2007-2008 financial crisis, a unifying and commonly accepted interpretation for them is still missing. In this paper we introduce an empirical and heuristic approach to analyze the price of the European housing market relative to the stock market, consistent with a general equilibrium approach, on the basis of a set of theoretically relevant variables. We perform panel data estimates (with GMM-DIF) of the relative price of the real estates for the 15 countries that were members of the EU on the 1st of January 1995, using annual data from 1993 to 2015. We follow, in this regard, the "general-to-specific" approach and GMM-diff estimating methodology. Our results show that the relative price of the real estates is not only affected by the fundamentals, but also displays a strong influence of autoregressive and "self-sustaining" mechanism in the relative prices.

Keywords: Aggregate real estate markets; Housing demand; Housing supply and prices; Housing investment yield

JEL Classification: R21, R31, E22

1. Are Real Estate Prices a Puzzle?

A long-lasting speculative bubble in the housing market was one of the main causes of the great recession. Since then, the real estate market prices have been the object of an increasing number of papers, where the possible links between the dynamics of the housing sector and the macro-economy go well beyond the role that an expansionary monetary policy might have played in 2007 in bursting the housing bubble, as shown by McDonald and Stokes (2013), Baldini and Poggio (2014) and Jones and Richardson (2014). Some of these links between housing and financial markets are rather obvious: real estate prices are related to the value of bank loans' collaterals and, hence, to the macro-economy, through the stability of the banking sector (Koetter and Poghosyan, 2010), the economic growth[1] and, more interestingly, through the macroeconomic tensions induced by the housing sector in the financial markets. In this regard, Bunda and Ca' Zorzi (2009) find that large current account deficits, decreases in price competitiveness and high public debt-to-GDP ratio, increase the probability that lending or housing boom be accompanied by financial market tensions shortly after expansions. Furthermore, housing ownership could be, in principle, associated to financial instruments allowing to borrow against home equity, although some empirical research show that elderly people (potentially more interested in this kind of contracts) do not seem to be very keen on them (see Fornero *et al*., 2011).

Another well-known and, obviously, completely different perspective is provided by the hedonic approach, a mainly microeconomic framework that allows to formalize and measure the impact of the specific features of each housing unit on its price (Ekeland *et al.*, 2004; Triplett, 2006; Epple *et al*., 2010; Caglayan and Arikan, 2011; Kuminoff *et al*., 2013; Bruzzo, 2017). In spite of its popularity among professional dealers, it does not carry significant macroeconomic implications for the housing price behavior and its links with the financial markets.

Our paper analyzes instead the determinants of the relative pressure of the housing market and financial markets. In particular, the macroeconomic housing price index is interpreted as the effect of aggregate portfolios investment decisions that include both financial assets and real assets, such as real estates. A measure that compares the stock prices and the real estate prices (like the simple ratio of the two price indexes) may provide information on the relative pressure of the two markets. We use then a general framework allowing to detect and measure the comparative relevance of the fundamentals variables affecting the real estate prices and other phenomena of self-sustaining price dynamic path that might be statistically significant, in spite of not being theoretically associated to the fundamentals of the economy.

The next section briefly surveys some recent macroeconomic contribution on the housing sector; Section 3 introduces the foundations of our approach; Sections 4 and 5 describe our empirical analysis and results; and Section 6 contains some concluding remarks.

2. Housing Market and the Macro-economy

A common feature of the current macroeconomic literature on housing market is focused on the market equilibrium and on the adjustment process that leads the market towards its equilibrium state. This section contains a brief description of this kind of literature, while the next section, by introducing our heuristic approach to the relative price of housing and stock markets, also explains how our interpretation can be consistent with a persistent disequilibrium in the housing market.

The pre-crisis contribution by Egebo *et al.* (1998) introduces an empirical investigation of housing investments for USA, Japan, Germany, France, UK, Italy and Canada, with the aim of providing a micro founded unified framework. Their analysis is based on the assumption that the stock of dwellings depends on the "user cost of housing" and on a set of exogenous variables, which include per capita income, demographic variables and operating and maintenance costs. The whole analysis boils down into a two-equation estimating model for the time paths of housing stocks and market-clearing prices where the real after-tax income and the financial market conditions (captured

[1] In this regard, Miller *et al*. (2011) find a significant effect of "predictable" increase in house pricing on the GDP by using a very detailed dataset containing GDP and housing data for several US urban areas.

by the high significance of the real interest rates for most countries) turn out to be key determinants for residential investments.

Gattini and Hiebert (2010) analyze the housing market with quarterly data (for the period 1970-2009) for the aggregate Euro area by using a vector error correction model (VECM), in order to capture the heterogeneous dynamics across variables. Their focus is not so much on a detailed theoretical micro foundation of a large and diversified set of variables, but, instead, on the co-movement of a few relevant regressors and on the different statistical properties of their long and short run trends. The model displays good forecasting properties and provides larger-scale trends in the euro area housing market.

Another comparative analysis, this time on 18 OECD countries (Australia, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Ireland, Japan, Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, the United Kingdom and the United States), based on a VECM is performed by Arestis and Gonzales (2013), who analyze the behavior of the housing prices with annual data from 1970 to 2011. The most significant and more persistent variable for all the countries is the disposable income, both in the short and in the long run. The second relevant variable is housing investments, while also credit and mortgage interest rate seem to carry a significant effect. The impact of taxation is relevant only in 8 out of 18 countries and, finally, unemployment and demographic factors seem to be less generally significant.

Auterson (2014) provides a forecasting model for housing prices in the UK, based on the micro foundation of the demand for housing services derived from an intertemporal utility maximization under a budget constraint that relates the real price of dwellings, its rate of change and its depreciation rate to the real financial assets, their rate of change, the inflation rate, the real (post-tax) disposable income and the tax-adjusted interest rate for a generic owner. The use of a micro founded model determines, in this case, a trade-off between the precision in the approximation of the variables employed for the estimates and the adherence to the standard “micro foundation” methodology. The final estimation of the housing price model shows that house prices rise faster than income and react to increases in housing supply and household debt relative to income. However, the model performs better in the long run than in the short run.

Gelain and Lansing (2014), using US quarterly data from 1960 to 2013 (even though their descriptive statistics consider US and Norwegian data going back to 1890), provide a comparative analysis of the behavior of the equilibrium price-rent ratio for housing within a standard asset pricing model. They analyze the model performances under the two different cases of rational expectations and “quasi-rational predictions”. Their model also accounts for time-varying persistence and volatility. The interesting result of this paper is that under fully-rational expectations, the model under-predicts the volatility of the U.S. price-rent ratio for reasonable levels of risk aversion.

Furthermore, only a moving-average specification of the model predicts a positive correlation such that agents tend to expect high future returns when prices are high relative to fundamentals. This feature is not only consistent with a wide variety of survey evidence from real estate but also with the well-established evidence on the stock markets, dating back to Chow (1989), who finds that an asset pricing model with adaptive expectations better performs than a model with rational expectations, for observed movements in U.S. stock prices and interest rates. In this regard, Huh and Lansing (2000) show that a model with backward looking expectations better predicts a temporary rise in long-term nominal interest rates in the US. More generally, moving-average forecast rules or adaptive expectations have been incorporated into conventional models Sargent

(1999, Chapter 6), Evans and Ramey (2006) and Huang, *et al*. (2009). In this regard, Granziera and Kozicki (2015) employ a model of not fully rational expectations that is actually able to explain the evolution of the average housing price-to-rent ratio, but does not explain the large and persistent fluctuations in the real estate market over the last decades and for this purpose the two authors introduce a model a rational bubble.

Finally, the detailed methodological survey by Ghysels, *et al.* (2013) on the statistical properties of housing price indexes seems to be consistent with the above mentioned contributions on the relevance of backward looking or moving average expectations models. Besides, it might contribute to provide a theoretical rationale to the extensive empirical literature on the so-called "technical analysis" of the financial markets, which focuses on the magnitude and intensity of price variances of financial and real assets compared to previous observable trends, by reflecting, in this way, the common professional practices of financial market operators.

Turning now to the empirical behaviour of our data, Figure 1 below shows that the trends of the real estate price index and the main national stock price index have roughly a similar time path in almost all countries, with only very few exceptions[2].

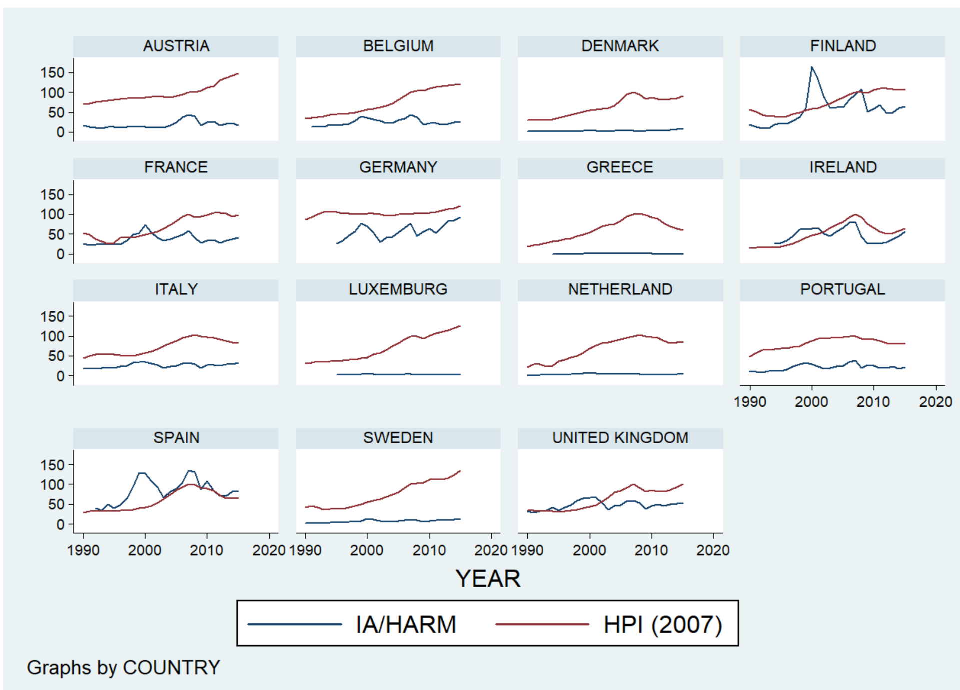

Figure 1. Comparing the harmonized stock price index at current prices, and the price index of housing (base year 2007)

2 Stata elaboration of the dataset composed by ECB and IMF data. The graph shows, for the 15 countries belonging to the European Union in 1993, the comparison between the harmonized stock index trends (IAHARM) and the house price index (HPI2007) - already harmonized with reference the base year 2007- for the time period 1993 to 2015 on an annual basis.

3. Excess Return on the Real Estate Market: An Unconventional and Heuristic Analysis

The housing bubble at the origin of the Great Recession has been analysed by a very extensive literature, since it is commonly regarded as one of the main causes of the Great Recession. However, the empirical analysis introduced in this paper does not refer to any notion of speculative bubble and is based instead on a particular interpretation of the excess return on the real estate market, defined as a significant appreciation (or depreciation) compared to the value suggested by the fundamentals.

The next step of our heuristic and empirical analysis consists of implementing a model that, instead of interpreting the equilibrium behaviour of the housing market, may explain the relative price of the housing market compared to the financial assets over time. For this purpose, we have introduced a variable given by the ratio between the price index of the real estate market of each EU country and its respective stock market index. Both indexes are harmonized, therefore a change in the ratio of the two indexes captures, in principle, an increase in the prices of housing units over the stock market of each country and this might detect (comparatively speaking) a capital gain.

The point of our empirical analysis is investigating whether and to what extent relative increases or decreases in the housing price indexes (compared to the stock market indexes) may be explained by a set of regressors capturing the influence, on the one hand, of the fundamentals of the economy, on the other hand, of "self-sustaining" and autoregressive price patterns. In particular, the use of a set of nested tests in a general "unrestricted" model yields a more specific and parsimonious specification that allows to compare and assess the relevance of the fundamentals and, on the other hand, of the well-known "self-sustaining" and autoregressive phenomena that have characterized the housing markets from the early 1990' to 2007.

We are using for this purpose a panel of EU countries for the period 1993-2015 and, for each country, the ratio of the real estate price index to the stock price index may be interpreted as the ratio of two asset prices in a context of general equilibrium. We can imagine, for simplicity, that in each country there are three types of assets: liquid financial assets (currency, government bonds and easily marketable debt securities), "less liquid" financial assets (represented by assets traded in stock markets) and "real" property activities. For a given level of financial wealth, according to the Walras law, if two of the three above-mentioned markets for financial assets are in equilibrium, the third market is also in equilibrium and may be omitted. Thus, leaving aside the market of "liquid" financial assets, we may consider two equations of "excess demand" for each of the two remaining assets:

$$\begin{aligned} P_{imm} &= f_1(x_1, x_2, \dots, x_n) \\ P_{shares} &= f_2(z_1, z_2, \dots, z_n) \end{aligned} \tag{1}$$

where P_{imm} is the price index of real estate, $f_1(x_1, x_2, \dots, x_n)$ its excess demand equation, $x_1, x_2, \dots, x_n$ its independent variables; P_{shares} the stock market index, $f_2(z_1, z_2, \dots, z_n)$ its excess demand equation, $z_1, z_2, \dots, z_n$ its independent variables. As shown in figure 1, the two indexes have a relatively similar trend.

The ratio P_{imm}/P_{shares} is a function of both the "fundamentals" $x_1, x_2, \dots, x_n$ of the housing market and of the "fundamentals" ($z_1, z_2, \dots, z_n$) of the stock market. An increase in the ratio can be determined by the "fundamentals" (current and lagged, to the extent that each regressor might affect the dependent variable with a different timing and to the extent that adjustment costs manifest their effect) or be influenced by "self-sustaining" price behaviour, captured by a strong significance of the lagged value of the ratio P_{imm}/P_{shares}. Since we have different simultaneous effects (with potentially different intensities), for our heuristic approach we have chosen a methodology that allows the data to specify the intensity and time length of their effects on the dependent variable: the "General-to-Specific" methodology (Harvey, 1989; Hendry, 1985, 1988).

Following this methodology, we estimate a general "unrestricted" model that includes the relevant regressors, suggested by the theoretical literature, with a suitable number of lags (in our case, two lags, since we are using annual data [3]). Then a set of significance tests allows to find the "redundant" variables in the general "unrestricted" model. The remaining significant regressors are employed for the final and "specific" estimate, that allows the theoretical interpretations of the empirical evidence.

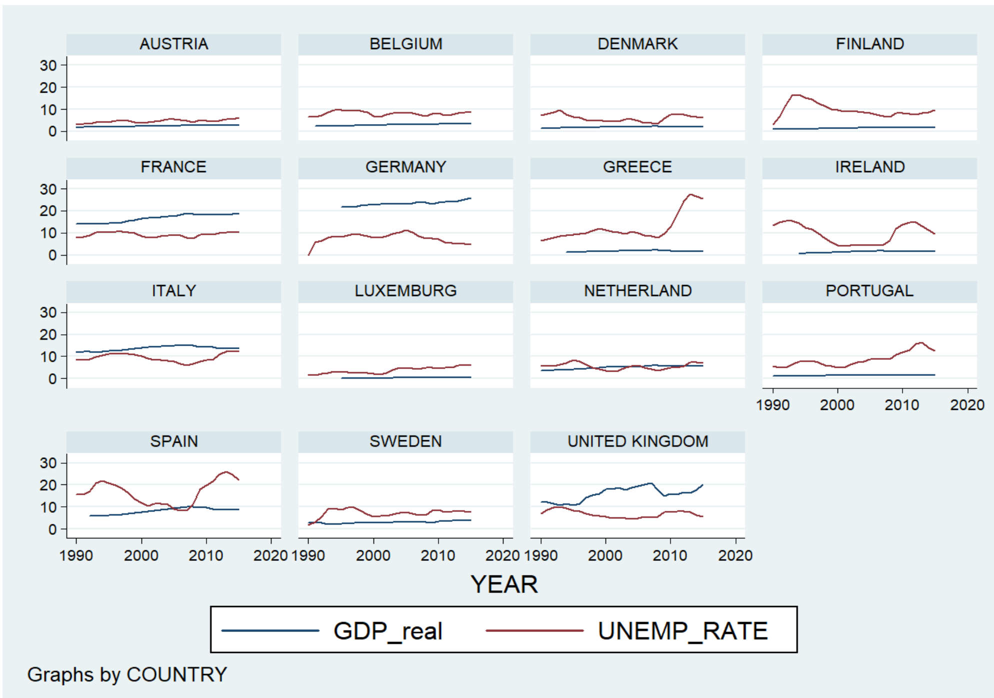

Figure 2. A look at the trends of the national GDP and the unemployment rate[4]

Some of the relevant independent variables may affect both the stock market index and the housing price index. For this reason we are jointly commenting them For what concerns the determinants of the share price, P_{shares}, the short-term nominal interest rate (denominated

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[3] In the above-mentioned contributions by Hendry and Harvey and in later contributions, the suitable number of lags to be employed for the estimates of the general "unrestricted" model was determined by performing preliminary Monte Carlo simulations. Since then, it was common to employ 4 lags when using quarterly data and 12 lags when using monthly data. In our case, since we are using annual data, we are employing two lags, in order to keep a more conservative experimental attitude and in order to be able to properly capture a lag structure that might allow a reparametrization of the estimates with suitable economic interpretation.

[4] Stata elaboration of the dataset composed by BCE and IMF data.

NOM_short_IR), represents the opportunity cost of investing in stocks; the trend of the "yield curve" (YC) is considered as a proxy for the performance of the stock market. For what concerns the determinants of the housing price index, P_{imm}, the demand and the equilibrium price in the real estate market can be affected by the business cycle. The explanatory variables employed for the estimates include the unemployment rate (UNEMP_RATE), which anticipates (albeit very slightly) the trend of GDP as shown in Figure 2. The unemployment rate should therefore be negatively correlated with P_{imm} and with the ratio P_{imm}/P_{shares}. Another theoretically relevant variable is the spread between short-term interest rates and long-term interest rates (SPREAD), which notoriously reflects expectations about future monetary policy and future short-term interest rates. In this respect, the SPREAD variable can also be interpreted as a proxy for the return on investment in housing. Of course, the price of housing should depend negatively on NOM_short_IR, since the variable representing the cost of debt also weighs negatively on the price of housing, as well as on the stock price.

The ratio of government debt to GDP is generally associated to an expansion of the volume of bank loans (Burda and Ca 'Zorzi, 2009; Nobili and Zollino, 2012) and therefore should, in principle, positively affect the demand and price of real estate. On the other hand it should be, in general, negatively correlated to the stock market, which traditionally tends to associate it with a measure of default risk.

The construction costs of housing units have not been included, since, as it is well known, they have not significantly changed in real terms over the time period under consideration.

4. Dataset and the Model

Our empirical analysis is based on a dataset that includes some relevant macroeconomic variable for 15 European countries on an annual basis from 1993 (the year of the Maastricht Treaty) to 2015. The starting year of our series coincides with the creation of the European Union.

The data source is the DATASTREAM database for some variables, the ECB website (European Central Bank) for other variables and the IMF archives (International Monetary Fund) for other variables.

The selected countries were the members the European Union on the 1st of January 1995: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, United Kingdom, Spain and Sweden.

The dependent variable is meant to capture the relative price of the real estate market compared to the stock market. The dynamics of such a variable may potentially detect the excess return of the real estate market, relative to the stock market. Our dependent variable is therefore defined as:

$$HPIIAHARM = \frac{HPI(2007)}{IAHARM} \tag{2}$$

where HPI (2007) represents the price index value of the property market, with 2007 as a reference year, defined “base year”. IAHARM is the relevant stock index[5] harmonized for consumer prices,

5. For the different countries, the following stock indexes were chosen: Austria (ATX), Belgium (BEL20), Denmark (OMXC20), Finland (OMXH25), France (CAC40), Germany (DAX30), Greece (ATHEX20), Ireland (ISEQ index DSE), Italy (FTSE MIB), Luxembourg (LuxX), Netherlands (AEX), Portugal (PSI20), United Kingdom (FTSE100 index), Spain (IBEX35) e Sweden (OMXS30).

also evaluated with respect to the base year 2007. The choice of the base year is not accidental since the year 2007 marks the first tangible hints of the impending crisis. For this reason it can be interpreted as the year of the actual outbreak that marks a significant qualitative change in the economy.

Changes from one year to another in the index HPIIAHARM might capture abnormal time path in the relative price, associated to excess returns in one of the two markets. Following the general-to-specific methodology, we begin by estimating a "general unrestricted" model with 2 lags, since it employs annual data.

$$HPIIAHARM = \alpha_0 + \sum_{i=0}^{2} \alpha_{1,t-i} NOM_{short_{IR_{t-i}}} + \sum_{i=0}^{2} \alpha_{2,t-i} UNEMP_{RATE_{t-i}} + \sum_{i=0}^{2} \alpha_{3,t-i} DEBGDP_{t-i} + \sum_{i=0}^{2} \alpha_{4,t-i} SPREAD_{t-i} + \sum_{i=0}^{2} \alpha_{5,t-i} YC_{t-i} + u_t \quad (3)$$

where u_t is a random shock, NOM_short_IR is the nominal rate of short-term interest; UNEMP_RATE indicates the unemployment rate, i.e. the percentage of unemployed individuals out of the total number of labors in one country; DEBGDP is the ratio of national public debt to gross domestic product, that indicates the overall economic situation; SPREAD represents the spread between the long-term and the short-term nominal interest rates, a variable that capture somehow the agents' expectations about future monetary policies (Shown in Figure 3); YC is the yield curve, that shows the distribution of actual returns of a set of similar bonds, only differing from each other for their maturity. Differently from the variable "SPREAD", YC also contains a proxy for expected changes in the risk premium.

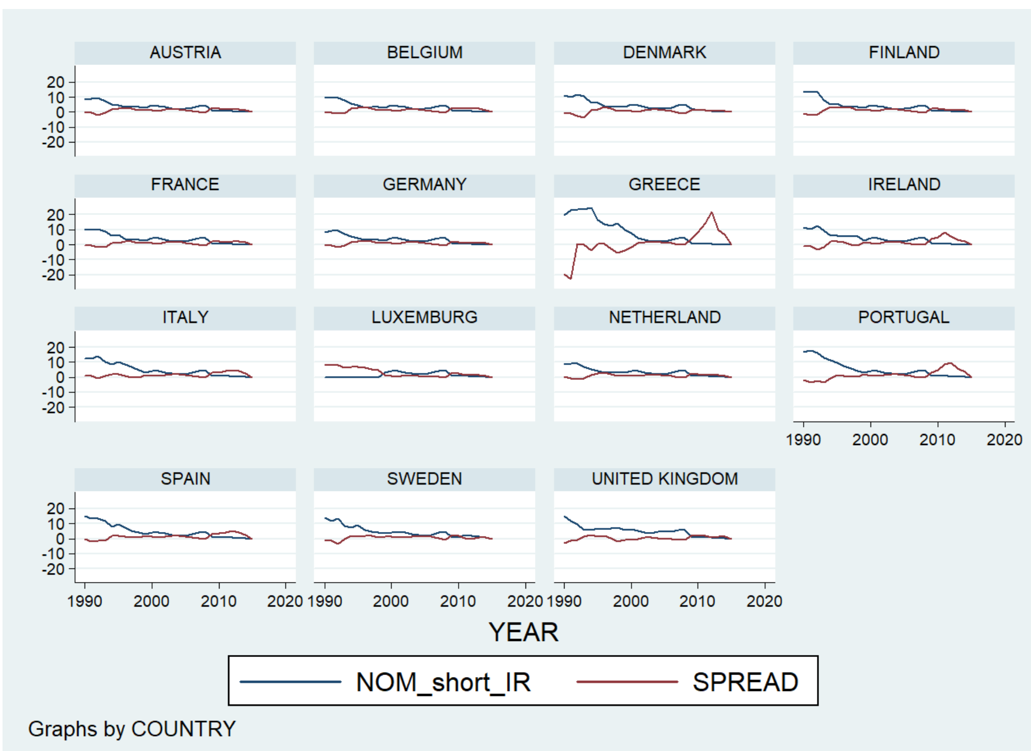

Figure 3. Comparing the trends of short-term nominal interest rate and the spread

We obviously need to make the model dynamic and, in order to perform panel data estimates, we have employed the Generalized Method of Moments (GMM-diff), following the approach suggested by Arellano and Bond (1988), both for the general unrestricted model and for the specific and restricted model.

5. Results of the Estimates

The estimates of the "General unrestricted" model gave the results reported in Table 1 below. As shown in Table 1, regressors are jointly significant, although, as usual, the "general unrestricted" model contains several redundant variables.

The debt/GDP ratio, both contemporary and lagged by 1 and 2 periods, is not significant, although it is a variable that should reflect the degree of systemic risk perceived by investors. This, of course, does not necessarily mean that the risk perceived by investors is not relevant to the financial and real investment decisions, but it simply suggests that the perceived risk does not seem to have a significant impact on the *relative price* of the real estate market compared to the stock market. If, for example, risk had a uniform effect on both the financial and the real market and it had no asymmetric effects on one or another, the excess return would not be significantly influenced by the DEBGDP variable.

Table 1. GMM-diff "general unrestricted" estimating model

Arellano-Bond dynamic panel-data estimation				Number of Obs. = 318		
Group variable: ID				Number of groups = 15		
Time variable: ANNO						
Number of instruments = 84				Wald $\chi^2(17)$ = 2119.48		
One-step results				Prob > $\chi^2(17)$ = 0.0000		
HPIIAHARM	**Coef.**	**Std. Err.**	**z**	***P* > |z|**	**95% Conf. Interval**	
HPIIAHARM$_{t-1}$	1.071***	.056	19.08	0.000	.961	1.182
HPIIAHARM$_{t-2}$	-.5281***	.057	-9.24	0.000	-.640	-.416
NOM_short_IR	8.380***	.882	9.50	0.000	6.652	10.108
NOM_short_IR$_{t-1}$	7.549***	1.280	-5.90	0.000	-1.006	-5.040
NOM_short_IR$_{t-2}$	.4518	1.023	-0.44	0.660	-2.466	1.562
YC	1.039	3.664	0.28	0.777	-6.141	8.220
YC$_{t-1}$	2.358	4.268	-0.55	0.581	-1.072	6.007
YC$_{t-2}$	5.729*	3.206	1.79	0.074	-.555	12.012
UNEMP_RATE	4.798***	1.417	3.39	0.001	2.021	7.574
UNEMP_RATE$_{t-1}$	4.123**	1.834	-2.25	0.025	-7.718	-.528
UNEMP_RATE$_{t-2}$	1.079	1.191	0.91	0.365	-1.255	3.412
DEBGDP	18.468	15.780	1.17	0.242	-12.460	49.396
DEBGDP$_{t-1}$	13.664	17.261	0.79	0.429	-20.167	47.495
DEBGDP$_{t-1}$	7.629	13.717	-0.56	0.578	-34.514	19.257
SPREAD	10.948***	3.710	2.95	0.003	3.678	18.219
SPREAD$_{t-1}$	8.300*	4.359	-1.90	0.057	-1.684	.242
SPREAD$_{t-2}$	1.967	3.257	-0.60	0.546	-8.350	4.416
Cons	17.739***	5.394	-3.29	0.001	-2.831	-7.166

Note: ***, **, and * indicate statistical significance at the level of 1%, 5%, and 10%, respectively.

Even the variable "Dividend Yield", which is a proxy for the performance of the stock market, is not significant (with a confidence level of 95%). Therefore, the excess return on the real estate market seems to be more influenced by other variables (perhaps related to expectations or to mechanisms that are self-sustaining) than by observable remuneration.

Table 2. GMM-diff "specific restricted" model

Arellano-Bond dynamic panel-data estimation				Number of Obs. = 318		
Group variable: ID				Number of groups = 15		
Time variable: ANNO						
Number of instruments = 74				Wald $\chi^2(7)$ = 1896.51		
One-step results				Prob > $\chi^2(7)$ = 0.0000		
HPIIAHARM	**Coef.**	**Std. Err.**	***z***	**P > *z***	**95% Conf. Interval**	
$HPIIAHARM_{t-1}$	.775***	.045	17.30	0.000	.688	.863
$HPIIAHARM_{t-2}$	-.259***	.043	-6.01	0.000	-.344	-.1747
NOM_short_IR	5.565***	.805	6.91	0.000	3.987	7.143
$NOM\_short\_IR_{t-1}$	-3.260***	.781	-4.17	0.000	-4.791	-1.728
UNEMP_RATE	5.039***	1.221	4.13	0.000	2.645	7.433
$UNEMP\_RATE_{t-1}$	-5.630***	1.060	-5.31	0.000	-7.708	-3.553
SPREAD	9.179***	.753	12.19	0.000	7.703	10.655
Cons	-7.200	4.935	-1.46	0.145	-16.872	2.473

Note: *** indicates statistical significance at the level of 1%.

Following the "general-to-specific" methodology and after eliminating the "redundant" variables with a battery of joint significance tests, we could estimate the "specific" or "restricted" model, shown in Table 2 above. The variables are all 99% significant, except for the intercept, kept anyway, as usual.

Re-parameterization and dynamic analysis of the results

The values and signs of the estimated coefficients in Table 2 suggests that the model is suitable for a re-parameterization allowing a dynamic interpretation of the results. In particular, the estimated coefficients for the lagged values in sequence for each regressor have opposite signs. More generally, it is possible to perform the re-parameterization starting from the "specific" and "restricted" model, whose estimates are the following:

$$\begin{aligned} HPIIAHARM = & \underset{(-1.46)}{-7.200} + \underset{(17.30)}{0.775}\, HPIIAHARM_{t-1} - \underset{(-6.01)}{0.259}\, HPIIAHARM_{t-2} + \underset{(4.13)}{5.039}\, UNEMP\_RATE_t \\ & \underset{(-5.31)}{- 5.630}\, UNEMP\_RATE_{t-1} + \underset{(6.91)}{5.565}\, NOM\_short\_IR_t \\ & \underset{(-4.17)}{- 3.260}\, NOM\_short\_IR_{t-1} + \underset{(12.19)}{9.179}\, SPREAD_t + u_t' \end{aligned} \tag{4}$$

where the figures in the brackets refer to the values of the Z-test of significance of each variable and u'_t another random error, different from u_t.

The regressors are jointly significant with a level of confidence higher than 99% and each regressor (with the exception of the intercept) are individually significant with a level of confidence higher than 99%. The absolute value of the coefficient of the regressor $HPIIAHARM_{t-1}$ is larger, in absolute value, than the coefficient of $HPIIAHARM_{t-2}$, which has an opposite sign.

The coefficients of $NOM\_short\_IR_t$ and $NOM\_short\_IR_{t-1}$ have opposite signs, and the coefficient of $NOM\_short\_IR_t$ is larger, in absolute value, than that of $NOM\_short\_IR_{t-1}$.

The coefficients of the regressors $UNEMP\_RATE_t$ and $UNEMP\_RATE_{t-1}$ have opposite signs, the coefficient of $UNEMP\_RATE_t$ is slightly larger, in absolute value, than that of $UNEMP\_RATE_{t-1}$, although very close. For these reasons, having defined the following variables:

$$DHPIIAHARM_{t-1} = HPIIAHARM_{t-1} - HPIIAHARM_{t-2}$$
$$DUNEMP\_RATE_t = UNEMP\_RATE_t - UNEMP\_RATE_{t-1}$$

the "general restricted" estimating model can be re-parametrized as follows:

$$HPIIAHARM = const + \gamma_1 DHPIIAHARM_{t-1} + \gamma_2 HPIIAHARM_{t-1} + \gamma_3 DUNEMP\_RATE_t + \gamma_4 UNEMP\_RATE_{t-1} + \gamma_5 DNOM\_short\_IR_t + \gamma_6 NOM\_short\_IR_t + \gamma_7 SPREAD_t + u'_t \quad (5)$$

The results of the estimates of equation (5) are shown in Table 3 below.

Table 3. GMM-diff estimates of the re-parametrized model

Arellano-Bond dynamic panel-data estimation				Number of Obs. = 318		
Group variable: ID				Number of groups = 15		
Number of instruments = 260				Wald $\chi^2(7)$ = 1793.50		
One-step results				Prob > $\chi^2(7)$ = 0.0000		
HPIIAHARM	**Coef.**	**Std. Err.**	**z**	**P >z**	**95% Conf. Interval**	
DHPIIAHARM$_{t-1}$	.354***	.044	8.08	0.000	.268	.440
HPIIAHARM$_{t-1}$	.580***	.273	21.23	0.000	.526	.633
NOM_short_IR$_t$	1.826***	.401	4.47	0.000	1.026	2.627
DNOM_short_IR$_t$	2.079***	.707	2.94	0.003	.694	3.464
DUNEMP_RATE$_t$	2.288**	.933	2.44	0.014	.452	4.111
UNEMP_RATE$_{t-1}$	-0.648	.422	-1.54	0.125	-1.475	.179
SPREAD$_t$	6.974***	.616	11.32	0.000	5.766	8.101
Cons	-3.218	3.573	-0.90	0.360	-10.221	3.784

Since in the "specific" and restricted model estimated in equation (4), the coefficients β_3 and β_4 of the variables $UNEMP\_RATE_t$ and $UNEMP\_RATE_{t-1}$ respectively display very close absolute values, it is very likely that the difference between the coefficients of these two variables be statistically not significant and/or null. Indeed Table 3 shows that γ_4, the coefficient of $UNEMP\_RATE_{t-1}$ is statistically not significant and rather small in absolute value. This means that the null hypothesis H_0: $\gamma_4 = 0$ cannot be rejected with the level of confidence of 95%, therefore the following second re-parameterized model has been estimated (the results of the estimates are shown in Table 4 below):

$$HPIIAHARM = const + \gamma_1 DHPIIAHARM_{t-1} + \gamma_2 HPIIAHARM_{t-1} + \gamma_3 DUNEMP\_RATE_t + \gamma_5 DNOM\_short\_IR_t + \gamma_6 NOM\_short\_IR_t + \gamma_7 SPREAD_t + u''_t$$

where u''_t is yet another random error.

Table 4. GMM-diff estimates of the second re-parametrized model

Arellano-Bond dynamic panel-data estimation				Number of Obs. = 318		
Group variable: ID				Number of groups = 15		
Time variable: ANNO						
Number of instruments = 259				Wald $\chi^2(7)$ = 1781.42		
One-step results				Prob > $\chi^2(7)$ = 0.0000		
HPIIAHARM	**Coef.**	**Std. Err.**	**z**	**P >z**	**95% Conf. Interval**	
HPIIAHARM$_{t-1}$	.561***	.024	22.99	0.000	.513	.603
DHPIIAHARM$_{t-1}$	.367***	.043	8.55	0.000	.283	.452
NOM_short_IR$_t$	1.813***	.412	4.40	0.000	1.005	2.621
DNOM_short_IR$_t$	2.212***	.707	3.13	0.002	.826	3.597
DUNEMP_RATE$_t$	2.845***	.865	3.29	0.001	1.149	4.540
SPREAD$_t$	6.630***	.577	11.50	0.000	5.500	7.760
Cons	-7.706***	2.094	-3.68	0.000	-11.811	-3.602

The regressors are jointly significant with the level of confidence of 99% and each regressor is individually significant with a level of confidence of 99%.

The high significance in the variable $SPREAD_t$ suggests that the relative price of the housing market seems to react to future expected tighter monetary policy, typical of "safe haven assets". The high significance and positive impact of an increase of unemployment (the variable $DUNEMP_t$) reflects the usual countercyclical behaviour of housing prices (the variable at the numerator of the ratio). The positive impact on the dependent variable of the level and increase of short run interest rate ($NOM\_short\_IR_t$ and $DNOM\_short\_IR_t$ respectively) suggests a prevailing effect of portfolio reallocation from the stock market to the housing market induced by these two last variables. Finally, the significance of the lagged level and increase of the dependent variable suggests a "self-sustaining" mechanism in relative prices, not explainable by the fundamentals.

6. Concluding Remarks

This paper introduces a heuristic empirical approach to analyse the behaviour of the European Housing market over the period 1995–2015. In particular, by defining the relative price of the housing market to the stock market (which may partly capture the excess return in the housing market) we formalize a framework broadly consistent with a general equilibrium interpretation and estimate it by following the "general-to-specific" approach, followed by a re-parameterization of the regressors that allows a theoretical interpretation of the results.

The estimates suggest that the relative price of the property market to the stock market displays, as expected, a counter-cyclical behaviour and seems to be also affected by the expectations of future expected tighter monetary policy as suggested by the high significance of the spread between short run and long run interest rates. This feature seems to be broadly consistent with a traditional interpretation, seeing the real estate property as "safe haven assets".

The estimates also display a positive and significant effect of the lagged level and lagged increase in the dependent variable, suggesting that it is also acting a self-sustaining mechanism in the relative price, i.e. an empirical behaviour not entirely explainable by the fundamentals and also broadly consistent with the behaviour of investors that tend to buy in phases of increasing prices.

The estimates suggests that the behaviour of the European real estate markets seem to be not only explained by the fundamentals, but also largely driven by a self-sustaining path in relative prices.

This result seems to properly fit throughout the whole time length of our analysis, and not only until 2007, therefore well beyond the end of the speculative bubble that affected the housing market in the major economies.

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