The « housing bubble » and financial factors: Insights from a structural model of the French and Spanish residential markets[1]

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Abstract

Over the last decade, France and Spain have experienced property price and residential investment increases which were among the strongest and the lengthiest in the euro area. Although the quality of the underlying data limits the precision of the estimates, the present paper aims at analysing the fundamental factors behind these evolutions: the analysis presented here attempts to assess whether the observed price dynamics may be attributed to a pure bubble phenomenon or to the large changes in financial and demographic factors. This is done by means of a structural model of the demand and supply sides of the housing market, i.e. using an error-correction model. When taking into account a standard set of macroeconomic variables, our estimates imply that residential property prices in France and Spain were approximately 20% above the level explained by their fundamentals. When demographic and financial factors such as the borrowing capacity are taken on board, the degree of overvaluation is drastically reduced. The adjustment path to equilibrium is slightly faster in France than in Spain, but both countries display a significant downward rigidity in prices.

[1] The views presented here are the authors' and do not necessarily reflect the views of the Banque de France. The authors gratefully acknowledge comments by Olivier de Bandt, Olivier Darné and Teresa Sastre as well as Jean Pierre Villetelle and Lionel Potier for the series they provided. All errors remain ours.

1. Introduction

Over the last decade, a number of OECD countries, including the USA and the UK but also continental European countries have experienced housing booms of a sometimes unprecedented scale and length. Among euro area countries, housing prices and residential investment were both particularly dynamic in France and Spain. During the last housing boom for example (1998-2007), the yearly average growth rate of house prices was above 10% in Spain and France, peaking at 18% for Spain and 16% for France in 2004. Since then, yearly growth rates have been declining very rapidly, and have even turned negative towards the end of 2008.

The magnitude and volatility of these developments may have dramatic consequences on the real and financial spheres of the economy through wealth effects, when applying, residential investment or the financial accelerator. Hence, diagnosing the causes of the recent large swings in property prices should in the first place allow forecasting the extent of the downturn lying ahead. In addition, understanding the fundamental factors behind the recent evolutions in housing prices should then help to suggest adequate economic policy measures, as this kind of volatility, even reflecting fundamental factors, may be costly in terms of financial stability.

Given the above, a distinction should be drawn between two different approaches to the explanatory factors underlying house prices dynamics. A first line of thought would be that prices are fully determined by their fundamentals. In that case, large and dramatic changes in the latter may explain similar evolutions in housing prices. One may only think of the deregulation of mortgage markets in the 1980s and the process of European monetary integration that have substantially softened credit conditions, while lowering interest rates simultaneously.

A second approach would consist in considering that observed house prices can, at least temporarily, depart from the path determined by their fundamentals. In theory, there can be many possible reasons behind such a departure from equilibrium levels. Specific rigidities could, for example, prevent supply from reacting immediately to an increase of demand (Ayuso and Restoy, 2006). Another possibility would be that price increases based on the sole expectation of further price increases. This is equivalent to the definition of a bubble that may be identified when “the reason the price is high today is only because investors believe that the selling price will be high tomorrow—when “fundamental” factors do not seem to justify such a price” (Stiglitz, 1990).

In the present analysis we will focus on the quantification of the degree of over- or undervaluation. Attention will also be paid to the adjustment path towards equilibrium. To that end, a structural model of the French and Spanish housing markets is estimated, the theoretical framework being one of an Error Correction Mechanism (ECM). The remainder of the paper is organised as follows: the next section presents the methodological choices leading to the selection of the model. Section 3 will detail the construction and data sources of the main variables of the model. In section 4, estimation results for the long-term equations are commented. Section 5 presents the results for the short term equations and section 6 offers some brief concluding remarks.

2. Estimation strategy

2.1 Estimation methodology

There are several approaches to account for the fundamental value of housing prices. A first, financial approach consists in modelling house prices such as any other asset price, valued according to the future discounted flow of revenues or services generated. More precisely, this financial approach implies exploiting the relationship between house prices and rents, as originally proposed by Case and Shiller (1989). Although valuable to assess the investors' viewpoint, this approach does not allow an explicit modelling of the respective role of fundamental macroeconomic factors, such as households' disposable income, the residential capital stock or demographics.

Structural models of the housing market, accounting for the dynamics of supply and demand of housing, allow identifying the role of the fundamental factors on house price formation. Initially the so-called stock flow models go back to the seminal article of DiPasquale and Wheaton (1994). The authors emphasised the importance of accounting for the very long lags in market clearing due to transactions costs and land supply rigidities. Subsequently, they apply error-correction models to their data, in order to allow for diverging dynamics in the short and the long run.

In the present analysis we will follow this macroeconomic approach, in order to explicitly account for the role of fundamental factors of the French[2] and Spanish real estate markets respectively. Both the supply and demand equations will be estimated[3] by means of ECMs as proposed by Engle and Granger (1987).

In addition, as we will focus on the long-run determinants of housing prices, the simultaneity in the determination of price and supply will be our main concern. McCarthy and Peach (2002) used a vectoral approach (VECM), which allows modelling accurately the interactions between the different variables. This methodology was motivated by the paper's objective, which was to account for the role of monetary policy in residential investment dynamics. Here, instrumental variables will rather be used to control for the endogeneity of the supply variables in the demand equation and of the demand variables in the supply equation, as this allows being more explicit in isolating the exogenous component of the endogenous variables. More specifically, the instruments used here will be the exogenous variables of the supply equation in the demand equation and vice versa. As endogeneity should be less of a problem at this horizon, the short run equations are estimated by OLS with Newey-West standard errors (1987) whenever heteroskedasticity is detected.

2.2 Basic Model

The aim of the present study is to model the structural demand and supply factors underlying residential property price developments in France and Spain. The methodological framework

[2] This type of model has been adapted to the French housing market by Bessone et al. (2005), who conclude that there is no housing bubble up to 2004.

[3] Indirectly we suppose that that the supply of housing is not rigid, since this assumption fits the observed evolutions of the 2000s during which residential investment experienced an important surge. According to our computation, the residential housing stock increased by 17% in France and by 55% in Spain over the 2000-2008 period.

adopted here is a version of the stock-flow model that is commonly used for the analysis of the housing sector (DiPasquale and Wheaton, 1994).

Our model is characterized by two long term relationships in which demand and supply factors determine housing prices and residential investment. On the demand side, the long run real price for housing p^d is given by the housing stock *h*, households' permanent income *y*, the user cost of housing *uc* and a demographic factor *n*.

The number of households can be chosen here to account for demographic changes that reach beyond birth and mortality rates and migratory fluctuations. Social changes regarding the composition of family units and population ageing imply that the number of households can grow faster than a country's population. More precisely, over the 1981-2008 period the number of households grew by an annual average of 1.8% in Spain and 1.3% in France[4], against an annual growth rate of only 0.7% for the Spanish population and 0.5% for the French population. However, in France, the number of households is measured by means of population censuses, which were not conducted every year, and is not available until 2008; hence, population will be used as a proxy in the French case.

Note that the number of households may be determined jointly with housing prices: for example, children may tend to stay longer at their parents' if they cannot find an affordable dwelling. This problem may somewhat extend to population as the decision to have a child may be constrained by housing space. This potential endogeneity problem means that we will have to test the direction of causality of these variables and examine alternative specifications excluding demographic factors.

Following the above, the long-term demand equation in logarithms can be expressed as:

$$p_t^{\ d} = \alpha_1 h_t + \alpha_2 y_t + \alpha_3 uc_t + \alpha_4 n_t + \varepsilon_t^D \qquad (1)$$

ε_t^D is a white noise for which $E[\varepsilon_t^D] = 0$, $V[\varepsilon_t^D] = \sigma_\varepsilon^2$. The user cost uc_t is computed following Poterba's definition (1992) and can formally be expressed as

$$uc_t = p_t\left[\left(1-\tau_t^y\right)r_t + \delta - E_t\left(\pi_{t+1}\right)\right]$$

where

p_t	is the price of housing per square meter in real terms ;
τ_t^y	the average income tax. This implies taking into account tax deductibility of interest payments for residential mortgages whenever it applies[5]. The relevant revenue tax rate would be a marginal one, but as the latter is not available for Spain and France, we use here an effective tax rate;
r_t	the long term interest rate (yield on 10 year government bonds) in real terms;

[4] Estimation of 2008's number of households in France based on INSEE première N° 1106 - October 2006 "Des ménages toujours plus petits", Alain Jacquot.

[5] In France, the deductibility of interest payments has been suspended from 01/01/1997 for new dwellings and one year later for all dwellings and reintroduced partly in 2007. In Spain, on the contrary income tax relief is offered on the purchase, building, rehabilitation or extension of a primary residence and both principal and interest payments on a mortgage can be deducted (for more details on the tax treatment of housing in Spain see the OECD, 2007b).

δ the depreciation rate for residential structures: for Spain, it has been fixed at 2%, implying an average life time of 50 years for residential buildings; for France, it is based on INSEE households' balance sheet accounts.

$E_t(\pi_{t+1})$ the anticipated capital gains. These gains were proxied by average residential property prices over the last four quarters, implying that agents form adaptive anticipations. We also test a more 'conservative' definition where capital gains equal past CPI inflation (Poterba, 1992).

Equation (1) has to be understood as a demand curve. The demand price level of homes depends negatively on the residential housing stock: an increase in the housing stock makes the housing supply more abundant and weighs hence on demand prices. Housing demand also declines in line with increasing residential capital user costs, as for that case it becomes less appealing to own a house than to rent it.

On the contrary, housing prices should increase parallel to households' permanent income: as income grows, demanded housing square meters per individual tend to increase. Demographic factors, such as population growth and ageing but also migratory movements and household formation, should also augment demand pressure and hence prices.

On the supply side, residential investment (i_t) is supported by real house prices p_t. Construction costs cc_t (encompassing the costs for labour and material inputs) should weigh on residential investment. One crucial assumption here is that existing home prices (used here) are in close relationship with new dwellings prices due to household arbitrage. In logarithms the supply side equation is given by

$$i_t = \beta_1 p_t + \beta_2 cc_t + \varepsilon_t^S \qquad (2)$$

ε_t^S is a white noise for which $E[\varepsilon_t^S] = 0$, $V[\varepsilon_t^S] = \sigma_\varepsilon^2$.

There seems to be, however, a large body of evidence that residential property prices and investment adjust slowly to exogenous shocks. At a given point in time, it is therefore possible to observe a difference between the actually observed price for housing and the one determined by fundamentals (DiPascale and Wheaton, 1994). Hence it seems plausible to introduce equations representing the short-term adjustments in the housing market. These short-run equations for the demand and the supply side of the French and Spanish residential housing market take the classical form of an error correcting process:

Demand equation:

$$\Delta p_t = \alpha_1 \varepsilon_{t-1}^D + \sum_{n=1}^{5} \alpha_{n+1} \Delta p_{t-n} + \alpha_7 \Delta h_t + \alpha_8 \Delta y_t + \alpha_9 \Delta n_t + \alpha_{10} \Delta rr_t + \varepsilon_t \qquad (3a)$$

Supply equation:

$$\Delta i_t = \alpha_1 \varepsilon_{t-1}^{S} + \sum_{n=1}^{n=5} \alpha_{n+1} \Delta i_{t-n} + \alpha_7 \Delta cc_t + \alpha_8 \Delta pi_t + \varepsilon_t \qquad (3b)$$

ε^S and ε^D are respectively the error-correction term from the demand equation (1) and the supply equation (2). Additionally, the five following explanatory variables were incorporated in the short run equations: lagged changes in real housing prices (Δp); real households' disposable income (y), real interest rates (rr) and construction costs (cc).

These 'standard' short term equations describe the adjustment path towards equilibrium. However, there seems to be a general consensus that there are asymmetries in the short term adjustments. More precisely, the downward movement of a declining housing market will not be as rapid and important as the upward movement in a rising market. That is to say that housing markets exhibit downward rigidity[6].

Gao et al. (forthcoming) have conducted this type of analysis for the United States. The authors find evidence that house prices not only exhibit serial correlation, but also downward rigidity. More precisely, although prices tend to overshoot the equilibrium in appreciating markets, they can experience downward rigidity during periods of decline.

In order to test this hypothesis for the French and Spanish housing markets, positive and negative values of the error-correction term were separately tested in the short run demand equation. If only the negative residuals prove to be statistically significant in the short-run, we would conclude that indeed house prices exhibit downward rigidity. Analytically this adjusted type of short term equation takes the following form:

Adjusted demand equation:

$$\Delta p_t = \alpha_1 \varepsilon_{t-1}^{Dpos} + \alpha_1 \varepsilon_{t-1}^{Dneg} + \sum_{n=1}^{5} \alpha_{n+1} \Delta p_{t-n} + \alpha_7 \Delta h_t + \alpha_8 \Delta y_t + \alpha_9 \Delta n_t + \varepsilon_t \qquad (4a)$$

Adjusted supply equation:

$$\Delta i_t = \alpha_1 \varepsilon_{t-1}^{Spos} + \alpha_1 \varepsilon_{t-1}^{Sneg} + \sum_{n=1}^{n=5} \alpha_{n+1} \Delta i_{t-n} + \alpha_7 \Delta cc_t + \alpha_8 \Delta pi_t + \varepsilon_t \qquad (4b)$$

ε^{Dpos} ε^{Dneg} are the positive and negative error correction terms from the demand equation (1), and ε^{Spos} ε^{Dpos} the positive and negative error correction terms from the supply equation (2).

[6] From an economic viewpoint this happens because sellers withdraw their houses from a declining market in order to prevent rapid prices declines.

3. Construction and sources of data

3.1. France

Housing prices used here are quarterly and seasonally adjusted existing home prices covering France as a whole produced by INSEE, retropolated by a series published by a real estate agents network, the FNAIM, on the basis of its transactions[7]. The INSEE hedonic index of housing prices is used here, which implies that housing prices are related to a standard dwelling in terms of quality and size, defined by elementary areas. Hence, part of the increase in demand due to higher income may be reflected in the increasing size and quality of the standard dwelling. According to the estimates, the hedonic correction however does not fully absorb the increase in permanent income, as the average characteristics of existing dwellings may evolve more slowly than the resulting demand. Absent sufficiently long time series of new home prices data, the simplifying assumption has to be made that arbitrage between existing and new dwellings leads to similar evolutions in the two series.

The housing stock is computed on the basis of yearly households' balance sheet accounts, interpolated with the residential investment series and deflated by national accounts' GFCF prices.

The other basic variables of the demand equation are households' permanent income and the user cost of residential capital. Households' permanent income is proxied by real disposable income. All series were deflated using the private consumption deflator.

3.2 Spain

For Spain, quarterly house prices used are the average price per square metre of all, new and existing dwellings released initially by the Spanish Ministerio de Fomento and currently by the Ministerio de la Vivienda[8]. This price index is not quality adjusted, which can be problematic as housing is not a homogenous good varying with its location, size or structure[9]. Keeping in mind that the exclusion of quality effects can imply an upward bias in the price data, it can still be expected that the used metric reflects relatively well house price developments over time.

As no balance sheet accounts are available for Spain, the residential capital stock was calculated on the basis of the permanent inventory method. The initialisation value was computed using the formula:

$$(GFCF \times average\_life\_span\_of\_capital)/2$$

GFCF equals residential gross fixed capital formation in volumes. The average life span of housing is deduced from a depreciation rate of residential structures that is fixed at 2% per

[7] An alternative choice would be an extrapolation on INSEE prices for Paris only. However, the evolution of prices between Paris and the rest of France was strongly divergent in the 1980s and beginning the 1990s, which would lead to a bias in the resulting series.

[8] According to the OECD, Spain displays the highest home owner rate among OECD countries (82% in 2005). This implies a negligible rental market encompassing less than 12% of all dwellings in 2005, which in turn entails that rents are not taken into account in this study when assessing home prices (OECD, 2007a).

[9] When hedonically correcting for location, Bover and Velilla (2001) find indeed that the official house price index for Spain includes an upward bias ranging from 0.75% to 1.2%.

annum implying that a not maintained residential structure has a life time of 50 years. This computation implies that measurement errors regarding the capital stock can be relatively important at the beginning of the estimation period, but should fade over time in line with capital depreciation.

Because of data limitations[10], prices for constructible land are very roughly approximated by agricultural land prices. Note that the approximation is substantial since factors such as zoning rules, but also transport and other infrastructure will affect the premium on land for construction purposes over other types of land use (ECB, 2003). The series for agricultural land prices is provided for by the Spanish ministry of agriculture and is originally deflated by the GDP deflator.

With the exception of the standardized ILO unemployment rate provided by Eurostat, the remainder of the series (number of households, households' disposable income, etc.) is primarily taken from national accounts. If not indicated otherwise, all series were deflated using the private consumption deflator.

3.3 Unit root and causality tests

The unit root tests conducted imply that all series in our data set are first order integrated (see annex 2). In addition, the series used for the computation of the demand and supply sides of the French and Spanish housing markets exhibit common trends, indicating the possible presence of a cointegration relationship between them (see figure 1 and 2, annex). Finally, preliminary Johansen's cointegration tests (not reported here) confirm that there is at most one cointegrating relationship among the respective demand and supply data sets[11].

We conduct Granger causality test in order to assess the risk of reverse causality between the endogenous and exogenous variables. For the demand equation, real disposable income, and population in France do granger-cause housing prices, the reverse hypothesis being rejected (see annex 3). On the contrary, both hypothesises on the direction of causality are not rejected for user cost and housing stock in France. This is hardly surprising for the housing stock which is considered endogenous. For the user cost, the causality from user cost to housing prices is hard to justify: user cost includes a lagged housing prices growth term as a proxy of expected capital gains and it is hard to justify the impact of housing prices on other user costs terms such as long term interest rates or taxes. For the Spanish data, real disposable income, the user cost, the number of households and the capital stock do granger-cause real house prices. The reverse sense of causality is rejected for any of the variables. This is reassuring for the number of households, as household formation can depend on property prices. We would expect that the housing stock granger-causes house prices as the former is deemed to be endogenous. In the following we maintain this hypothesis, since we consider that in the long term it is determined simultaneously with housing prices.

On the supply side, it is more difficult to disentangle the direction of causality according to Granger tests (see annex 3). For France, both directions are possible between residential investment and its two envisaged determinants, housing prices (which are actually supposed to be endogenous) and construction costs. For the Spanish data, all exogenous variables do granger-cause residential investment. We do not find a reverse causality from residential

[10] The only existing series on constructible land prices in urban areas begins only in 2004.
[11] For the demand data set in France, the trace test indicates one or two cointegration relationships depending on the critical value (1 or 5%).

investment to house prices. Both direction of causality are possible for building starts, implying that instruments for the former will be introduced in the following computations.

4. Equilibrium values from long term equations

4.1. Standard demand factors

Equation (1) is estimated by Two Stage Least Squares for France and Spain. Demographic factors (population and the number of households) are introduced in some of the equations. A third regression for Spain includes also the standardized ILO unemployment rate that accounts for a precaution motive of Spanish households (which does not appear significant in France). The estimation results are displayed in Table 1.

For France and Spain, the housing stock's coefficient is negative as expected and close to what McCarthy and Peach (2002) find for the United States (-4.2) or Bessone et al. for France (-3.6 the latter study does not explicitly take into account demographic factors).

The coefficient on household's disposable income is greater than 1 in equations 1, 3, 4 and 5, indicating a high long-run income elasticity that is consistent with common conceptions about housing demand. More precisely, this is consistent with the idea that dwelling service is a superior good whose demand grows faster than income. Permanent income also captures general expectations about the state of the economy and housing prices themselves, which reinforces its impact. Also, Martínez-Pagés and Maza (2003) find a long run house price income elasticity that is with 2.8 rather close to the result obtained here. Bessone et al. find a coefficient of 8.3 for France.

The user cost has the expected significant negative impact on demand prices for France. Once demographic factors are introduced, it is not significant for Spain. This is the case for various ways of calculating it, i.e. for different hypothesis regarding anticipated gains. The statistical non-significance of the user cost might be related to the data problems interfering in its calculation (see also part 2 of this study). However, this result is in line with what other studies on the subject find: Pagés and Maza (2003) for the case of Spain and McCarthy and Peach (2002) for the United States also conclude that the user cost is not significant in their respective calculations.

Demographic factors are proxied by population growth for France[12] and by the number of households for Spain. As expected, these factors have a significantly positive impact on demand prices. This underlines the large impact household formation and hence socio-demographic factors (geographical mobility, mono-parental family structures, migration etc.) have on housing demand (see also Gonzalez and Ortega, 2009). Also, at first sight, the difference in magnitude between the coefficients on demographic factors between France (+28.9) and Spain (+5.7) is striking. The use of different variables (number of households vs. population) explains this gap. More precisely, as households grow two to three times faster than population, we may expect a higher coefficient for population in France than for households in Spain.

[12] For France, data on the number of households were available only on a discontinued basis and do not cover the whole estimation period.

Table 1: Housing prices: Long-term demand relationship

	France		Spain		
	Eq.1	**Eq.2**	**Eq.3**	**Eq.4**	**Eq.5**
Housing stock	-2,67***	-6.42***	-1.98***	-4.46***	-4.50***
Gross disposable income	3,80***	0,54***	2.91***	3.43***	3.52***
User cost	-0,38*	-0,15**	-0.25***	-	-
Demographics[1]	-	28,94***	-	5.76***	5.41***
Unemployment rate	-	-	-	-	-0.13*
Sargan P-value	0.88	0.57	0.45	0.99	0.99
Wu-Hausman F test P-value	0.00	0.00	0.00	0.00	0.00
Adjusted R^2	**0.88**	**0.98**	**0.96**	**0.99**	**0.99**

* p<0.10, ** p<0.05, *** p<0.001, according to the values tabulated in Engle and Granger (1987).

[1] Population for France; number of households for Spain.

Notes: The estimation period is 1980-2008 for France and 1982-2008 for Spain. All regressions include a constant that is not reported here. Estimations were computed by Two-Stage Least Square. Exogenous instruments for the capital stock are construction costs and the long-term interest rate.

First-step estimates' F tests indicate that instruments are strongly significant. Sargan-Hansen tests of instruments over-identification do not reject the null hypothesis of orthogonality of instruments. Wu-Hausman tests of exogeneity reject the null hypothesis of exogeneity of the housing stock. Joint residual skewness / kurtosis test do not reject the null hypothesis of normality. Breusch-Pagan tests reject the null hypothesis of homoskedasticity. Hence, heteroskedasticity robust variance-covariance matrix estimates are used. Cumby-Huizinga (IV) or Breusch-Godfrey (OLS) reject the null hypothesis of no autocorrelation, which is to be expected when ECM are estimated in two steps, as it is the case here.

It is also noteworthy that the inclusion of demographic factors for Spain is necessary to obtain stationary residuals for the long term equations. The number of households will hence be taken into account for all following computations for the demand side of the Spanish housing market.

Regression 5 includes also the standardized ILO unemployment rate whose coefficient is negative and statistically significant. The explicative power of the unemployment rate is, however, limited in comparison to the other explanatory variables, as reflected by the coefficients relative magnitude. It is not a significant determinant for France, as gross disposable income may capture most of the impact of unemployment.

In order to determine whether these demand equations can be modelled as an error correcting processes, we test for the residuals' stationarity. According to the Shin (1994) test, the null hypothesis of cointegration of residuals is not rejected, at the 10% threshold for the equation 2, 3, 4 and 5 but only at the 1% threshold for equation 1, which is not fully satisfactory for this test. This may be due to the fact that the cointegration relationship did not work as prices departed strongly from their demand equilibrium value from 2004 onwards. For equations 3, 4 and 5, unit root tests[13] concluded as well that the residuals of equations 2-5 were stationary at the 1% threshold.

Having established the possibility of modelling the demand side of the Spanish and French housing market as an ECM, we check for the robustness of the above mentioned equations by estimating them over several periods (see annex 4 for estimation results). This is particularly important, as the significant imbalances that started building up in the countries' property market after 2000 may have altered our estimations' results. Over the 'pre-bubble period', coefficients remain significant and have the proper sign. Their magnitudes are close, the main difference being permanent income, which contributes more to explain housing price changes in the recent period as it increased significantly since 2004. The stationarity test for the residual is now satisfactory for all equations: the null hypothesis of cointegration of residuals is never rejected, at the 10% threshold.

Part of the recent increase in housing prices remains unexplained on the demand side. In 2008, housing prices are about 0-19% above the price explained by the usual long-term determinants for France and 11-25% for Spain[14]. Some of the data used to estimate these overvaluation ranges are badly measured (first of all housing prices themselves) or are proxied (permanent income, expected capital gains in user costs) and hence these estimates are to be taken with caution. The ranges presented here appear however to be robust to different specifications and alternative data.

The increase in prices is explained up to 2005 for France and up to 2003 for Spain in particular by the increase in gross disposable income. Afterwards, the increases in the supply of dwellings and, after 2006, in the user cost of housing capital have weighed on long-run prices, leading to a growing overvaluation of prices despite their slowdown. In France, the acceleration of population from 2000 onwards explains most of the housing boom. However, the pace of household formation is supposed to have decreased since 2004 from 1.5% to 1.1% and equation 1 may hence over-estimate equilibrium prices in 2008.

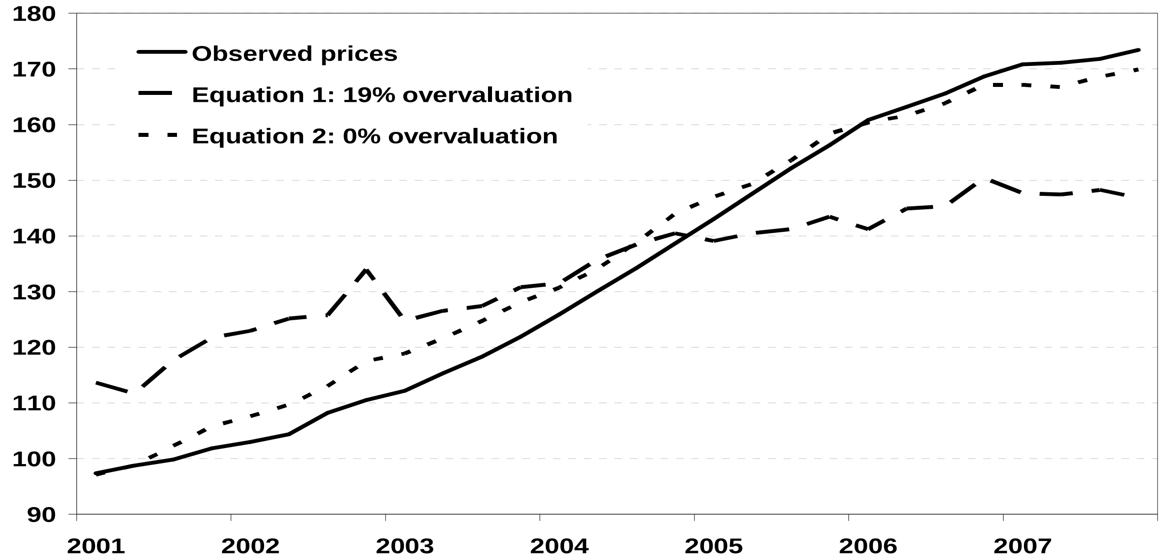
Over the 1980s and 1990s, we can see that housing prices have often departed from their long-run equilibrium values and remained persistently over- or under- valued. Several boom and bust episodes may be identified for both France and Spain: boom in the beginning of the 1980s, of the 1990s and middle of the 2000s; bust in the second half of the 1980s and of the 1990s and beginning of the 2000s. This persistence may be due either to serial correlation of housing prices or to omitted variables, such as financial factors.

[13] 'Classical' unit root tests (ADF and Philllips-Perron) were conducted using the critical values tabulated by Engle and Yoo (1987). In addition, Ng-Perron (2001) unit root tests were also undertaken, as they have two advantages in comparison to more 'classical' unit root tests: their power is enhanced by local GLS detrending of the data and the use of modified information criteria leads to substantial size improvements. Note that the test results in favour of the residuals' stationarity are also in line with Granger's and Newbold's (1974) rule for spurious regressions. More precisely, as the equations' Durbin-Watson Statistics (not reported here) are higher than the adjusted R^2, chances are that the equations' residuals are stationary.

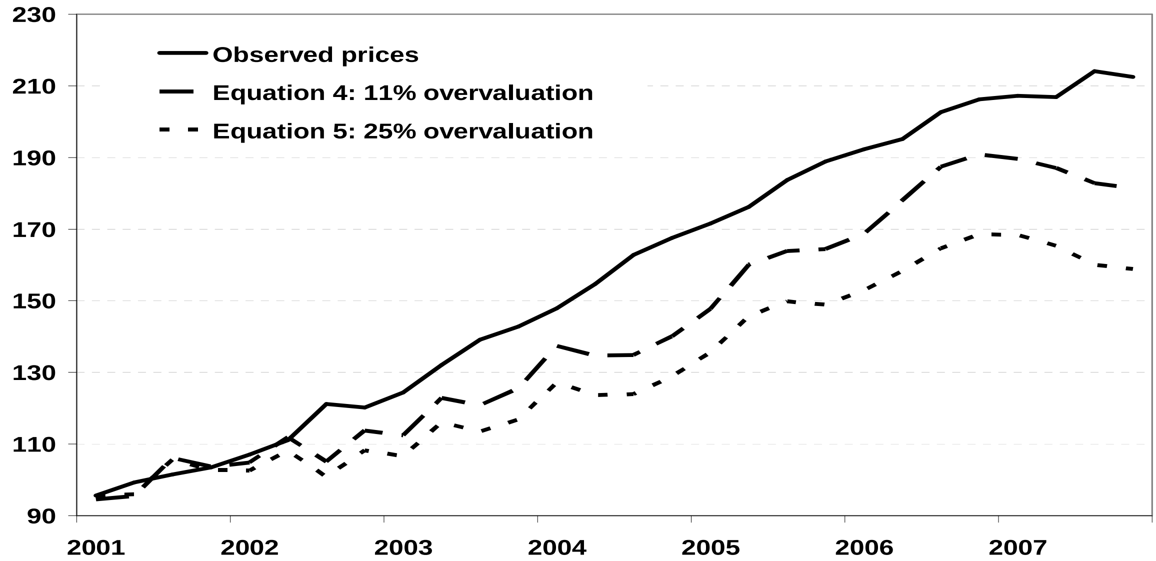
[14] This is in line with the magnitude of overvaluation (roughly 20%) that the IMF (2009) finds (figure 1). In addition, the given equation reproduces well the results that Pagés and Maza (2003) found for the Spanish housing market in 2002.

Figure 1: Long term demand equation: Housing prices and fitted values

France



Spain



4.2 Demand side: Is the overvaluation a 'pure' bubble phenomenon or does it reflect changes in financial factors?

The overvaluation of housing prices may reflect several phenomena. Either one or several fundamental variables have been omitted from the equation. Subsequently, the recent house price dynamics could be explained by the evolutions of that omitted variable. Or the recent house price boom is a "pure" bubble phenomenon. In that case, the recent important house price increases would stem from investors' sole expectations of further price increases.

Concerning the omitted fundamental variables, one may think of financial variables as there have been major evolutions over the period in consideration. Indeed, financial factors have been pointed as one of the major determinants in differences in national housing market dynamics. For example, Tsatsaronis and Zhu (2004) have emphasised how different characteristics of mortgage markets regarding loan to value ratios, mortgage rate references, valuation methods or securitisation practises may affect the interactions between housing prices and other macroeconomic variables (GDP, interest rates, bank credit).

Over the horizon of this analysis, major regulatory changes intervened in both the French and Spanish mortgage markets. In 1987, the end of administrative control of credit ("*encadrement du crédit*") triggered a period of fast increases in loans and housing prices as banks competed for market shares. No such a major regulatory change can be observed in the recent period. Although securitisation regulation has been softened in the 1990s, its development in France for housing credit has not been on such a large scale as in the US.

In Spain, the liberalisation of the mortgage market goes back to the year 1981. It is from that date onwards that universal banks and other specialised credit institutions are allowed to enter the market and to compete with public mortgage banks and savings banks, which before then were the only mortgage lenders. This increase in competition, coupled with the low prevailing interest rates, has triggered an important expansion in housing mortgages (OECD, 2000). According to the Asociación Hipotecaria Española, total outstanding mortgage lending has accelerated strongly from 12,921 million to around € 900 billion over the past two decades. Over that same period, the number of new mortgages subscribed each year rose from 135,000 to close to 1,700,000[15].

Apart from these important regulatory changes, a series of other factors has had an impact on banks' pricing tactics for mortgages. In the first place, the process of European monetary integration has contributed to a decline in interest rates, a development of which banks and consumers have benefited from in both countries. In addition, banks' pricing and margin behaviour has very much evolved over the period in consideration. Especially in France, mortgages credits have become a product that banks use to attract and secure loyalty of their clients.

Consequently, rates on mortgage credits have been very much reduced: for an average over the 1990-2008 period of 7.6% (11.5% in 1990), fixed rates on mortgage credits (the dominant type of credit) have decreased to 4.5% in 2005 and 5.5% on average in the 2000s. The Spanish market has experienced a similar evolution: while the average mortgage rate stood at roughly 11% over the 1990-2000 period, rates fell to an average of 4.7% for the 2000-2008 period.

Simultaneously, the average duration of new mortgage credits has substantially increased in France: from 11.8 years in average in 1989, it increased to 14.3 years in 1999 and accelerated to 19.2 years in 2008 (Modèle Fanie, Observatoire du crédit immobilier). There is evidence that credit duration has substantially increased in Spain as well, although data are scarcer than for France. According to l'Estadistica Registral Immobiliara, average credit duration was of around 15 years over the 1990s and stands at approximately 26 years in 2007 (see also Girard-Vasseur and Quignon, 2006). While the rise in the average duration of mortgages has increased households' borrowing capacity, overall credit conditions may have softened as well. However, only very short time series are available by means of the bank lending survey to support that trend.

[15] These figures include both residential and commercial lending.

Given the above, we propose to construct an indicator of maximum indebtedness that synthesises some of the indications on financial factors mentioned in the preceding paragraphs. This indicator should be understood as the maximum amount of money a household can borrow for the purchase of a house given his income, the average duration of mortgages and interest rates for newly contracted mortgages.

A household may borrow up to a monthly payment equal to a third of its income. It is thus possible to compute a maximum average amount of indebtedness per households (K) as:

$$K = \frac{1}{3} GDI \times \Sigma_{t=1}^{T} \frac{1}{(1+r)^t} \qquad (4)$$

Where *GDI* equals gross disposable income in value per household, *T* is average mortgage duration and r_t the average interest rate on mortgages.

The results for that computation are presented in table 2. Permanent income and user costs have been removed from the regressions as borrowing capacity already includes a gross disposable income term and takes into account changes in interest rates. As can be seen from the results, the borrowing capacity has the expected positive impact on housing prices in France and Spain. The Spanish housing stock is statistically not significant we hence present directly the equation excluding the latter.

For both countries the inclusion of the borrowing capacity explains practically all of the overvaluation period in housing prices observed in the previous equations. Although borrowing capacity computation relies on credit duration data that are directly observed only on the last period of estimation that would imply that the overvaluation found in the previous parts of the analysis is not a bubble phenomenon. On the contrary, much of the observed fluctuations can be explained when taking into account financial factors that are not part of the usual macroeconomic approach to house price dynamics. This is all the more striking that many of the changes in financial factors, such as credit condition softening, are not taken into account in this borrowing capacity indicator. Although financial factors may be considered as “fundamental” factors, one may note that they can be subject to a greater volatility than other fundamental factors and lead to a greater volatility of housing prices themselves, as the financial crisis has emphasised. For Spain, Ayuso and Restoy (2006) also conclude that the recent market boom is not due to speculative behaviour.

Table 2: Housing prices: financial factors

	France	Spain
Housing stock	-11.8***	-
Borrowing capacity	3.17***	0.07***
Demographics	27.6***	8.67***
Unemployment rate	-	-0.12***
Sargan P-value	0.20	-
Wu-Hausman F test	0.13	-
Adjusted R^2	0.97	0.99

* p<0.10, ** p<0.05, *** p<0.001, according to the values tabulated in Engle and Granger (1987).

Notes: Estimation period: 1990-2007 for France, 1993-2007 for Spain. All regressions include a constant that is not reported here. Estimations by Two-Stage Least Square. Exogenous instruments for the capital stock are construction costs and the long-term interest rate. First-step estimates' F tests indicate that instruments are strongly significant.

Sargan Hansen tests of instruments over-identification do not reject the null hypothesis of proper specification. Wu-Hausman test of exogeneity does not reject the null hypothesis of exogeneity of the housing stock for the demand price equation, but is close to the 10% significance threshold. Joint residual skewness / kurtosis test does not reject the null hypothesis of normality for eq.1. Breusch Pagan tests do not reject the null hypothesis of homoskedasticity for Spain but reject it for France. Hence, robust standard errors are used. According to the Shin (1994) test, the null hypothesis of cointegration of residuals is not rejected at the 10% threshold for France and Spain. Cumby-Huizinga (IV) or Breusch-Godfrey (OLS) reject the null hypothesis of no autocorrelation, which is to be expected when ECM are estimated in two steps, as it is the case here.

4.3 Supply

Equation (2) is run for France and Spain; the results are displayed in table 3. As expected, housing prices tend to support residential investment as suppliers of residential dwellings may benefit from the increased price of their production. Construction costs weigh on residential investment in the case of France, but are not significant in the Spanish case. We replace construction costs by another cost factor, real long term interest rates. In addition, as in Sastre and Fernández-Sánchez (2005), we introduce a quantity variable (as opposed to the prices variables already used), namely building starts[16]. Both variables are statistically significant and exhibit the expected signs.

[16] The production process of housing units implies that even at steady state there is a delay between the building start and the moment the housing unit is put on the market, the latter being the moment at which the unit is taken into account as residential investment. For that reason, building starts are introduced in the long term relationship with two lags.

According to the Shin test (1994), the null hypothesis of cointegration of residuals is not rejected at the 10% threshold for the French equation and at the 10% threshold for the Spanish equation.

Table 3: Residential investment: Long-term supply relationship

	France	Spain	
	Eq.1	**Eq.2**	**Eq.3**
Housing prices	0,80***	0.27***	0.28***
Construction costs	-0,63***	-0.08	-
Interest rate	-	-0.06***	-0.06***
Building starts (-2)	-	0.46***	0.46***
Sargan P-value	0.77	0.27	0.27
Wu-Hausman F test	0.01	0.00	0.01
Adjusted R^2	0.76	0.97	0.97

* p<0.10, ** p<0.05, *** p<0.001, according to the values tabulated in Engle and Granger (1987).

Notes: The estimation period is 1980-2008 for France. All regressions include a constant that is not reported here. Estimations were computed by Two-Stage Least Square. For France, exogenous instruments for housing prices are user cost and population; for Spain instruments are population, land prices and construction costs for equation 3.

First-step estimates' F tests indicate that instruments are strongly significant. Sargan-Hansen tests of instruments over-identification do not reject the null hypothesis of orthogonality of instruments. Wu-Hausman tests of exogeneity reject the null hypothesis of exogeneity of the housing prices. Joint residual skewness / kurtosis test do not reject the null hypothesis of normality only at 1%. Breusch Pagan tests do not reject the null hypothesis of homoskedasticity.

The increase in housing prices explains more than all of the acceleration in residential investment in the 2000s, while some limited over investment appears by the end of the estimation period in France as prices declined.

For the Spanish housing market we find that actual investment is somewhat beneath the path projected by the theoretical relationship. However, this result hinges also on the inclusion of property prices for which we had found a certain degree of overvaluation. This introduces an upward bias in our estimations for the fundamental value of investment.

5. Short-term equations: which adjustment path to equilibrium?

5.1 Demand

The results for the different short run demand equations are presented in table 4. The equations were estimated using OLS with Newey-West standard errors (1987) whenever heteroskedasticity was detected.

Table 4: Housing prices: Short-term demand relationship

	France		Spain	
	Eq.1	**Eq.2**	**Eq.3**	**Eq.4**
Error correction term (-1)	-0,10***		-0.07**	-
Error correction term (-1) positive values		-0,07	-	0.09
Error correction term (-1) negative values		-0,12***	-	-0.23***
Δlog Housing prices (-1)	0,44***	0,43***	-	-
Δlog Housing prices (-2)	0,25**	0,26***	-	-
Δlog Housing prices (-3)			0.14**	0.12*
Δlog Housing prices (-4)			0.47***	0.47***
Δlog Housing prices (-5)			0.16*	0.16*
Δlog Interest rates (lagged)[1]	-0,07*	-0,07*	-0.03*	-0.04**
Δlog Land prices (-2)			0.36**	0.42***
Adjusted R^2	0.50	0.50	0.33	0.39

* p<0.10, ** p<0.05, *** p<0.01

Estimation period: 1980-2008 for France; 1982-2008 for Spain. Estimations by OLS with Newey-West standard errors when needed. All regressions include a constant that is not reported here.

Breusch-Godfrey test statistics does not reject the null hypothesis of no autocorrelation. Joint residual skewness / kurtosis test does not reject the null hypothesis of normality of residual for eq.1 and 2. Breusch-Pagan tests do not reject the null hypothesis of homoskedasticity for eq.1 and 2 but are close to critical values for equations 3 and 4; hence Newey-West standard errors are used for those equations.

[1] Interest rates are short-term interest rates (-6) for Spain and housing credit interest rates (-2) for France.

For France and Spain[17], the error correction terms are significant, meaning that housing prices do converge to their fundamental value. The point estimate of the error correction term is about -0.10 for France and -0.07 for Spain, indicating that half of the gap between housing prices and their fundamental value is bridged over the course of two years for France and roughly 2.5 years for Spain[18].

None of the 'basic' explanatory variables (household's disposable income, capital stock, demographics) are statistically significant for Spain and France. For Spain, the short term interest rate is significant, while it is housing credit interest rates that are significant for France. This is consistent with the predominance of variable rates credit in Spain and fixed rates in France. Both interest rates are lagged (by a year and a half for Spain and a half-year for France), as changes in market rates are not immediately passed through into credit rates, while there is a lag between the decision to grant a credit and the purchase itself.

In addition, past variations of residential prices are highly significant (and displaying a positive sign). This indicates that property prices in the short term are mostly explained by their own developments in the recent past. This finding is in line with the perception that house prices often exhibit serial correlation in the short term, as Case and Shiller (1987) and Capozza et al. (2004) show for local markets in the United States.

In France and Spain, what does determine property price formation in the short run is past price dynamics. In other words, when prices are engaged in a rising trajectory, they will continue to increase in the short term, only because they did so in the very recent past. Only interest rates are significant, entailing that financing conditions play a role for property price formation in the short run.

Columns 2 and 4 present the results when positive and negative values of the error correction term are introduced separately. Only the coefficient on negative residual values is highly significant. This underlines a downward rigidity of housing prices in France and Spain.

5.2 Supply

Results for the supply equation are presented in table 5. In the short run, we may not take into account the endogeneity of housing prices and estimate by OLS (Newey-West standard errors). The error correction term are significant, supporting for the French market a correction of half the gap between equilibrium and current residential investment in 4 years. The point estimation of the error correction term for the Spanish equation implies that the wedge between the actual and fundamental levels of residential investment is closed in a little more than a year. This is particularly fast given the production process of housing.

Lagged changes in residential investment are significant, showing some inertia in this variable. For Spain, lagged investment bears a negative coefficient, entailing that the series displays mean reversion which can be expected for a growth rate. Among the fundamental determinants, construction costs weigh, even in the short run, on residential investment. Housing prices are not significant in the French case. They are significant in the Spanish equation, but we chose here to include prices for new dwellings as there is a more direct

[17] The residual used for the French short term equation is the one deduced from the demand equation including financial factors. For Spain, it is the residual from equation 3 of table 1.
[18] For the US, McCarthy and Peach (2002) find a rate of price adjustment of 18% per year; according to DiPasquale and Wheaton (1994) the adjustment could account for 16% -29% a year.

nexus between these price data and residential investment[19]. Their coefficient is statistically significant and bears the expected positive sign.

Table 5: Residential investment: Short-term supply relationship

	France	Spain
	Eq.1	**Eq.2**
Error correction term (-1)	-0.04**	-0.21***
Δlog Residential investment (-1)	0.57***	-
Δlog Residential investment (-2)	0.20*	-
Δlog Residential investment (-3)	-	-
Δlog Residential investment (-4)	-	-0.20**
Δlog Construction cost (-1)	-0.11*	-1.76***
Δlog Real housing prices (-1)	0.06	-
Δlog Real housing prices (-1) (new dwellings)	-	0.32***
Adjusted R^2	0.48	0.22

* p<0.10, ** p<0.05, *** p<0.001

Estimation period: 1980-2008 for France. Estimations by OLS with Newey-West standard errors. All regressions include a constant that is not reported here.

Breusch-Godfrey test as well does not reject the null hypothesis of no autocorrelation. Joint residual skewness / kurtosis test do not reject the null hypothesis of normality of residual. Breusch-Pagan tests reject the null hypothesis of homoskedasticity. Hence, Newey-West standard errors are used for both equations.

6. Conclusion

Taking into account a standard set of fundamentals, this study highlights some overvaluation both on the French and Spanish market, reaching some 20% by end-2008. When enriching fundamentals with a measure of households' borrowing capacity, most of this overvaluation however disappears as credit duration increased substantially in both countries since the 1990s. This emphasises that the analysis of housing prices should include banking practises much beyond interest rates. This could be extended in particular to credit standards applied to the approval of loans, when long enough time series will be available.

[19] Replacing total property prices by prices for new dwellings improves the equation's fit substantially.

Although this study points to the role of fundamentals rather than speculation in the recent run-up of housing prices, this does not entail that large movements in housing prices may not be taking place. Indeed, as emphasised by the current crisis, credit conditions may be more volatile than other fundamentals and may give rise to large changes in equilibrium housing prices. Although they display downward rigidity, housing prices movements are also highly inert, which means that it takes time to deviate from an ongoing path.

Hence, monetary policy has limited power to control housing price dynamics. First, housing prices displays a strong inertia which makes difficult an accurate control of their movements through interest rates. Second, housing prices may be sensitive to different segments of the interest rate curve within the euro area (e.g. short-term segment in Spain or long term one in France), leading to highly heterogeneous reactions of European housing markets. Finally, banking practises such as credit duration are important determinants of housing price changes. In the debate on the need of monetary policy to control potentially damaging housing booms, this pleads for the use of a wider set of policy tools, and first of all structural reforms to make housing supply flexible enough to curb down lasting housing prices appreciation.

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Annex 1

Figure 1a (log demand variables, France)

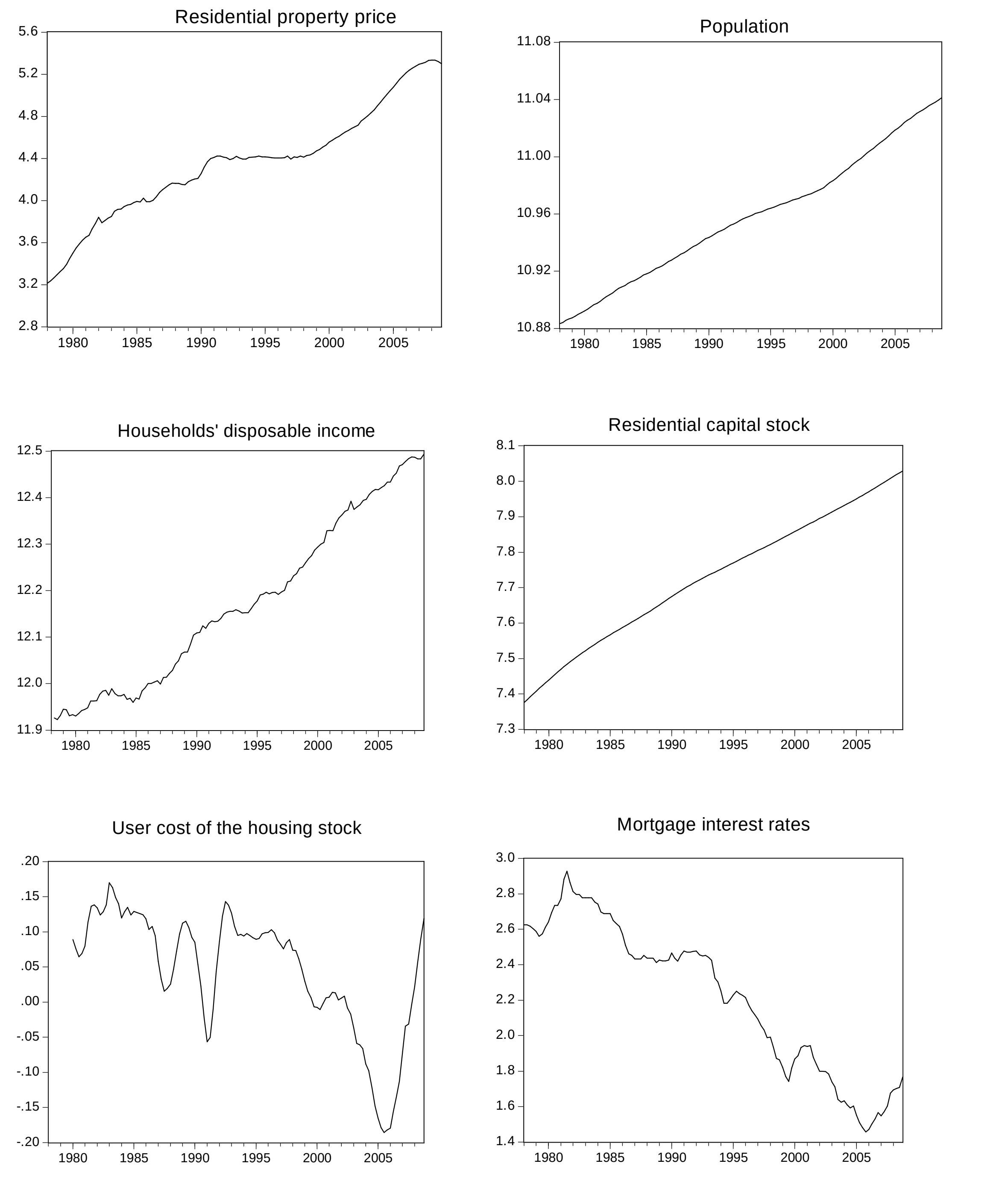


Figure 1b (log demand variables, for Spain)

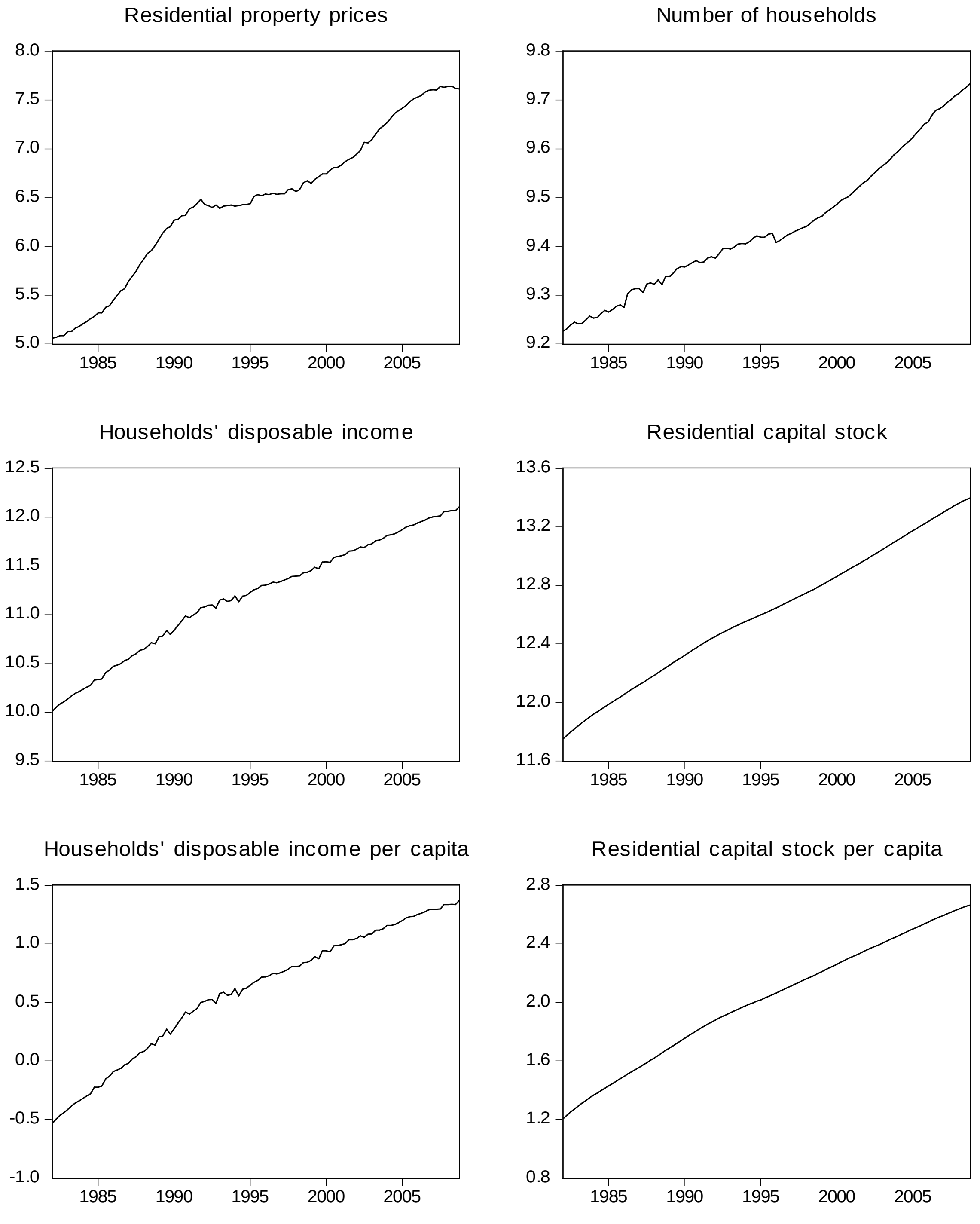


Figure 2a (log supply side variables, France)

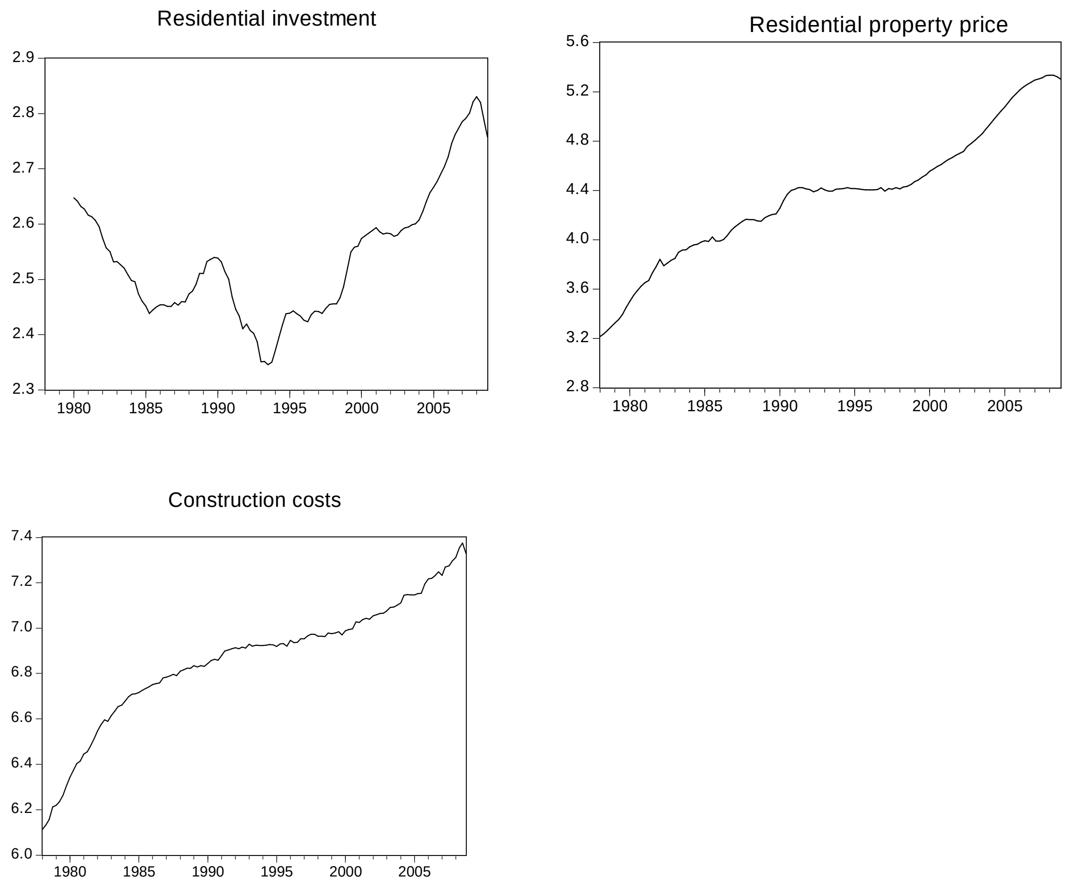
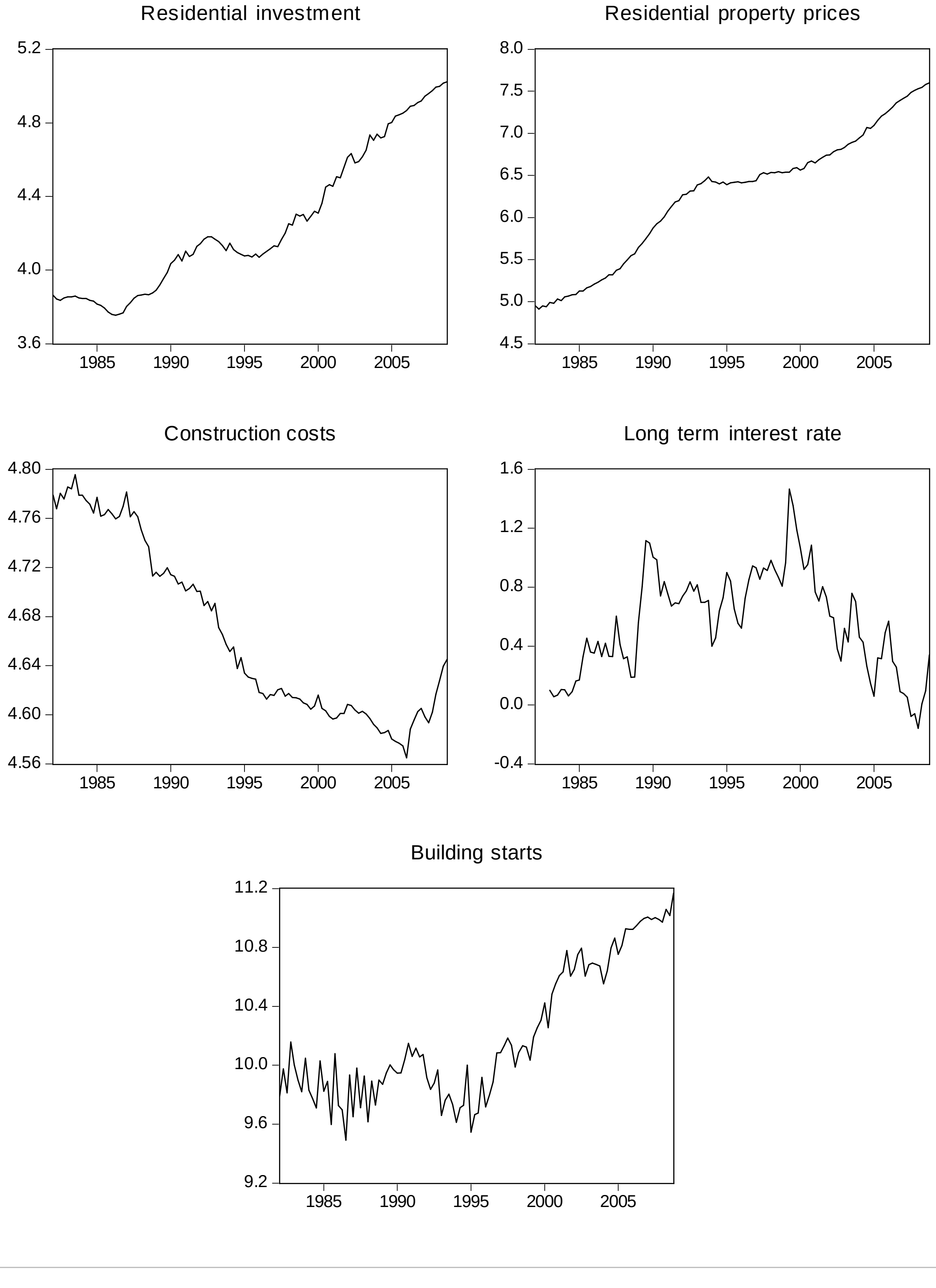


Figure 2b (log supply side variables, Spain)



Annex 2 - Unit Root tests for main variables

France

Ng-Perron - Ho: series has a unit root		
	I (0)	**I (1)**
Real property prices	0.98	-7.11*
Housing stock	0.46	-16.43*
Real disposable income	1.84	-13.99**
Population	2.29	-7.50*
Construction costs	2.73	-16.01***
Residential investment	-2.77	-17.92***

Series including structural breaks		
User cost	-2.42	-4.76***
Borrowing capacity	2.88	-4.49***

* p<0.10, ** p<0.05, *** p<0.001, according to Ng and Perron (2001); note that critical values can vary depending on whether a trend is included or not.

Critical values for the tests with structural breaks are based on Lanne and Lütkepohl (2002).

Spain

Ng-Perron - Ho: series has a unit root		
	I (0)	**I (1)**
Property prices	-0.44	-76.6***
Property prices (new dwellings)	1.44	-27.5***
Construction costs	-4.04	-13.9***
Capital stock	1.70	-5.01
Residential investment	2.24	-34.8***
Building starts	1.88	-17.2*
Disposable income	0.91	-29.1***
Population	1.80	-9.28
Number of households	0.30	-47.6***
Unemployment rate	-4.52	-32.8***

Series including structural breaks		
Long term interest rates	-0.63	-5.48***
Mortgage interest rates	-0.65	-4.75***
Short term interest rates	-2.02	-7.57***
User cost	-2.30	-8.94***
Borrowing capacity	-0.49	-2.60*
Agricultural land prices	-2.01	-2.67*

* p<0.10, ** p<0.05, *** p<0.001, according to Ng and Perron (2001); note that critical values can vary depending on whether a trend is included or not.

Critical values for the tests with structural breaks are based on Lanne and Lütkepohl (2002).

Annex 3 – Residual tests

Granger causality tests

France

Demand

	Observations	F-Statistic	Probability
Real disposable income does not Granger Cause House prices	121	2.43757	0.0918
House prices does not Granger Cause real disposable income		0.75202	0.4737
User costs does not Granger Cause House prices	114	7.65918	0.0008
House prices does not Granger Cause user costs		8.13631	0.0005
Population does not Granger Cause House prices	122	4.46939	0.0135
House prices does not Granger Cause Population		1.83388	0.1644
Housing stock does not Granger Cause House prices	122	5.59351	0.0048
House prices does not Granger Cause housing stock		2.75562	0.0677

Supply

	Observations	F-Statistic	Probability
Construction costs does not Granger Cause Residential investment	115	15.2270	0.0002
Residential investment does not Granger Cause Construction costs		25.0033	0.0000
House prices does not Granger Cause Residential investment	115	11.4688	0.0010
Residential investment does not Granger Cause House prices		1.38725	0.2414

Spain

Demand

	Observations	F-Statistic	Probability
User cost does not Granger Cause House prices	103	13.1	0.00
House prices does not Granger Cause User cost does		0.90	0.35
Number of households does not Granger Cause House prices	107	4.78	0.03
House prices does not Granger Cause Number of households		0.81	0.37
Population does not Granger Cause House prices	107	4.85	0.03
House prices does not Granger Cause Population		33.6	0.00
Unemployment rate does not Granger Cause House prices	105	2.55	0.06
House prices does not Granger Cause Unemployment rate		3.81	0.01
Disposable income does not Granger Cause House prices	100	1.94	0.06
House prices does not Granger Cause Disposable income		2.52	0.02
Capital stock does not Granger Cause House prices	100	2.09	0.05
House prices does not Granger Cause Capital stock		2.27	0.02

Supply

	Observations	F-Statistic	Probability
Building starts not Granger Cause Residential investment	107	5.76	0.02
Residential investment does not Granger Cause Building starts		23.2	0.00
Interest rate (lt) does not Granger Cause Residential investment	103	4.08	0.05
Residential Investment does not Granger Cause Interest rate (lt)		1.78	0.19
Construction costs does not Granger Cause Residential investment	107	2.53	0.12
Residential investment does not Granger Cause Construction costs		3.53	0.06
House prices does not Granger Cause Residential investment	99	2.00	0.05
Residential investment does not Granger Cause House prices		1.20	0.31

Normality tests

France

Royston (1991): normal distribution of residuals		
	Chi-square	**Probability**
Demand equations		
Long term 1	1.74	0.4186
Long term 2	0.58	0.7477
Long term 3 (borrowing capacity)	1.08	0.58
Short term 1	3.07	0.2159
Short term (positive and negative residuals)	4.23	0.1207

Supply equations		
Long term	8.20	0.0166
Short term	0.99	0.6106

Spain

Jarque-Bera – Ho: normal distribution of residuals		
	Jarque-Bera	**Probability**
Demand equations		
Long term 1	0.52	0.77
Long term 2	0.92	0.63
Long term 3 (borrowing capacity)	3.14	0.21
Short term 1	35.3	0.00
Short term (positive and negative residuals)	14.0	0.00

Supply equations		
Long term	1.59	0.45
Short term	0.38	0.83

Tests for serial correlation

France

Cumby-Huizinga (IV) or Breusch-Godfrey (OLS) test: no serial correlation		
	Chi-Square	**Probability Chi-Square(.)**
Demand equations		
Long term 1	98.85	0.00
Long term 2	76.20	0.00
Long term 3 (borrowing capacity)	13.51	0.01
Short term 1	3.71	0.45
Short term (positive and negative residuals)	4.27	0.37

Supply equations		
Long term	65.97	0.00
Short term	1.24	0.54

Spain

Breusch-Godfrey – Ho: no serial correlation		
	Obs*R-squared	**Probability Chi-Sqare(.)**
Demand equations		
Long term 1	16.8	0.00
Long term 2	17.9	0.00
Long term 3 (borrowing capacity)	11.5	0.00
Short term 1	1.01	0.61
Short term (positive and negative residuals)	0.62	0.73

Supply equations		
Long term	7.28	0.03
Short term	2.77	0.25

Tests for heteroskedasticity

France

Breusch-Pagan-Godfrey – Ho : no heteroskedasticity		
	Scaled explained SS	**Probability Chi-Sqare(.)**
Demand equations		
Long term 1	36.12	0.00
Long term 2	12.48	0.0288
Long term 3 (borrowing capacity)	15.47	0.00
Short term 1	0.32	0.5715
Short term (positive and negative residuals)	0.14	0.7109
Supply equations		
Long term	2.33	0.51
Short term	5.90	0.0151

Notes: We also compute Koenker's (1981) statistic in order to check for the robustness of results. For virtually all equations this second statistics implies the absence of heteroskedasticity in line with the test results presented above. For the first long term demand equation Koenker's statistic rejects the null hypothesis of homoskedasticity. In addition, results for the short term demand equations are close to the 5% threshold and it is for those same equations that residuals were found not to be normally distributed. These equations were therefore estimated using Newey West standard errors.

<u>Spain</u>

Breusch-Pagan-Godfrey – Ho : no heteroskedasticity		
	Scaled explained SS	**Probability Chi-Sqare(.)**
Demand equations		
Long term 1	6.79	0.08
Long term 2	4.10	0.39
Long term 3 (borrowing capacity)	2.82	0.41
Short term 1	11.5	0.08
Short term (positive and negative residuals)	6.88	0.33
Supply equations		
Long term	3.28	0.35
Short term	9.76	0.05

Notes: We also compute Koenker's (1981) statistic in order to check for the robustness of results. For virtually all equations this second statistics implies the absence of heteroskedasticity in line with the test results presented above. For the first long term demand equation Koenker's statistic rejects the null hypothesis of homoskedasticity. In addition, results for the short term demand equations are close to the 5% threshold and it is for those same equations that residuals were found not to be normally distributed. These equations were therefore estimated using Newey West standard errors.

<u>Annexe 4 demand equations up to bubble period</u>

Housing prices: Long-term demand relationship up to the bubble period

	France		Spain	
	Eq.1	**Eq.2**	**Eq.3**	**Eq.4**
Housing stock	- 7.36 ***	-0.95***	-5.23***	-4.47***
Gross disposable income	0.47**	1.64***	3.89***	3.70***
User cost	-0.34**	-0.46***	-	-
Demographics	33.5***	-	6.31***	4.17***
Unemployment rate	-	-	-	0.16*
Sargan P-value	0.66	0.17	0.54	0.99
Wu-Hausman F test	0.00	0.00	0.00	0.00
Adjusted R^2	0.88	0.89	0.98	0.98

* p<0.10, ** p<0.05, *** p<0.001, according to the values tabulated in Engle and Granger (1987).

Notes: The estimation period is 1980-2003 for France and 1982-2000 for Spain. These dates were chosen as they marked the end of the ‘pre-bubble period, i.e. residential property prices started growing at two digit rates afterwards. All regressions include a constant that is not reported here. Estimations were computed by Two-Stage Least Square. Exogenous instruments for the capital stock are construction costs and the long-term interest rate.

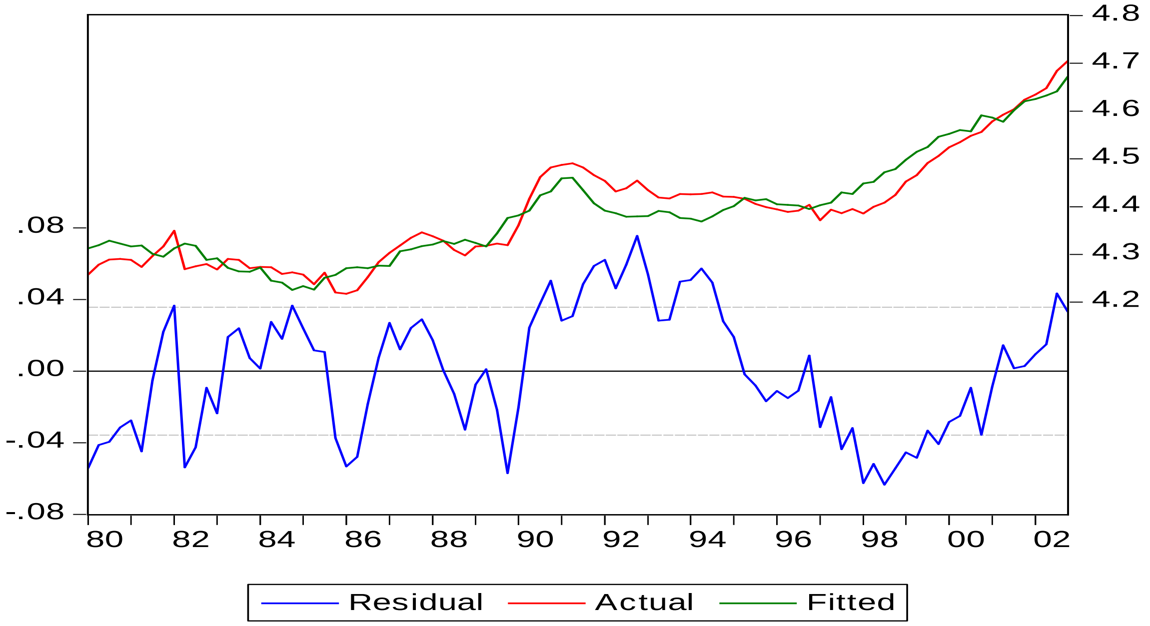
First-step estimates’ F tests indicate that instruments are strongly significant. Sargan-Hansen tests of instruments over-identification do not reject the null hypothesis of orthogonality of instruments. Wu-Hausman tests of exogeneity reject the null hypothesis of exogeneity of the housing stock. Joint residual skewness / kurtosis test do not reject the null hypothesis of normality. Breusch-Pagan tests reject the null hypothesis of homoskedasticity for equations 1 and 2; heteroskedasticity robust variance-covariance matrix estimates are hence used for those equations.

Annex 5 Residuals for the long term and short term equations

Residuals of the demand equation 2, annex 4, France

Exogenous variables: real disposable income, housing stock and user cost

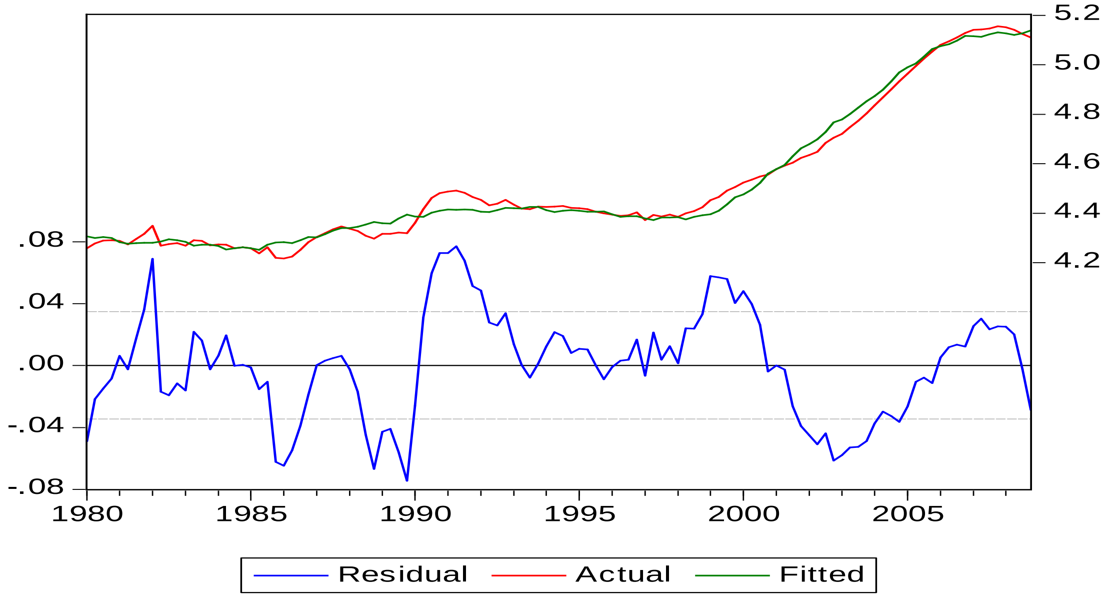
1980:1-2002:4



Residuals of demand equation 2, table 1, France

Exogenous variables: real disposable income, user cost, housing stock and population

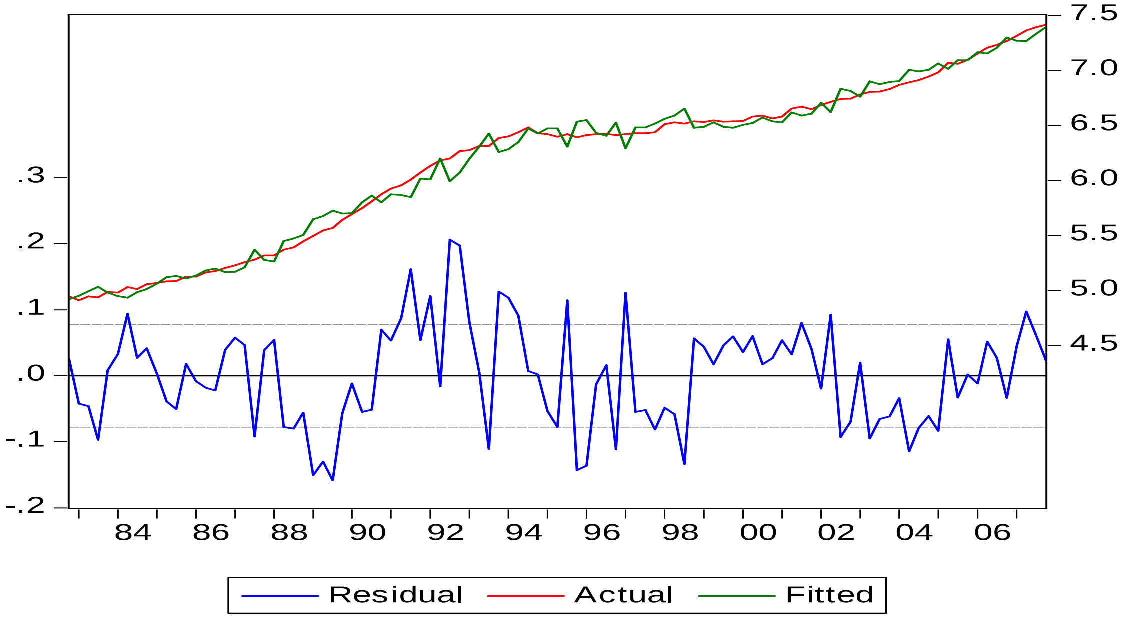
1980:1-2008:4



Residuals of demand equation 4, table 1, Spain

Exogenous variables: real disposable income, housing stock and number of households

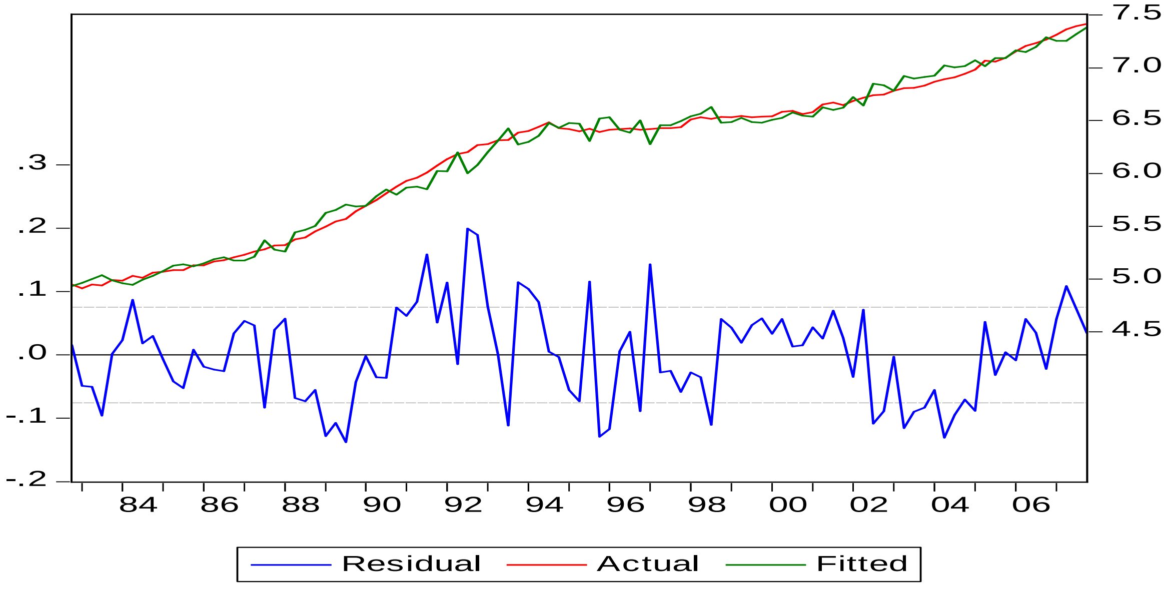
1982:1-2007:4



Residuals of demand equation 5, table 1, Spain

Exogenous variables: real disposable income, housing stock, number of households, unemployment rate

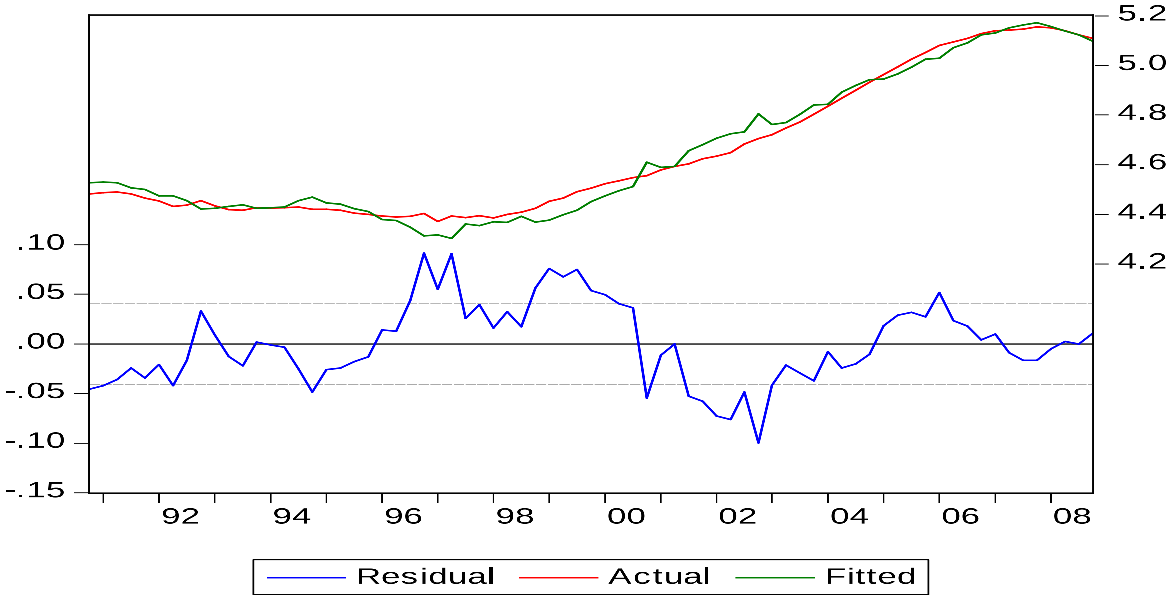
1982:1-2007:4



Residuals of demand equation including borrowing capacity, table 2, France

Exogenous variables:

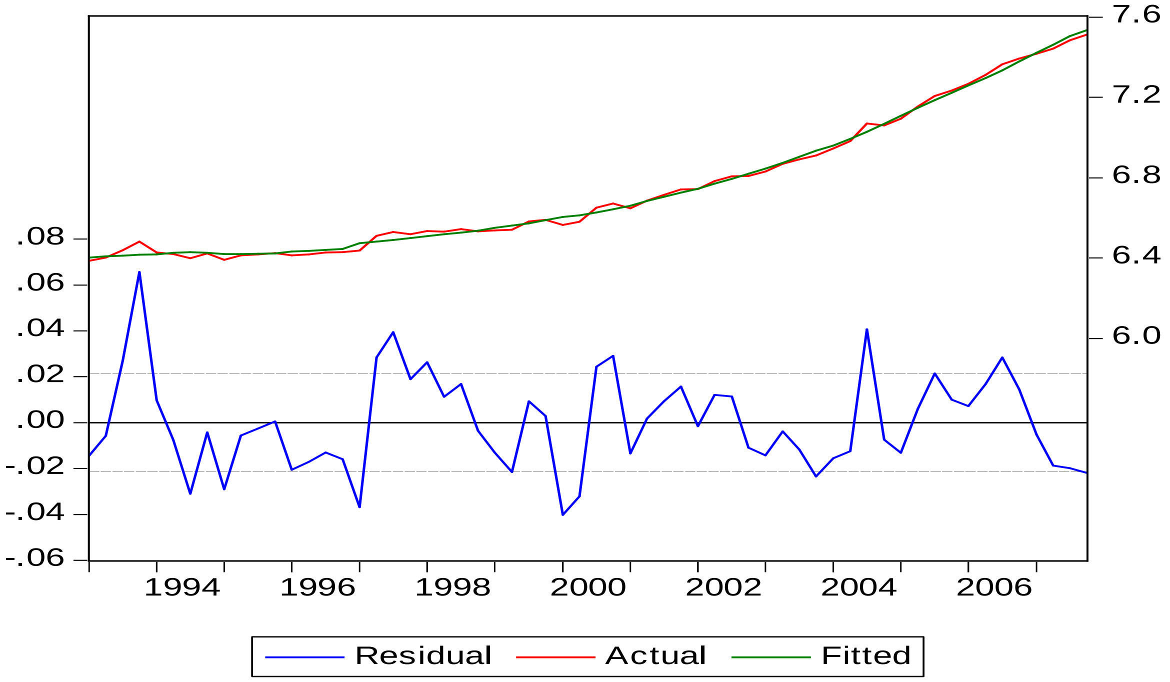
1990:1-2007:4



Residuals of demand equation including borrowing capacity, table 2, Spain

Exogenous variables: Population, borrowing capacity, unemployment rate

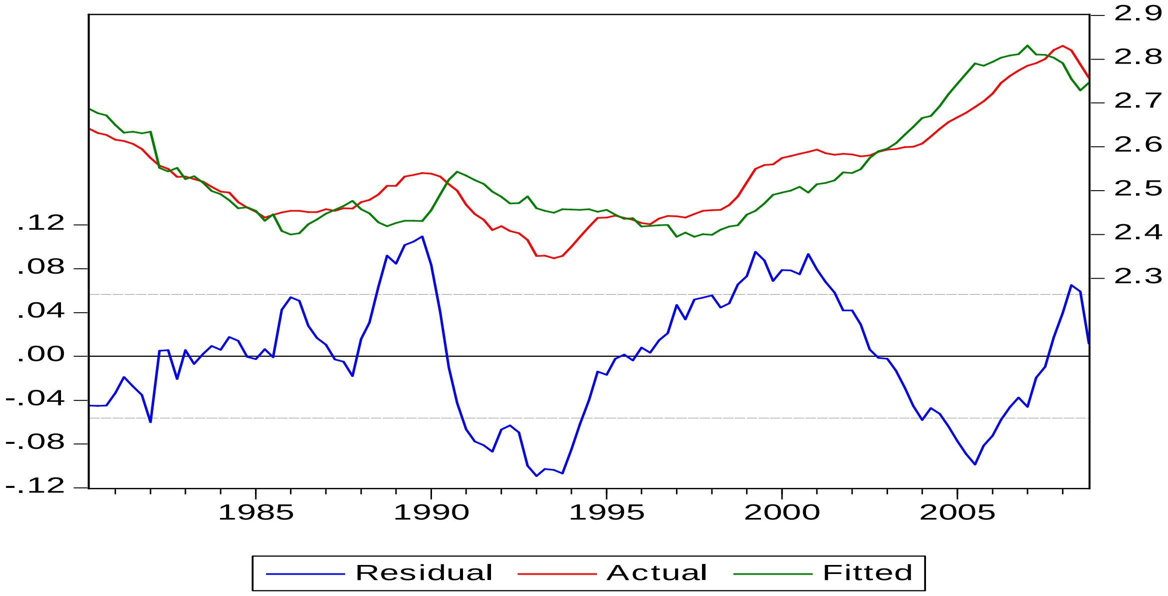
1993:1-2007:4



Residuals of supply equation 1, table 3, France

Exogenous variables:

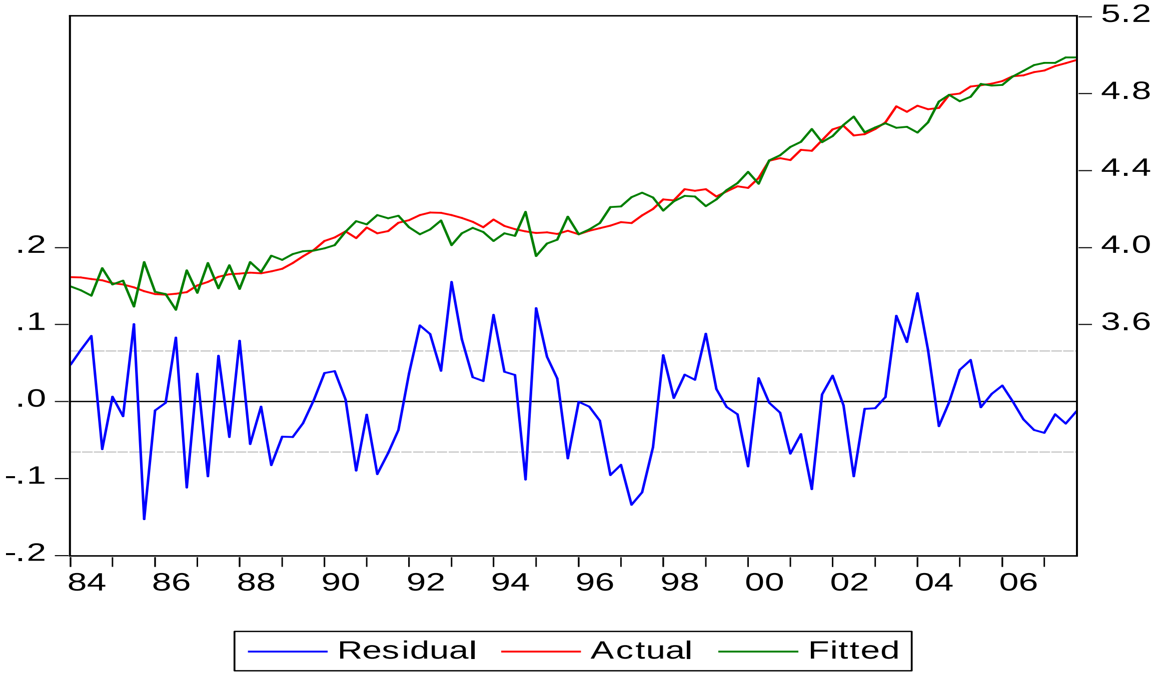
1980:1-2008:4



Residuals of the supply equation 2, table 3, Spain

Exogenous variables: real house prices, real long term interest rate and building starts

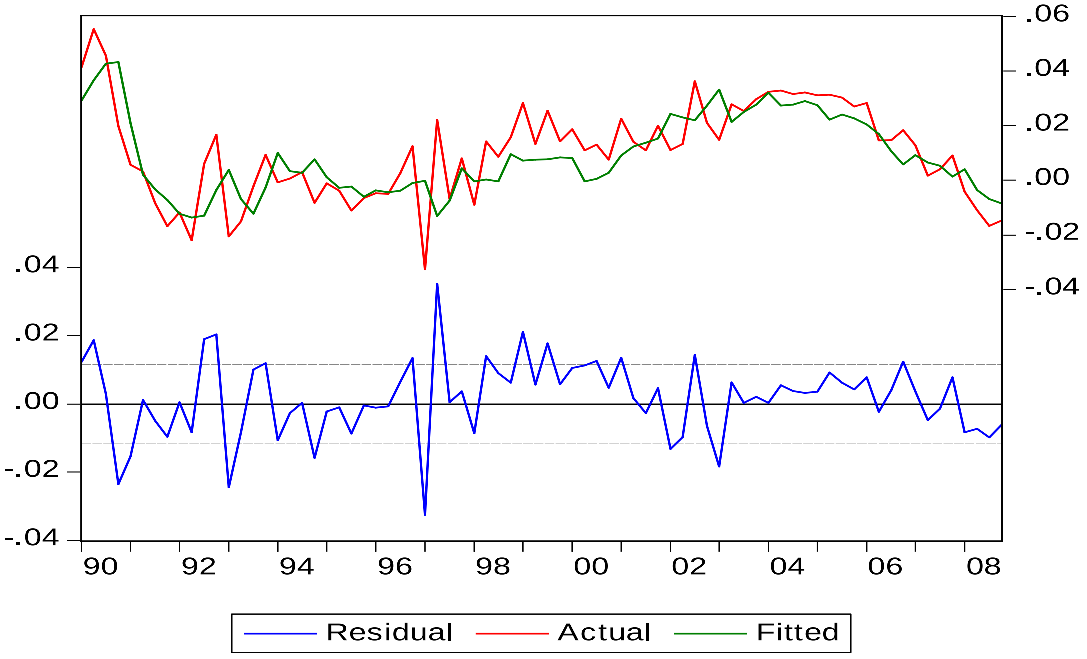
1984:1-2007:4



Residuals of short term demand equation 1, table 4, France

Exogenous variables: error correction term, lagged property prices, interest rates

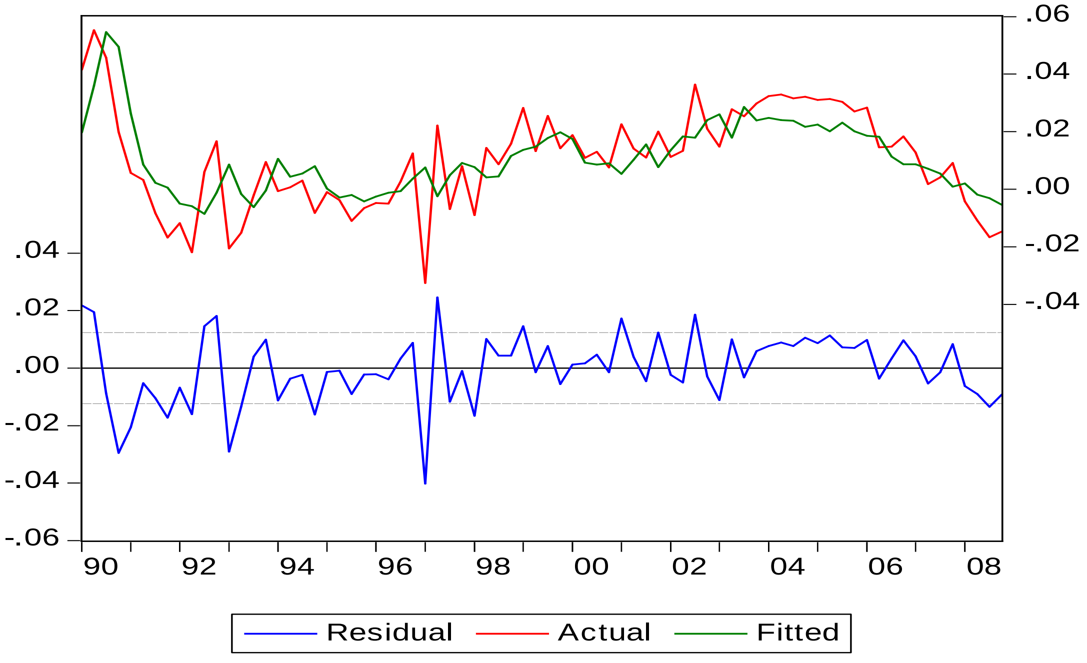
1990:1-2008:4



Residuals of short term demand equation 2, table 4, France

Exogenous variables: error correction term, lagged property prices, interest rates

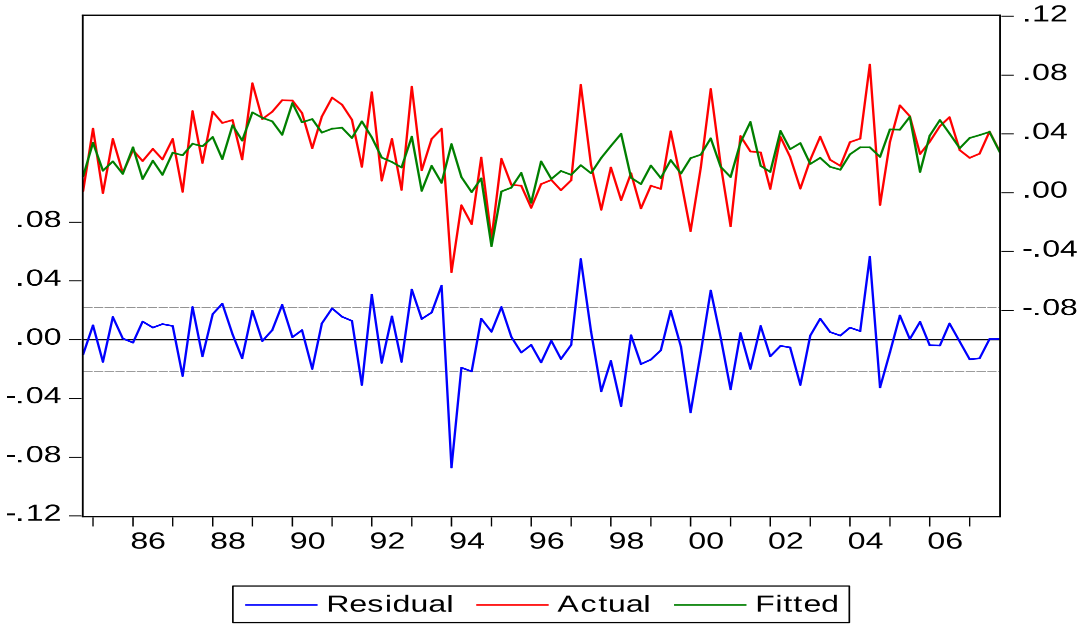
1990:1-2008:4



Residuals of short term demand equation 2, table 4, Spain

Exogenous variables: lagged property prices, interest rates, land prices

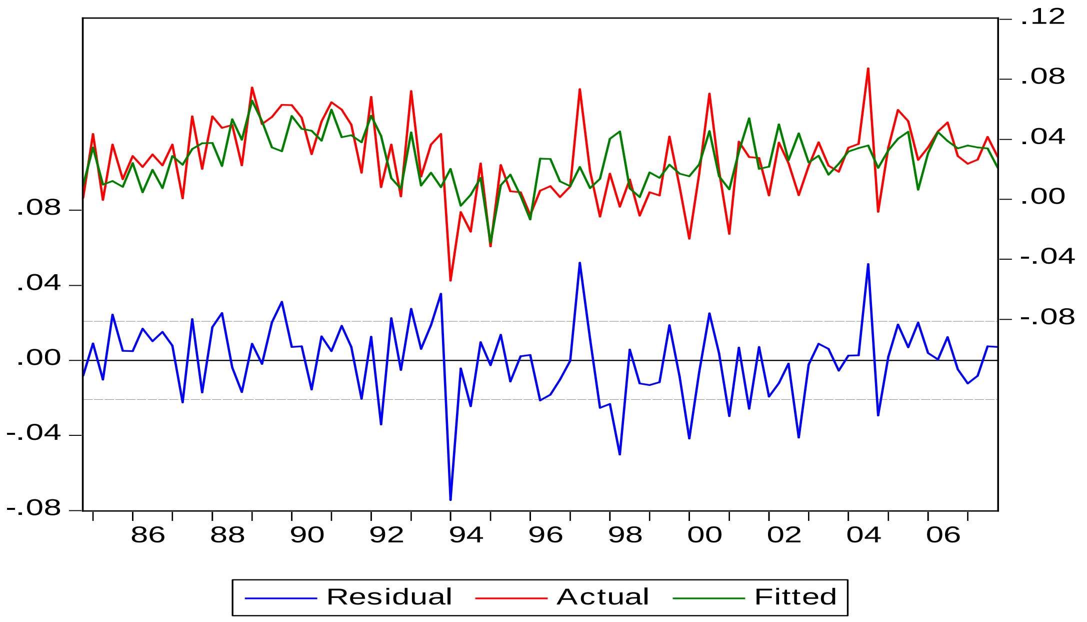
1982:1-2007:4

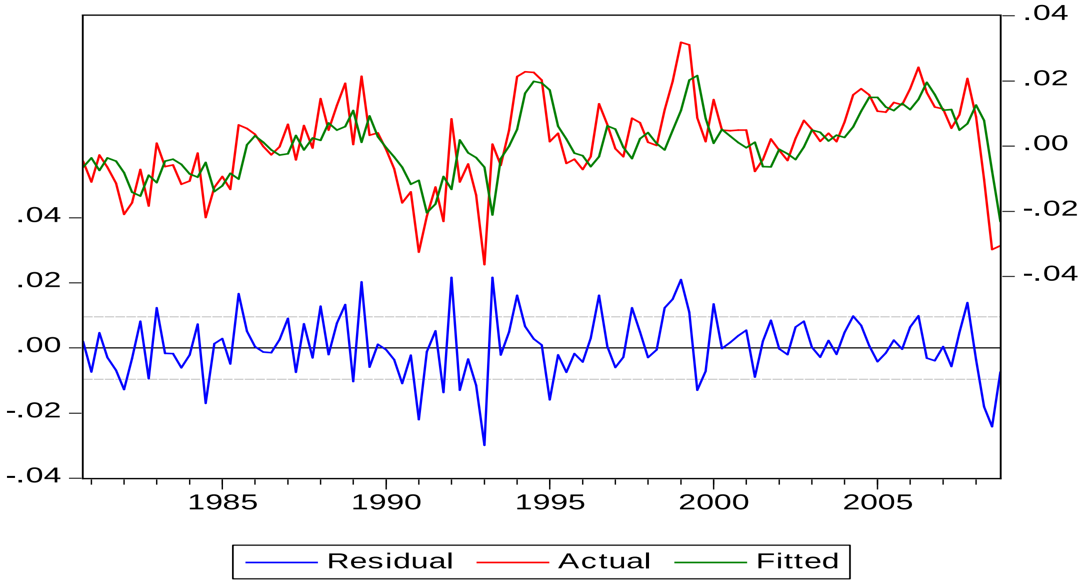


Residuals of short term demand equation 2, table 4, Spain

Exogenous variables: positive and negative residual, lagged property prices, interest rates, land prices

1982:1-2007:4



Residuals of short term supply equation 1, table 5, France
Exogenous variables: lagged residential investment, interest rates, construction costs, house prices 1982:1-2007:4


Residuals of short term supply equation 2, table 5, Spain
Exogenous variables: lagged residential investment, interest rates, construction costs, house prices (new dwellings) 1982:1-2007:4