

Housing Market Dynamics in Spain

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(draft version, comments welcome)

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Abstract:

This paper shows that the recent house price increases in Spain could be explained by market fundamentals such a structural decline in mortgage interest rates, a reduction in the inflation rate, and increases in disposable income. Given the current projections of the EURIBOR interest rates, inflation, and increases in disposable income, housing prices are projected to grow in both nominal and real terms over the medium term, albeit at a slower pace than in recent years.

Eliminado: This result contrasts with previous studies, which found a housing market bubble oscillating between 8 and 52 percent of the market prices.

I am gratefully acknowledged to the comments of the participants of the Monetary Affairs and Exchange Department (MFD) of the International Monetary Fund. In particular, comments from Antonio García Pascual have been very useful. All remaining errors are mine.

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I. Introduction.

Between 1976 and 2005, the average price of a new house in Spain increased by 3.5 percent per year in real terms. Nowadays, the average price of a new house in major cities like Madrid or Barcelona is about 4,000 euros per square meter, or 30 times higher than in 1976. These developments have attracted a growing attention in the public and in the media. House price concerns consistently ranks among the five main sources of concern in Spain in the latest polls of the *Centro de Investigaciones Sociológicas* (CIS). The increased interest in housing market developments motivated the creation of a Housing Ministry in April 2004 by the new government.

Most of the existing literature on recent housing market developments in Spain points out to the existence of a housing market bubble. According to this literature, market fundamentals such as the steep decline in interest rates in recent years, the steady decline in the inflation rate, the deepening of the mortgage market, and the increases in disposable income cannot fully explain the steep increases in housing prices in recent years. The estimates of the size of this bubble vary considerably between the different studies. For instance, Balmaseda, San Martín y Sebastián (2002) and García-Montalvo (2003) estimate that prices are around 28 percent higher than they should be according to market fundamentals. Martínez Pagés and Maza (2003), using a similar econometric approach to the one used in this paper, estimated that housing prices were at between 8 and 20 percent higher than the long-term equilibrium value as of end-2002. The Bank of Spain most recent update of this model (with data until end-2004) estimates the size of the disequilibrium at between 24 and 35 percent of the average house price. The World Economic Outlook, chapter II (September, 2004) concludes that fundamentals cannot explain between 10 and 20 percent of the recent evolution of house prices. Finally, The Economist (2003) estimates a price bubble equivalent to 52 percent of the average house price.

An immediate policy implication of these results is that, given the growing importance of residential mortgages in Spain (almost 50 percent of GDP as of end-September, 2005)² and the fact that more than 99 percent of new residential mortgages are contracted at variable interest rates, a sharp increase in interest rates and a slowdown in economic growth may trigger a reduction in house prices that could have serious consequences on the health of the financial system. Due to these concerns, the Bank of Spain has repeatedly exercised moral suasion, and advised commercial banks to be more cautious when extending new mortgage loans.

Most of the studies cited above assess the existence of a housing market bubble by comparing the price-to-earning ratio (i.e., house price-to-rental income ratio) since 1999 with

² This ratio still compares favorably with the U.S, where it stood at about 67 percent of GDP in 2005, despite lower rates of home ownership (69 percent versus 85 percent in Spain).

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its average in the previous decades. However, in Spain, such indicator is not a valid approach for measuring the size of the house market bubble. Because of rental market regulations that are heavily tilted in favor of tenants, and the slowness of court actions to resolve flagrant abuses benefiting tenants (damage to the premises, unpaid rents, etc...), the size of the rental market in Spain is the smallest in Europe. Indeed, only about 10 percent of main housing units are rented³ (Eurostat, 2001), while the stock of unoccupied homes doubles this percentage.⁴ This reflects that purchasing residential real estate for rental purposes is not an attractive alternative, for many investors. In addition, we may argue that the equilibrium price-to-earning ratio has increased after the adoption of the euro by Spain driven by a sizable reduction in the long-term interest spreads of about 500 basis points with respect to countries like Germany.

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This paper develops and calibrates a dynamic model of the Spanish housing market. Because of the difficulty to find what is a “long-term equilibrium value of house market prices” given the structural changes of the Spanish economy since the adoption of the euro, the objectives of the paper are different and more modest. First, the paper investigates if the increases in house prices since 1997 can be explained by the evolution of fundamentals, such as the steep decline in average mortgage interest rates, the reduction in the inflation rate and the easier access to mortgage lending derived from it, and the increases in disposable income. It is found that, although the price increases have been higher than explained by the model, the difference is not statistically significant. Second, using the IMF’s current set of projections for the EURIBOR interest rates, CPI inflation, and the disposable income growth, the model predicts that on average real housing prices will increase by about 8 percent a year during the next five-year period (down from 1.5 percent during 2000- 2005).

Eliminado: The main finding of the paper is that, as of end-2004, there is no evidence of the existence of a housing market bubble. Market fundamentals,

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The remainder of the paper is organized as follows. Section II describes developments in the Spanish housing market and compares them with those in Germany—a country with substantially lower declines in interest rates and increases in disposable income during the same period—and in the U.S, with housing market developments more similar to Spain’s. Section III develops and calibrates a dynamic model of the housing market. Section IV projects average housing prices during the next five-year period given the expected evolution of interest rates, inflation, and disposable income. Section VI summarizes the main policy implications of these results and outlines some house market reforms that would improve social welfare.

II. Developments in the housing market

³ The share of rental units, which reached 40 percent of total housing units in 1960, has decreased steadily over time.

⁴ On the contrary, in the rest of Europe, the ratio is two rented housing units to one unoccupied home.

Since 1976, the average price of a new house in Spain has increased at an average annual rate of 3.5 percent in real terms. During this period, the real mortgage rate has oscillated between negative values in 1977-78 and a peak of 11 percent in 1992, with the rates since the adoption of the Euro, well-below the historical average. Average CPI inflation has decreased from a peak of 26.4 percent in 1977 to a historical low 1.4 percent in 1998. Real GDP growth during the period averaged 2.7 percent, with sharp contrasts between the low-growth periods of 1977-1984 and 1992-1996 and the rest of the period. Demographic and sociological changes have reduced steadily the average size of a household from almost 4 individuals per household in 1976 to about 2.7 nowadays.⁵

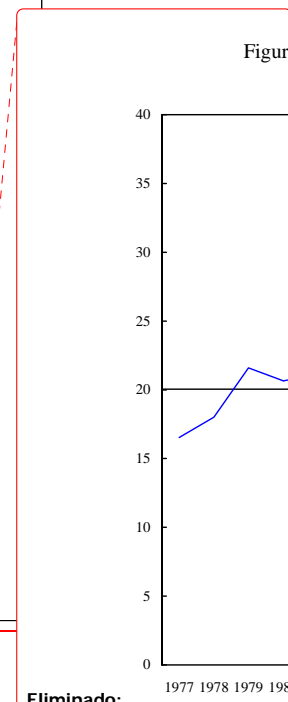
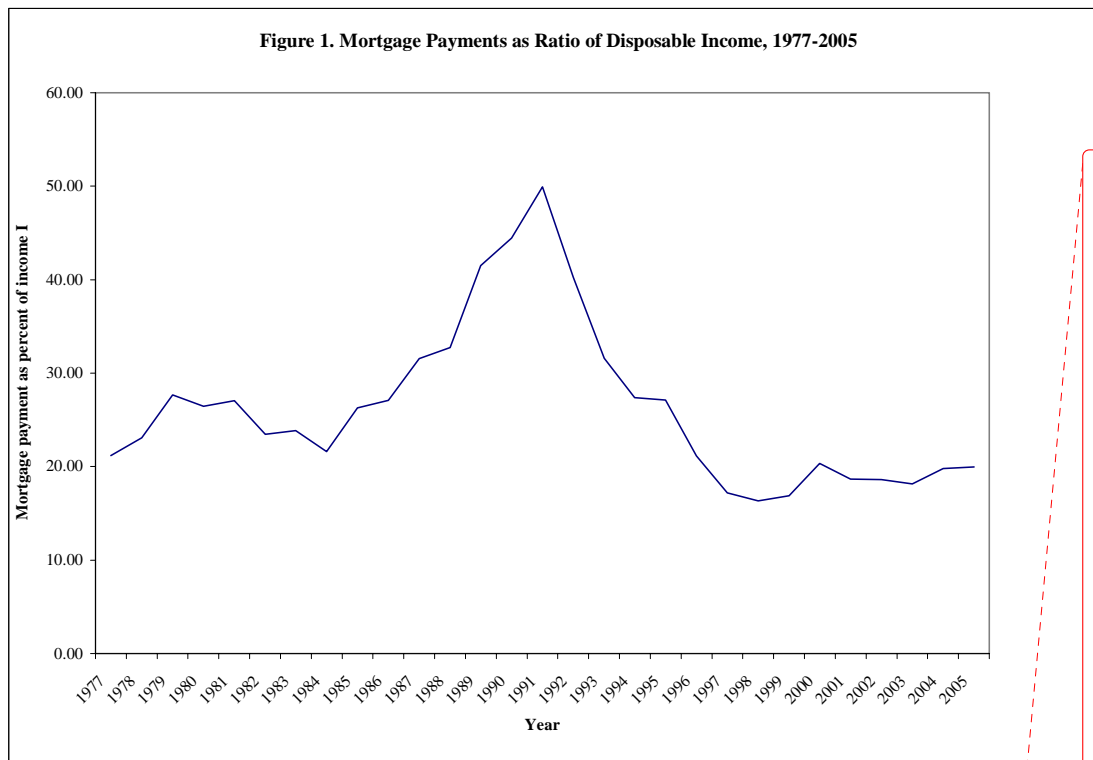
Given all these changes, and assuming an average length of new mortgages of 25 years and an average size of a housing unit of 93.75 sq. meters,⁶ these trends imply that the share of average household disposable income allocated to servicing a new mortgage of a typical Spanish house unit (the inverse of the affordability ratio), has experienced significant changes during the period. Figure 1 shows that this share went from a maximum of almost 50 percent in 1991 to a minimum of just 16 percent in 1998. As of end-2005, despite recent increases in house prices, the share of disposable income allocated to service new mortgages is still 20 percent, or about 30 percent below the historical average.

⁵ Data extrapolated from the Statistics National Institute population census conducted every 10 years.

⁶ In fact, the average length of new residential mortgages increased quite considerably during the period. If we consider this factor, the average household mortgage service decline in the last period would be considerably steeper than depicted in Figure 1. But also the average size of a housing unit has increased over time. For simplicity reasons, the figure considers an homogeneous home and a homogenous mortgage maturity during the 1977-2005 period.

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We can distinguish four different subperiods regarding housing market developments: 1976-1984, 1985-1991, 1992-1997 and 1998-2005 (Table 1). During the 1976-1984 period, real house prices declined by about 19 percent (2.4 percent a year on average) due to negative real household income growth and high inflation. Also, real mortgage interest rates, which were negative at the beginning of the period, increased to nearly 9 percent in 1983-1984. The housing market trends were reversed in 1985-1991, a period of strong income growth, declining inflation, and a small decline in real interest rates until 1989. As a result, real house prices increased by 13 percent on average during each year of the period. In 1992-1997, the sharp increases in real interest rates—which started in 1989, with real interest rates reaching a double-digit level in 1990-1992—and the slowdown in economic growth reduced the real price of new homes by 33 percent.

Real house prices recovered in the 1998-2005 period, albeit at a slower pace than in the previous expansionary period (1985-1991). Moreover, contrary to what happened between 1985 and 1991, house price increases were associated with a sharp reduction in real interest rates, which averaged only 1.4 percent in 1998-2005, due to the adoption of the euro in 1999 which in turn reduced the interest differential paid on Spanish debt with respect to core

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European countries -such as Germany- from about 500 basis points in the first half of the 1990s to virtually zero and even negative levels in recent years. Also, the steady reduction in the inflation rate and inflationary expectations has deepened the mortgage market and increased the average maturity of mortgage loans by about 10 years during the period. Overall, despite the house price increases in this subperiod, the percentage of disposable income allocated to the payment of a standard mortgage was nearly 30 percent lower in 2005, than its historical average in 1976-2005, and substantially lower than the average during the previous expansionary period of 1985-1991.

Table 1. Spain: By subperiods: house prices and related factors
(average)

	1976-1984	1985-1991	1992-1997	1998-2005	total
real house price					
euros per square meter	245.2	419.6	420.8	557.1	398.9
rate of change	-2.4	14.2	-5.5	8.3	3.5
real household disposable income					
euros	142.9	158.8	165.8	189.7	163.5
rate of change	-0.9	2.2	1.0	2.4	1.2
CPI	15.9	6.5	4.0	3.0	7.5
real mortgage interest rate	3.4	8.6	7.5	1.4	5.1

It is important to notice that, in the past, every major change in housing prices has been preceded by increases (decreases) in the affordability ratio well above the period average. For instance, the price increases in 1985-1991 were preceded by relative high affordability ratios in the previous years, with a mortgage service-to-income ratio which averaged about 23 percent between 1982 and 1984. Similarly, the substantial correction in the market between 1992 and 1997 followed the deterioration in the affordability ratio in the previous period, which reached a peak in 1989-1991. Finally, the house price increases since 1998 also followed a period in which house affordability reached its maximum.

House price developments: Comparison between Spain and the U.S., 1976-2004

The pattern of average house prices in Spain is similar to the United States. As in Spain, in the U.S. average house prices have increased in real terms during the period, albeit at a lower pace (1.4 percent). Also, the different subperiods are strikingly similar: in the U.S., a decrease in real house prices in the 1976-1982 period was followed by a relatively fast growth in housing prices until 1989 (in the U.S. both the expansionary and deflationary real price cycle was anticipated by 2-3 years), a new decline in real prices until 1996, and real increases during the 1997-2004 period.

A key difference between the two markets, however, is the much lower variability in mortgage interest rates in the U.S, with a standard deviation three times lower than in Spain. Also, mortgage indebtedness of the U.S. economy is substantially higher than in Spain despite the lower ownership rates in the U.S (69 percent versus 85 percent in Spain): total mortgage

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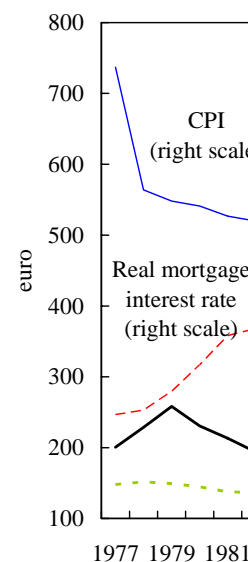
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Table

real house price
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Sources: Housing Ministry, I

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debt amounted to 67 percent of GDP in the U.S, and 50 percent of GDP in Spain in September 2005. This is explained by the fact that less than one quarter of houses in Spain are subject to mortgage payments.

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House price developments: Comparison between Spain and Germany, 1976-2004

Eliminado: 2004

The performance of the housing market in Germany since 1976 has been quite different from Spain's and the U.S's. Overall, average real house prices in Germany decreased by 11 percent during that period. Also, the price cycle has been quite different. During 1976 and 1981, real house prices increased in Germany by about 15 percent (compared with declines in both Spain and the U.S.) but declined since then, except for a brief period in 1989-1991 in which prices increased slightly, due to the expectations derived from the German unification. In fact, in the 1992-2004 period, average house prices have declined by 17 percent. Average real household income growth remained flat during the period⁷, while real interest rates showed a slower decline—and variability—than in Spain.

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The relatively favorable performance of the Spanish housing market compared to other economies such as the U.S and, especially, Germany can be explained by the evolution of structural factors such as higher average growth, a more pronounced reduction in the inflation rate, and in particular, a sharper reduction in the mortgage interest rates especially following Spain's entry in the Euro area. Therefore, any analysis of the house market dynamics in Spain should capture this permanent, structural change, that distinguishes the market performance in Spain in 1998-2005 from the performance in other countries and also from housing price developments in previous periods.

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III. The Model

Due to the relative inelasticity of the supply of housing (mostly because of land market regulations) and the considerable lags between increases in housing market demand and the reclassification of new residential land, real house prices, $\log P_{house}$, are assumed to exclusively depend on demand factors (in particular, the real household disposable income, $\log Y$; the real mortgage rate, $mortgage$; and the rate of inflation, $d\log CPI$) and adjust in response to deviations in these factors forcing the movement towards the long-run equilibrium state or comovement, which can be represented as:⁸

⁷ The small increase in real per capita disposable income was offset with the decline in the average household size.

⁸ Another important demand factor is foreign investment in the residential market, which has increased from 0.15 percent of GDP in 1993 to 0.95 percent of GDP in 2003 (source: Bank of Spain). However, the available data on foreign investment in the residential sector are

(continued)

$$\log Phouse = f(\log Y, mortgage, dlogCPI) \quad (1)$$

Deviations from the equilibrium are expected to be corrected gradually through short-run adjustments. Higher disposable income, lower mortgage interest rates, and lower inflation rates are expected to raise housing demand, thus, ultimately increase housing prices. Higher inflation rates imply—*ceteris paribus*—a higher nominal mortgage rate and therefore higher initial mortgage costs. Thus, because banks usually limit mortgage service costs up to about 35 percent of the current household income, a reduction in the inflation rate would increase the mortgage loan that the bank would be willing to extend to the household, and therefore the demand for houses and their prices. In other words, a decline in the inflation rate would ease credit constraints for households. Table 2 shows that, in Spain, the decline in inflation from an average of about 16 percent in 1977-1984 to 3 percent in 1998-2004 implied that, given other factors equal, the amount of principal that could be financed through a mortgage loan increased by 238 percent:

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Table 2. Effect of Inflation on Mortgage Financing 1/

Period	Average inflation rate	Nominal interest rate	Maximum mortgage financing (in percent of household income)	Increase with respect to 1976-1984
1976-1984	15.9	19.5	177.4	...
1985-1991	6.5	10.1	315.3	177.7
1992-1997	4.0	7.6	386.7	218.0
1998-2004	3.0	6.6	423.0	238.4

1/ Initial mortgage equals 35 percent of disposable income. Assumes same real interest rate for all subperiods, equal to 3.6 percent (average for 1976-2004 period), and same disposable income for all subperiods.

We model the housing dynamics using a vector error correction model (VECM), which allows to estimate the long-run (or cointegrating) relationship between the four variables—*logPhouse*, *logY*, *mortgage*, *dlogCPI*—while allowing short-run adjustments towards the long-run equilibrium.

Estimation results

Data for this study cover the period 1977-2005 and include annually observations for the following variables: real housing prices (in logarithm), real mortgage rate, real household disposable income (in logarithm) and rate of inflation. The annually series for average

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insufficient to include this variable in the econometric analysis, as the serie only goes back to 1990.

housing price per square meter in Spain is obtained combining data from different sources: 1977-1984 from the company *Tecnigrama*, 1985-1986 from *Sociedad de Tasación*, and 1987-2005 from Spain National Institute of Statistics (INE). While the data compiled by *Tecnigrama* refers to the city of Madrid, the data from the other two sources refer to the average housing price in Spain. In order to link both time series, we follow the approach in Martínez Pagés and Maza (2003).⁹

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Appendix I describes the sample data and presents the results for testing for unit roots and for cointegration. The estimated cointegrating and adjustment coefficients for the equation that explains the dynamics of housing price are shown in equation (2) (the coefficients of the rest of the equations of the system are shown in Appendix I).

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$$\Delta \log Phouse_t = -0.023(\log Phouse_{t-1} - 6.434 \log Y_{t-1} - 0.051 mortgage_{t-1} - 0.122 dlog CPI_{t-1} + 28.513) + 0.352 \Delta \log Phouse_{t-1} + 1.816 \Delta \log Y_{t-1} - 0.011 \Delta mortgage_{t-1} + 0.0002 \Delta dlog CPI_{t-1} + 0.009(2)$$

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Using the VECM estimates, we computed the impulse response functions to determine the effect of one standard deviation shock to one of the innovations (particularly to disposable income, mortgage rate, and inflation) on current and future values of housing prices (Appendix II). Changes in the random innovations of rate of growth of disposable income result in positive permanent changes in housing prices, while mortgage rate inflation have the opposite effect.

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Based on the VECM model estimates, the next step is to determine whether the fundamental variables explain the recent evolution of housing prices, or if on the contrary, price increases exceeded the model projections. The estimated residuals of the model during the 1998-2005 period, though positive, are not statistically significant, and therefore we could conclude that the evolution of house prices is the expected given the evolution of market fundamentals. Notice that the model detects significantly high house prices in the previous expansionary period, and unusually low in the periods that preceded and followed this expansionary period (that is, in these periods the evolution of the explanatory variables alone cannot explain the actual changes in house prices). Also, the inclusion of a dummy variable taking the value of 1 for 2002 and beyond is not statistically significant either, and stresses the above-described result of a recent evolution of house market prices according to fundamentals.

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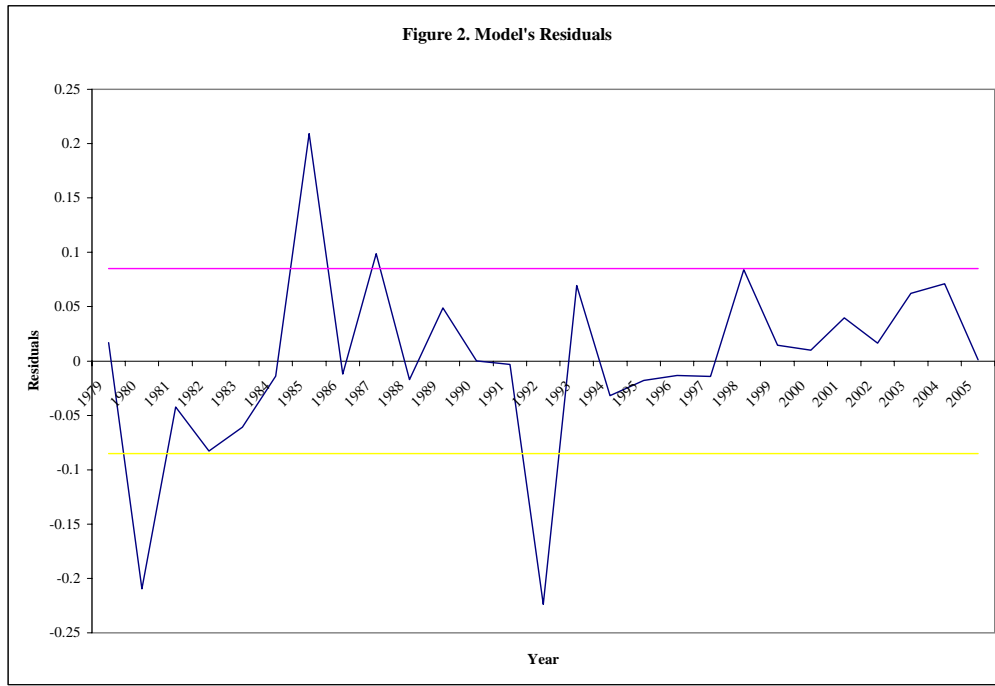
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⁹ In particular, the approach to link both time series consists in adjusting data for 1977-1984 considering the differences in average prices and standard deviation of the house prices between Spain and Madrid for the period in which both series are available.



IV. Forecasting (2006-2011)

To project the expected increases in house prices for the period 2006-2011, we use the EURIBOR interest rates projected in the latest IMF's World Economic Outlook set of projections, while the CPI inflation rate and the average household income are projected to grow in line with the IMF staff medium term projections for the Spanish economy (average real GDP growth of about 3 percent, inflation that would decrease slowly to 2.7 percent at the end of the 5-year period).

Substituting the values of these variables into the equation that describes house price dynamics (2), we derive that the estimated house prices for the period 2006-2011, and conclude that prices would increase at an average annual rate of about 8 percent in the near future. That is, housing prices are projected to grow in both nominal and real terms over the medium term, albeit at a slower pace than in recent years.

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Table	
	Euro LIBOR
	Adjusted mortgage rate
	CPI inflation
	Average household income
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V. Housing Market Policy Implications

As of end-2005, there is no evidence of a housing market bubble in Spain, as current prices are broadly in line with fundamentals and the projected changes in mortgage interest rates, disposable income, and inflation rates would leave room for real price increases over the medium term. However, if prices keep increasing at a similar pace in 2006 and beyond as in the last five years, then the evolution of market fundamentals may not be able to explain these sort of increases. Given the important increase in the supply of new housing units in the last period and the recent deceleration of house prices, a continuation of past price increases seems unlikely though.

Financial sector implications

Under the reasonable assumption that the rate of problem loans in the mortgage market is closely related to the ratio of disposable income allocated to finance a house loan, an interesting exercise is to find what mortgage interest rate and what rate of real GDP growth would be consistent with a ratio of loan problems of about 5 percent (that is, the peak reached during the early 1990s)¹¹. We find out that, given current prices, an interest rate of 9.7 percent and a slowdown of economic growth to nearly zero would be consistent with a deterioration in the affordability ratio to levels similar to 1989-1992. Therefore, we need a threefold increase in current interest rates and an important decline in the expected growth rates to start having problems in the banking sector due to developments in the housing market. Such negative shocks seem unlikely.

The low probability of a financial sector crisis derived from recent developments in the housing market is composed with other factors, such as the relatively high household savings rates and the low debt/assets ratio. Despite recent declines, as of end-2004, Spain still had a relatively high household savings rate of 10.7 percent of disposable income, compared to U.K.'s 6.4 percent or U.S.'s 1 percent. Total residential mortgage lending represented only 8.6 percent of residential households wealth, one of the lowest ratios in the OECD. For the sake of comparison, in the U.S total household mortgage debt amounted to US\$8,049 billion in 2004, almost 50 percent of the market value of the households real estate (US\$17,165 billion).¹²

¹¹ In 2004, it stood at an historical low of 0.36 percent.

¹² Source: Federal Reserve System, Flow of Funds Accounts of the United States, <http://www.federalreserve.gov/releases/z1/current/z1.pdf>.

Table 4.1

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Structural policies

The above described results do not mean that there is no room for substantial improvement in housing market policies, especially regarding the land market and the development of a rental market.

A deregulation of the land market is unlikely to affect significantly the average prices of a house *units* in the long run since the desired share of income allocated to housing expenditures –given by households’ preferences- is likely not to change by much. A land market deregulation aimed to reduce the cost of residential land would improve welfare, because households would be able to purchase larger homes by the same price. In other words, cheapest residential land would mean that households can get bigger houses for the same price. In Spain, heavy land market regulations imply only 5 percent of the land that may be allocated for residential and commercial use (about 20 million hectares in Spain) is actually available for residential and commercial use. In fact, in the U.S., where the land market is in general much more deregulated than in Spain, the average cost of a square meter of a housing unit is about 50 percent lower than in Spain’s. The main obstacle for land market deregulation is that residential land sales-related proceeds are a major source of revenue for local governments, and therefore they are interested in limiting the supply of land to increase prices. A welfare-maximizing policy solution would be to change the sources of financing of local governments to eliminate this incentive to reduce residential land supply.

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Regarding the rental market, a change in the current regulatory framework that favors property against renting would increase the supply of existing housing units in the market. The current framework establishes a minimum period of five years for rental contracts in which rent increases are indexed to the CPI, tax incentives that are biased towards home purchases, and the lack of legal safety for home owners in case of unpaid rents. The improvement in this regulatory framework would increase the supply of housing available in the market, as some –or, probably, most- of the estimated 3 million empty housing units in Spain would be available in the market, reducing house price increases pressures.

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Appendix I. Data sample

Eliminado: description, test results for unit roots, and test results for cointegration

Con formato: Izquierda

Table I.1. Data.

	Average price per m2, new housing units 1/	Average household income (in euros) 2/	Mortgage interest rate (in percent) 3/	Consumer Price Index (in percent)4/
1977	87.4	5523	13.8	26.4
1978	116.0	6600	13.5	16.5
1979	151.5	7503	14.2	15.6
1980	155.8	8378	14.8	15.2
1981	164.8	9115	15.6	14.4
1982	170.9	10346	14.8	14
1983	177.3	11551	16.3	12.2
1984	189.5	12846	15.3	9
1985	260.4	14020	14.7	8.2
1986	329.9	15972	13.5	8.3
1987	427.6	17760	13.5	4.6
1988	511.4	19503	12.8	5.8
1989	623.3	21637	15.0	6.9
1990	720.4	23696	15.3	6.5
1991	796.6	23287	15.2	5.5
1992	689.7	25319	15.4	5.3
1993	698.9	25704	11.7	4.9
1994	699.1	26624	10.3	4.3
1995	707.6	28781	11.0	4.3
1996	717.5	29911	8.2	3.2
1997	724.1	31281	6.3	2
1998	805.2	32857	5.2	1.4
1999	896.1	34706	4.9	2.9
2000	992.0	36616	6.4	4
2001	1104.4	38356	4.9	2.7
2002	1225.1	40653	4.4	4
2003	1387.1	42873	3.5	2.6
2004	1618.6	45279	3.3	3.2
2005	1786.2	49572	3.4	3.7

Sources: *INE*, Bank of Spain, Tecnigrama, and *Sociedad de Tasacion*

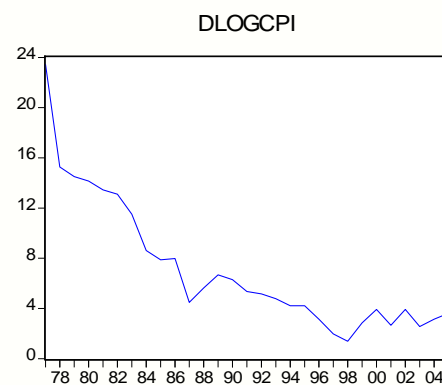
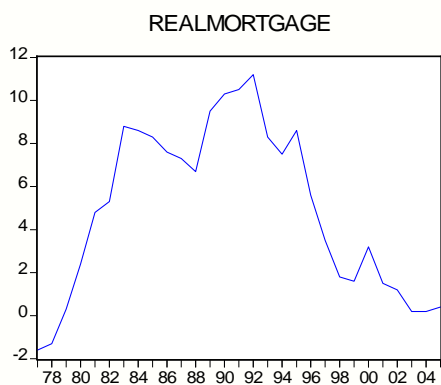
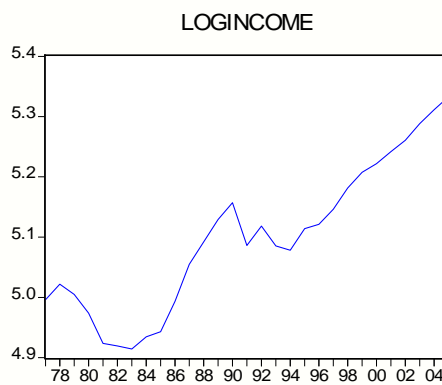
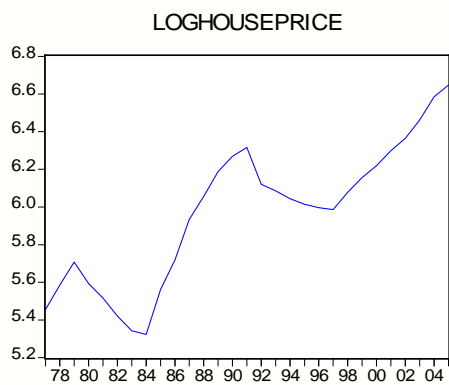
1/ For 1976-1985, data for Spain are linked-average and standard deviation- with data provided by Tecnigrama f provided by de Sociedad de Tasacion. For 1987-2005, data provided by the Housing Ministry.

2/ *INE* data, adjusted by average household size.

3/ Average mortgage interest rates (Bank of Spain, 1985-2005). For 1977-1984, serie is linked with average long

4/ *INE*.

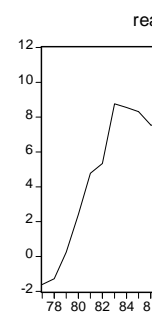
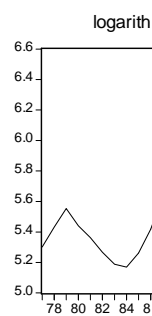
Figure I.1: Graphic Description of the Variables Used in the Model.



Eliminado: Table I.1. Data sample

Year	Real house prices (in euros per square meter)	Real income
1977	211.6	
1978	241.0	
1979	272.3	
1980	243.0	
1981	224.8	
1982	204.5	
1983	189.0	
1984	185.4	
1985	204.8	
1986	239.6	
1987	296.9	
1988	343.6	
1989	392.3	
1990	414.1	
1991	460.6	
1992	405.0	
1993	392.1	
1994	377.1	
1995	375.6	
1996	368.8	
1997	369.8	
1998	389.3	
1999	425.1	
2000	469.6	
2001	525.2	
2002	596.5	
2003	684.0	
2004	778.4	

Sources: Ministerio de Fomento, INE, Tecnigr



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Appendix II: Test Results for Unit Roots, and Test Results for Cointegration

Con formato: Izquierda

The stationarity status of each variable was investigated using the augmented Dickey-Fuller test (ADF). Test results on the levels and on the first differences are shown in Table I.2. The level variables are each integrated integrated of order one (with the exception of the rate of inflation) and stationary in first differences.

Table I.1. Unit Root Augmented Dickey-Fuller Test Statistics, 1977-2005
Model with constant

	level		first difference	
	t-ADF	p-value	t-ADF	p-value
LOGHOUSEPRICE	-0.32	0.91	-3.21	0.03
LOGINCOME	0.58	0.99	-4.18	0.00
REALMORTGAGE	-1.44	0.55	-3.90	0.01
DLOGCPI	-4.70	0.00	8.00	0.00

Note: Results of the ADF test of stationarity around a non-zero constant.

The null hypothesis is that the variable under investigation has a unit root, against the alternative that it does not. The number of lags was chosen using the modified Schwartz criterion.

Table I.2. Unit root /

logPhouse
logY
mortgage
dlogCPI

Note: Results of the ADF
The null hypothesis is the
against the alternative the
using the modified Schw

Eliminado: 4

Using multivariate cointegration technique developed by Johansen, we tested for the number of cointegrating relationships. The results indicate that the variables are cointegrated. While the hypothesis of no cointegration is rejected, the hypothesis of one cointegrating relationship is not rejected.

Table I.2: Johansen Cointegration Test.

Null Hypothesis	Eigenvalue	Trace Statistic	Critical Value	0.05 Prob.
None *	0.794696	73.0962	54.07904	0.0004
At most 1	0.507206	30.34806	35.19275	0.1517
At most 2	0.216683	11.24115	20.26184	0.5191
At most 3	0.158123	4.647261	9.164546	0.3243

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
Model where there is intercept (but no trend) in cointegrating equation.

Eliminado: 4

Null Hypothesis

None
At most 1
At most 2
At most 3

Eliminado: Model where there is ir

The estimated cointegrating vector is shown in Table I.3, with the vector normalized on the variable *logPhouse*.

Eliminado: 4

Eliminado: 4

Table I.3: The Cointegrating Vector (standard error in parentheses)

LOGHOUSEPRICE	LOGINCOME	REALMORTGAGE	DLOGCPI	intercept
1	-6.434278	-0.051199	-0.121593	28.06151
	-0.40299	-0.00791	-0.01302	

Note: Standard errors in parenthesis

<i>logPhouse</i>	<i>log</i>
1	-6.5
	(0.4

Eliminado: Note: Standard errors in parenthesis

The adjustment parameters, which show short-run adjustments towards the long-run equilibrium state are presented in Table I.4.

Table I.4. Error Correction: the Adjustment Parameters

	D(LOGHOUSEPRICE)	D(LOGINCOME)	D(REALMORTGAGE)	D(DLOGCPI)
Cointegrating equation	-0.0231 (0.062)	0.1082 (0.023)	-3.0367 (1.785)	1.6692 (1.331)
D(LOGHOUSEPRICE(-1))	0.3524 (0.123)	0.1243 (0.046)	4.7142 (3.523)	3.5216 (2.628)
D(LOGINCOME(-1))	1.8161 (0.388)	0.1028 (0.145)	-20.7506 (11.083)	-1.3618 (8.265)
D(REALMORTGAGE(-1))	-0.0113 (0.010)	0.0078 (0.004)	-0.1394 (0.288)	0.0000 (0.215)
D(DLOGCPI(-1))	0.0002 (0.006)	-0.0014 (0.002)	0.0659 (0.176)	-0.0407 (0.132)
C	0.0087 (0.013)	0.0029 (0.005)	0.1398 (0.365)	-0.6132 (0.272)

Note: Standard errors in parenthesis

Eliminado: 5

Eliminado: ¶

Table I.5. Error correction: the adjustment parameters

	$\Delta \log$
Cointegrating equation	
$\Delta \log Phouse_{t-1}$	
$\Delta \log Y_{t-1}$	
$\Delta \log mortgage_{t-1}$	
$\Delta \log CPI_{t-1}$	
intercept	

Note: Standard errors in parenthesis

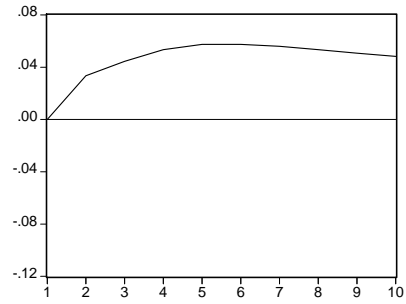
Con formato: Izquierda

Appendix III. Impulse-response functions

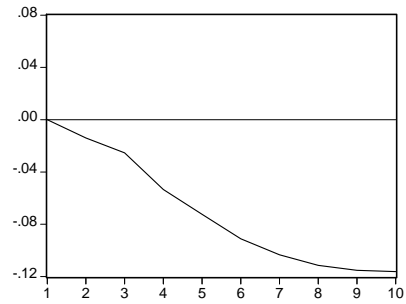
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(Francia)

Response to Cholesky One S.D. Innovations

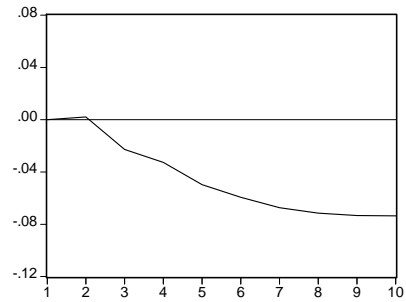
Response of LOGHOUSEPRICE to LOGREALINCOME



Response of LOGHOUSEPRICE to REALMORTGAGERATE

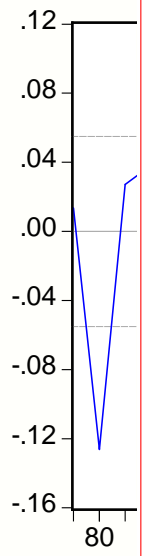


Response of LOGHOUSEPRICE to LOGCPI



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Eliminado: Appendix III.
Residuals



Eliminado:

Figure 3. Spain: Evolution of real house prices and related factors

