IS THERE A STABLE RELATIONSHIP BETWEEN REAL INTEREST RATES AND HOUSING PRICES? EVIDENCE FROM SEVERAL EURO AREA COUNTRIES

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Abstract:
This paper analyzes the relationship between real interest rates and housing prices in three European Union countries (France, Spain and the Netherlands) between 1999 and 2010. The main objective is to test whether there is a stable long-run relationship between both variables, as well as whether there are differences across countries. In order to do so, I use different real interest rates (short-term and long-term) and different housing price indices (nominal and real), and apply cointegration techniques and propose an error correction model, following the two-stage methodology suggested by Engle and Granger, in order to examine the different dynamics in the short and the long term. The main conclusion is that the relationship between real interest rates and housing prices is weak, although there are differences across countries. This has some implications for the single monetary policy conducted by the European Central Bank.

Keywords: Housing price, monetary policy, interest rate, monetary union, cointegration, error correction model

JEL Classification: C50, E42, E52

1. INTRODUCTION

This article examines the influence of real interest rates on housing prices in three of the countries that are part of the European Economic and Monetary Union (EMU), namely France, Spain and the Netherlands. The basic objective is to analyze the evolution of both variables from 1999 to 2010 and see if it is possible to verify the existence of a long-term stable relationship between them. The housing market is of central concern to monetary policy makers because of its important role in the economy, for two main reasons. On the one hand, the influence of changes in real interest rates on economic activity depends largely on the relationship real interest rates and the price of housing. On the other hand, to the extent that this relationship varies across EMU countries, it will also contribute to explain the current asymmetries in the transmission of the single monetary policy. The interest rate channel is the conventional channel through which monetary policy affects real economic activity. The rationale behind this channel is that when the central bank modifies interest rates, due the existence of certain price rigidities in the economy, it can also influence the long-term real interest rate, which is the relevant variable for the spending decisions of economic agents.

The analysis of the relationship between real interest rates and housing prices is of particular importance for the European Central Bank monetary policy for a number of reasons. First, there is a controversy about the role played by the evolution of real interest rates in the formation of a bubble in the housing market in certain countries. Second, it provides additional evidence to assess whether it is appropriate to include the price of certain assets in the central bank's objective function. Finally, it sheds some light on potential sources of asymmetric effects derived from the adoption of a single monetary policy within the Euro area. Thus, we want to investigate the potential relevance of monitoring both variables for the monetary policy of the European Central Bank. The issue is very significant from the perspective of Euro area stability as for the definition of the monetary policy objectives.

In general, the existence in the EU of important differences in patterns of ownership, financing systems and transaction costs of housing has deep implications for the transmission mechanism of the interest rate. As far as the financing of housing is concerned, different financing systems have developed historically within their own national boundaries, and reflect the influence of political and geographical factors. There are a considerable number of barriers to the convergence of financial systems within the European Monetary Union. There is a need for greater integration of corporate bond and share markets, greater cross-border mobility, fiscal harmonization, the move to a consolidated pension system, and an increase in cross-border competition in the banking and insurance sectors. Such evolution of the institutions has a clear effect on the behaviour that the ECB should take on each scenario, making the implementation of monetary policy particularly difficult. In addition, the variety of systems across countries has been reinforced by policy measures to promote housing finance in the domestic capital markets, which have promoted housing finance through tax benefits and other measures.

These actions have created a mosaic of deliberate distortions in the market. Given these institutional differences across countries, it is possible to classify economies based on the volatility of real house prices and the connection between real house prices and consumption. Within the European Union, the countries of the Germanic area have the lowest levels of volatility, being Germany characterized for having a small sector of home ownership and a large one of housing rental. At the other extreme, countries that have experienced greater liberalization of mortgage markets also suffered the greatest price volatility. Booms in the price of housing assets in each of these countries coincided with large expansions in mortgage loans. In this sense and broadly speaking, changes in interest rates have a greater impact on housing prices in countries with more developed and flexible mortgage markets, which correspond mainly to the Anglo-Saxon economies, like is reflected in the work developed by Borio (1996), Giuliodori (2005) and Calza et al. (2007).
As far as methodology is concerned, we use the Augmented Dickey-Fuller (ADF) unit root test and the Phillips-Perron (PP) test. Then, we develop an error correction model for each country that relates the evolution of housing price and the interest rate through four alternative model specifications.

This article is divided into five sections. Once the subject under study has been introduced, in the second section we establish the analytical framework. The third section discusses the main characteristics of the data and the econometric methodology employed. The fourth section presents the empirical results and their implications for the conduct of monetary policy in the Eurozone. Finally, and the fifth section summarizes the main conclusions that have emerged from the analysis.

2. RELATED LITERATURE

From a theoretical perspective, interest rates are a key variable to explain house prices through their effects on the user cost of capital. The rate that is relevant to housing demand is the long-term mortgage rate, which reflects expectations of future short-term rates over the period of homeownership. When monetary policy raises short-term interest rates, long-term interest rates also tend to rise because they are linked to expected future short-term rates. Consequently, the user cost of capital rises and the demand for housing falls.

According to standard neoclassical models of housing activity, the user cost of capital is a key determinant of the demand for residential capital, because this variable takes account of several factors: the mortgage rate, the expected rate of appreciation of housing prices and the depreciation rate for housing. As far as house prices are concerned, the expected return on the asset ”house” has to be equal to the return on an alternative investment with a comparable level of risk. As shown in Poterba (1984 and 1991), this condition, together with the equilibrium condition in the market for housing services, implies that real house prices depend on income, the housing stock and the user cost of capital, which is the alternative return on investments with the same level of risk minus the expected increase in house prices net of depreciation.

The relevance of interest rate changes to explain house price behaviour can be illustrated by analysing the latter from a purely financial approach which exploits the parallelism between a house which provides rents (or housing services) and a financial asset which provides different payoffs during a long period. The simplest case under this approach is the well-known Gordon dividend discount model. In this model the long-term equilibrium level of real house prices is derived as the present value of future real rents, discounted using a constant discount factor. Usually the discount factor is obtained adding a constant risk premium to the ex-post real interest rate:

$$\frac{D}{P} = r + RP - d \qquad [1]$$

where *D* stands for real rents, *P* is the real house price, *r* is the risk-free real interest rate, *RP* is the risk-premium on the housing asset and *d* stands for the future growth rate of real rents.
Expression [2] can be rewritten as:

$$P = \frac{D}{r + k} \qquad [2]$$

where *k* stands for the spread $RP - d$. Given *D* and *k*, expression [2] can be used to estimate the impact on prices of changes in interest rates. The non-linear relationship between *P* and *r* implies that this impact is highly sensitive to the level of both *r* and *k*.

According to the theory on the monetary policy transmission mechanism, five channels are usually identified as potentially affecting economic activity and prices: interest rates, bank credit, assets prices, expectations and the exchange rate. As the first one is particularly relevant for housing, it will receive particular emphasis. However, when evaluating the relationship of the interest rate to the price of housing, it is also necessary to consider additional channels. Such considerations may be important in understanding the different role that financial systems play in the transmission of monetary policy.

Empirical studies addressing the importance of the interest rate channel show a moderate impact and its dependence on the economies where the study is carried out (Giuliodori, 2005). These results have been generally justified by the uneven degree of competition and integration of financial markets, as well as the type of credit policy carried out by banks. For instance, the greater the use of variable interest rates, the greater the effect of this channel. Thus, in Anglo-Saxon economies, including the Dutch, with more liberalized and competitive credit markets, the interest rate mechanism is more powerful than in other European countries. However, Bernanke (2007) notes that empirical evidence suggests that the influence of monetary policy on real variables is greater than that of the traditional transmission mechanism just discussed, given the modest results obtained in empirical work. Because of this reality is necessary to take into account the so-called bank lending channel at large.

The bank credit channel, according to Bernanke and Gertler (1995), is a way to amplify and propagate the effects of the interest rate mechanism. These authors disaggregate the channel into two components: the balance sheet channel and the bank lending channel. The transmission mechanism of the balance sheet reflects the impact that changes in interest rates have on the value of the assets that borrowers use as collateral for the loans they require. In the case of real estate assets, the effect seems to work on consumption via a credit market version of the so-called financial accelerator. So the increasing prices of real estate assets due to a fall in the interest rate raise bank lending, causing a further increase in investment and output (Cecchetti et al., 2000 and Mishkin, 2001), with a clear feedback effect. As far as the mortgage credit supply channel is concerned, monetary policy affects the external finance premium by shifting the credit supply curve of financial institutions. For borrowers with a high dependence on bank credit, such as families and small businesses, if the supply of credit is reduced, the external finance premium would increase by raising the costs for borrowers to find new funding streams and overcome the adverse selection problem that they would have with a new lender.

The price of assets is the third transmission channel that especially affects housing. The intensity of this mechanism will increase with the weight of real estate assets as a proportion of the total assets of households and firms (Visco, 2007). In addition, institutional differences in mortgage markets across countries will cause differences in the speed and intensity of the transmission of monetary policy impulses.

The issue of monetary policy and asset prices has been receiving much attention because central banks have faced daunting challenges from large swings in various types of asset prices. There is economic literature on the problem of asset inflation and its possible inclusion in the reaction function of central banks. Cecchetti et al. (2000) argue that central banks should react to the bubbles, in both financial and housing markets. The main arguments in favour of monetary policy intervention to stop the bubbles generated in house prices is justified, on the one hand, on the fact that the deviation of assets price from their theoretical foundations could lead to inappropriate investments, decreasing the efficiency of the economy (Dupor, 2005). On the other hand, it is argued that to the extent the agents are aware that the monetary authority will react to bubbles in the price of certain assets it would be possible to prevent their growth beyond a certain level (Cecchetti et al., 2000). Authors like Ceccheti et al. (2000) and Borio and Lowe (2002) consider that a rise in interest rates can moderate the prices growth slowing the formation of the bubble and prevent the accumulation of financial imbalances.

In contrast, other authors are skeptical that the monetary policy responds to movements in asset prices (Bernanke and Gertler, 2001; Mishkin, 2007). Mishkin (2001) points out that the arguments of Cecchetti et al. (2000) in favour of the use of asset prices as a monetary policy objective are totally dependent on the knowledge of the existence of a bubble by the monetary authorities. Moreover, movements in interest rates have highly uncertain effects on asset prices, so to raise interest rates to try to deflate them could have the opposite effect than expected.
Given all the above considerations, we might expect that the effects of the monetary policy transmission mechanisms on housing presents considerable differences both over time and across countries.

3. DATA AND METHODOLOGY

This study covers the period from 1999 to 2010 based on quarterly data. The choice of 1999 as the start year of the series was based on the commencement date of the third stage of EMU. With respect to the spatial boundary, it is limited to three countries (France, Spain and The Netherlands) that are integrated into EMU and with different structural features. The different evolution, but with a common trend, that housing prices have had in the three countries under analysis is illustrated in Figure no. 1. As one can observe, the three countries have gone through a long expansionary phase, with different intensity, in a first stage. In this sense, Spain and Netherlands are two countries that have shown higher growth in relative terms. By contrast, from 2007 to 2008 for Spain and The Netherlands, there is a turning point. France, showed a saw-tooth pattern between 2007 and 2008, but the inflationary process continued until the end of the study period.

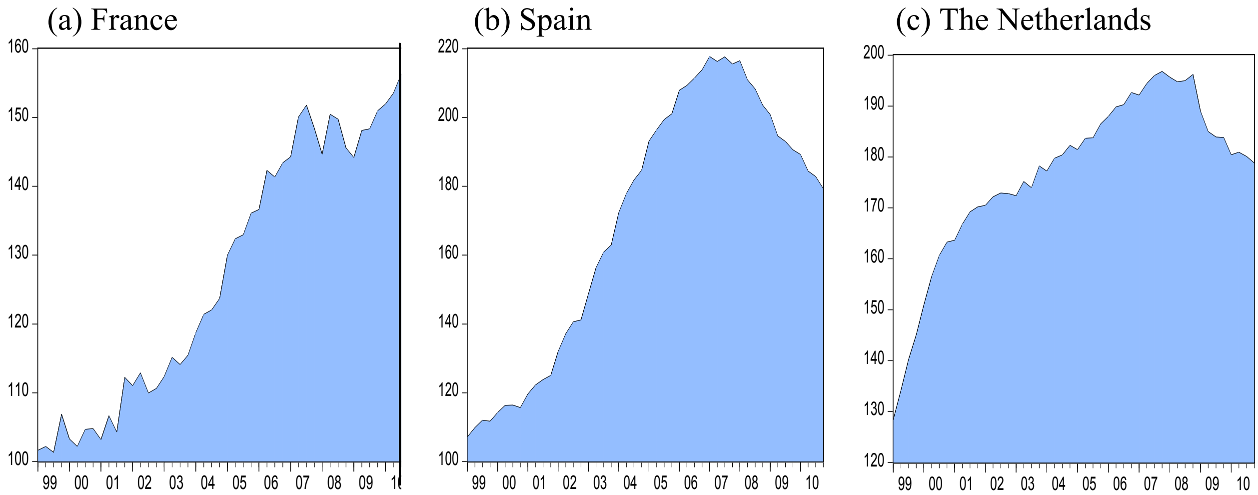

Figure no. 1. Housing price index
Source: Compiled from Bank of Spain

As far as the evolution of real interest rates is concerned, as shown in Figure no. 2, it was very similar in all the economies under study. In France they were always higher, followed by Holland and Spain. During the period covering from 2003 to 2008, there was an increase in the gap between European Union as a whole and countries as France, Spain and Netherlands. Since 2008, the differential was sharply reduced.

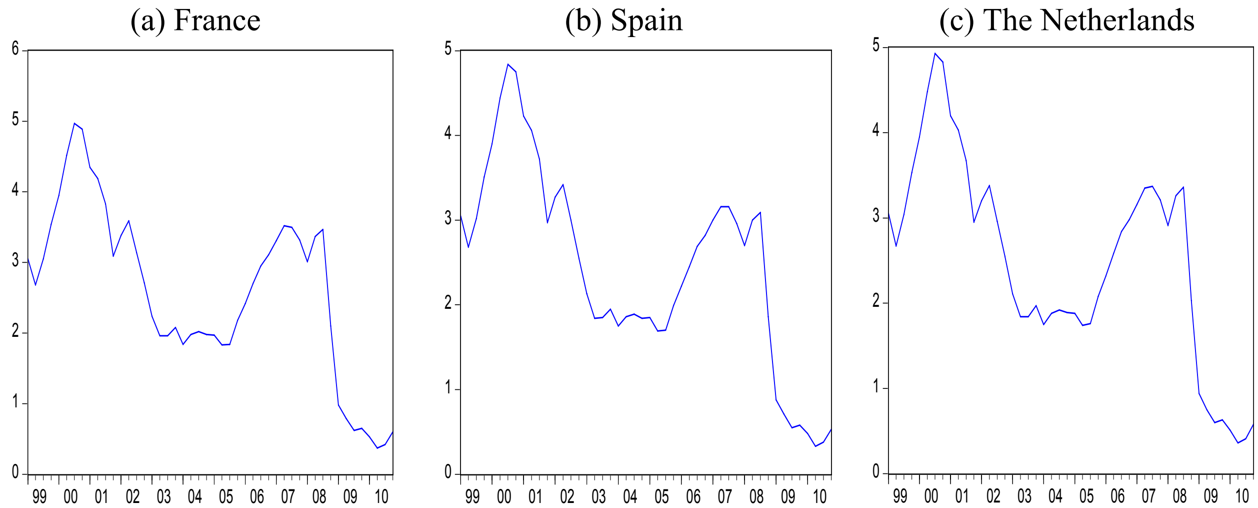

Figure no. 2. Real interest rate
Source: *Compiled from Eurostat*

The approach proposed for the analysis consists in testing the cointegration of the house price and interest rate variables in order to subsequently build an error correction model. We have used four approaches to both magnitudes that are detailed in Table no. 3.1.

Table no. 3.1. Analysed Models

	Housing Price Index	*Interest Rates*
Model 1	Nominal (Source: Bank of Spain)	Real (Source: Eurostat)
Model 2	Real (Fuente HICP: Eurostat)	Real
Model 3	Real	Long-Term (Source: Eurostat)
Model 4	Nominal (log)	Long-Term (log)

The housing price index is collected by the Bank of Spain from the statistical offices in France, Spain and The Netherlands, and measures the evolution housing prices, both new and second hand. On the other hand, we have used the Harmonized Indices of Consumer Prices (HICP), available from Eurostat, to transform the nominal value of the housing price index into real terms.

The official interest rates are the main instrument of monetary policy for central banks to achieve its primary objective of maintaining price stability. Therefore, we based our real interest rate in the European Central Bank interest rates deflated by the HICP of each country. On the other hand, for long-term interest rate we have used the Maastricht criterion bond yields. These are long-term interest rates used as a convergence criterion for the European Monetary Union.

At a methodological level, the first step was to verify the order of integration of the variables involved and, so, test at a later stage if the housing price and real interest rates move together over time and if differences between them are stable, i.e. stationary, even though each particular series contains a stochastic trend and is therefore non-stationary. In our case it would check if both variables are non-stationary of order I(1) and to see if there is a linear combination of both that is stationary or I(0), which would mean that they are cointegrated.

There are different methods to test whether a time series is stationary. Among the most commonly used are the ones we have chosen for this study, namely the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) test. Dickey and Fuller (1979) showed that under the null hypothesis of a unit root this statistic does not follow the conventional Student's t-distribution. For this reason, they obtained asymptotic results and simulated critical values for various test and sample sizes. More recently, MacKinnon (1991, 1996) carried out a greater set of simulations than the tabulated by Dickey and Fuller. In addition, MacKinnon estimated response surfaces for the results of the estimates, allowing the calculation of the critical values of Dickey-Fuller and p-values for arbitrary sample sizes. For this paper, we have used the critical values developed in Mackinnon (1996). For those cases where this test was not passed, we used the Phillips-Perron test (1988) to assess whether it would be feasible to continue with the next stage of the analysis. This test extends the Dickey-Fuller's test in order to allow for autocorrelation in the disturbances, and is a more general test, of which the Dickey-Fuller's test is a particular case.

Once the integration variable order has been checked, we followed the methodology proposed by Engle and Ganger (1987) in two stages to estimate the ratio of error correction model. In the first stage we estimated the OLS cointegration relationship to calculate the error with one delay ($\hat{\varepsilon}_{t-1}$). Next, in a second step, we estimated the parameters of the error-correction model. The cointegration analysis is closely related to the error correction model since the so-called Granger Representation Theorem (Granger, 1981 and Engle and Granger, 1987) establishes a correspondence between these models and cointegrated relationships.

Although the first-stage estimators are consistent, even superconsistent, there are some problems that can be solved using the method in three stages proposed by Engle and Yoo (1989). However, we have chosen not to use it, following Guisan (2003), who argues that there is little difference between the two methods and that, in general, it is enough to apply two-stage method by Engle and Granger.

If the real interest rate, that is represented like IR_t, and the price of housing, PV_t, have the same order of integration (I(1)) and are cointegrated using the relation $PV_t = \beta_1 + \beta_2 IR_t + u_t$ then the error correction model associated with it would be:

$$\Delta PV_t = \alpha + \delta \Delta IR_t + \gamma\left(PV_{t-1} - \hat{\beta}_1 - \hat{\beta}_2 IR_{t-1}\right) + \varepsilon_t = \alpha + \delta \Delta IR_t + \gamma u_t + \varepsilon_t$$

[1]

Thus, variations in PV_t (ΔPV_t) depend on the variations experienced by IR_t across $\delta \Delta IR_t$ and the balance that ocurred in the previous period $PV_{t-1} - \hat{\beta}_1 - \hat{\beta}_2 IR_{t-1}$, through the error correction term $\gamma\left(PV_{t-1} - \hat{\beta}_1 - \hat{\beta}_2 IR_{t-1}\right)$.

If the variable PV_t was in the previous period above its equilibrium value, γ is expected to be negative. Thus, the coefficient γ, corresponding to the error correction term, represents the rate of convergence of the short to long term. Therefore, once adjusted the error correction model given by $\Delta PV_t = \alpha + \delta \Delta IR_t + \gamma\left(PV_{t-1} - \hat{\beta}_1 - \hat{\beta}_2 IR_{t-1}\right) + \varepsilon_t$ it could be possible to measure the validity strenght of the model $PV_t = \beta_1 + \beta_2 IR_t + u_t$ in the long term.

4. EMPIRICAL RESULTS

The main results derived from our econometric exercise are reported in Tables 4.1 and 4.2.

Table no. 4.1. ADF and PP unit root tests

Model 1 (p-value (*))

Country	Variable	Test	Trend I(0)	Trend I(1)	Trend and intercept I(0)	Trend and intercept I(1)	None I(0)	None I(1)
France	Pv	ADF test	0,9292	**0,0000**(1)	0,3785	**0,0000**(1)	0,9983	0,1311
		Lag Length	0	0	0	0	0	3
	i	ADF test	0,326	0,0802	0,1792	0,2659	0,3013	**0,0092**(1)
		Lag Length	3	2	3	2	1	2
	ols resids	ADF test	0,5673	-	0,6454	-	0,1407	-
		Lag Length	0		1		0	
		PP test	0,5322	-	0,7759	-	0,1209	-
		Bandwidth	2		2		2	
Spain	Pv	ADF test	0,134	0,7983	0,8637	0,5948	0,5181	0,2771
		Lag Length	5	4	5	4	5	4
		PP test	-	**0,0419**(1)	-	**0,0088**(1)	-	**0,0021**(1)
		Bandwidth		3		0		5
	i	ADF test	0,3707	0,0784	0,1703	0,2666	0,2956	**0,0095**(1)
		Lag Length	3	2	3	2	1	2
	ols resids	ADF test	0,2541	-	0,8984	-	**0,0377**(1)	-
		Lag Length	1		1		1	
The Netherlands	Pv	ADF test	**0,0000**(1)	0,0817	0,5995	0,2721	0,4929	**0,0095**(1)
		Lag Length	0	2	0	2	4	2
		PP test	**0,0003**(1)	-	0,6376	-	0,9432	-
		Bandwidth	4		3		5	
	i	ADF test	0,3089	-	0,176	-	0,2942	-
		Lag Length	3		3		3	
	ols resids	ADF test						
		Lag Length						
		PP test						
		Bandwidth						

Model 2 (p-value (*))

Country	Variable	Test	Trend I(0)	Trend I(1)	Trend and intercept I(0)	Trend and intercept I(1)	None I(0)	None I(1)
France	Pv	ADF test	0,8461	**0,0000**(1)	0,3958	**0,0000**(1)	0,9625	**0,0000**(1)
		Lag Length	0	0	0	0	0	0
	i	ADF test	0,326	0,0802	0,1792	0,2659	0,3013	**0,0092**(1)
		Lag Length	3	2	3	2	1	2
	ols resids	ADF test	0,5706	-	0,7911	-	0,1419	-
		Lag Length	0		0		0	
		PP test	0,5603	-	0,7663	-	0,1379	-
		Bandwidth	1		2		2	
Spain	Pv	ADF test	**0,0071**(1)	0,8937	0,1753	0,7273	0,2848	0,4276
		Lag Length	4	4	4	4	5	4
		PP test	0,55	**0,0000**(1)	1,0000	**0,0000**(1)	0,743	**0,0000**(1)
		Bandwidth	4	3	1	4	5	3
	i	ADF test	0,3707	0,0784	0,1703	0,2666	0,2956	**0,0095**(1)
		Lag Length	3	2	3	2	1	2
	ols resids	ADF test	0,2686	-	0,9932	-	**0,033** (1)	-
		Lag Length	4		5		4	
The Netherlands	Pv	ADF test	0,7651	**0,0227**(1)	0,9396	0,1575	0,1403	**0,0014**(1)
		Lag Length	4	3	4	3	4	3
		PP test						
		Bandwidth						
	i	ADF test	0,3089	-	0,176	-	0,2942	-
		Lag Length	3		3		3	
	ols resids	ADF test	0,9684	-	0,8018	-	0,4646	-
		Lag Length	5		3		5	
		PP test	**0,0011**(1)	-	0,1049	-	**0,0001**(1)	-
		Bandwidth	3		1		4	

Model 3 (p-value (*))

Country	Variable	Test	Trend I(0)	Trend I(1)	Trend and intercept I(0)	Trend and intercept I(1)	None I(0)	None I(1)
France	Pv	ADF test	0,8461	**0,0000**(1)	0,3958	**0,0000**(1)	0,9625	**0,0000**(1)
		Lag Length	0	0	0	0	0	0
	i	ADF test	0,7818	**0,0000**(1)	0,174	**0,0003**(1)	0,4485	**0,0000**(1)
		Lag Length	0	1	0	1	0	0
	ols resids	ADF test	0,1416	-	0,4477	-	**0,0157**(1)	-
		Lag Length	0		0		0	
		PP test						
		Bandwidth						
Spain	Pv	ADF test	**0,0071**(1)	0,8937	0,1753	0,7273	0,2848	0,4276
		Lag Length	4	4	4	4	5	4
		PP test	0,55	**0,0000**(1)	1,0000	**0,0000**(1)	0,743	**0,0000**(1)
		Bandwidth	4	3	1	4	5	3
	i	ADF test	0,5146	**0,0002**(1)	0,6254	**0,0013**(1)	0,7161	**0,0000**(1)
		Lag Length	0	0	0	0	0	0
	ols resids	ADF test	**0,0334**(1)	-	0,2997	-	**0,0026**(1)	-
		Lag Length	0		0		0	
The Netherlands	Pv	ADF test	0,7651	**0,0227**(1)	0,9396	0,1575	0,1403	**0,0014**(1)
		Lag Length	4	3	4	3	4	3
		PP test						
		Bandwidth						
	i	ADF test	0,836	**0,0001**(1)	0,2266	**0,0004**(1)	0,417	**0,0000**(1)
		Lag Length	0	0	0	0	0	0
	ols resids	ADF test	0,6672	-	0,921	-	0,1262	-
		Lag Length	4		4		4	
		PP test	0,204	-	0,2866	-	**0,0019**(1)	-
		Bandwidth	4		2		4	

Model 4 (p-value (*))

Country	Variable	Test	Trend I(0)	Trend I(1)	Trend and intercept I(0)	Trend and intercept I(1)	None I(0)	None I(1)
France	Pv	ADF test	0,8886	**0,0000**(1)	0,3985	**0,0000**(1)	0,9981	0,2460
		Lag Length	0	0	0	0	0	4
	i	ADF test	0,822	**0,0001**(1)	0,2409	**0,0004**(1)	0,4303	**0,0000**(1)
		Lag Length	0	0	0	0	0	0
	ols resids	ADF test	0,1105	-	0,5672	-	**0,0115**(1)	-
		Lag Length	0		0		0	
		PP test						
		Bandwidth						
Spain	Pv	ADF test	0,1126	0,8515	0,9485	0,5138	0,5996	0,3213
		Lag Length	5	4	5	4	5	4
		PP test	-	**0,0332**(1)	-	**0,003** (1)	-	**0,0016**(1)
		Bandwidth		3		0		6
	i	ADF test	0,5156	**0,0002**(1)	0,6735	**0,0015**(1)	0,7377	**0,0000**(1)
		Lag Length	0	0	0	0	0	0
	ols resids	ADF test	**0,0289**(1)	-	**0,0297**(1)	-	**0,0022**(1)	-
		Lag Length	0		1		0	
The Netherlands	Pv	ADF test	**0,0000**(1)	-	0,0726	-	0,517	-
		Lag Length	0		0		4	
		PP test	**0,0000**(1)	-	0,1874	-	0,9684	
		Bandwidth	4		4		5	
	i	ADF test	0,8857	**0,0001**(1)	0,3525	**0,0005**(1)	0,3844	**0,0000**(1)
		Lag Length	0	0	0	0	0	0
	ols resids	ADF test						
		Lag Length						
		PP test						
		Bandwidth						

(1)With a significance level of 5% we accepts the hypothesis of stationarity.
(*) MacKinnnon (1996) one-sided p-values.
(**) Automatic based on SIC, MAXLAG=9 for the ADF test.
(***) Bandwidth (Newey-West using Barlett kernel).

Table no. 4.2. Error Correction Models

	MODEL 1		
Spain	$\Delta \bar{P}\bar{V}_t = 1.608320 + 1.088959\, \Delta IR_t - 0.031934\, u_t$	R2 = 0.094747	[1.1]
	3.0001105 0.725642 -1.948844		
	(0.0044) (0.4719) (0.0577)		
	MODEL 2		
Spain	$\Delta \bar{P}\bar{V}r_t = 0.484887 + 0.884623\, \Delta IR_t - 0.027560\, u_t$	R2 = 0.031687	[2.1]
	0.871501 0.570165 -1.053367		
	(0.3882) (0.5715) (0.2979)		
The Netherlands	$\Delta \bar{P}\bar{V}r_t = 0.384863 + 2.118770\, \Delta IR_t - 0.198115\, u_t$	R2 = 0.417009	[2.2]
	1.336063 2.772162 -4.472162		
	(0.1884) (0.0081) (0.0001)		
	MODEL 3		
France	$\Delta \bar{P}\bar{V}r_t = 0.569156 + 0.772404\, \Delta ILP_t - 0.103257\, u_t$	R2 = 0.119319	[3.1]
	1.642376 0.614921 -2.169495		
	(0.1078) (0.5418) (0.0356)		
Spain	$\Delta \bar{P}\bar{V}r_t = 0.488553 - 4.025450\, \Delta ILP_t - 0.073547\, u_t$	R2 = 0.126464	[3.2]
	0.933853 -2.023731 -2.080119		
	(0.3555) (0.0491) (0.0434)		
The Netherlands	$\Delta \bar{P}\bar{V}r_t = 0.309976 + 1.522698\, \Delta ILP_t - 0.164652\, u_t$	R2 = 0.267096	[3.3]
	0.965565 1.310005 -3.413918		
	(0.3395) (0.1970) (0.0014)		
	MODEL 4		
France	$\Delta l\widetilde{PV}_t = 0.009708 + 0.039281\, \Delta lILP_t - 0.051848\, u_t$	R2 = 0.091805	[4.1]
	2.919765 0.761530 -1.640102		
	(0.0056) (0.4505) (0.1083)		
Spain	$\Delta l\widetilde{PV}_t = 0.011003 - 111886\, \Delta lILP_t - 0.078545\, u_t$	R2 = 0.357886	[4.2]
	4.146343 -2.569457 -4.780254		
	(0.0002) (0.0137) (0.0000)		

As seen from the above table data, the results are not clear in most of the cases. Although the sign of the error correction term is always negative, there are problems with the p-values for the explanatory variables in many of the equations. However, two models in Spain (real housing price / long-term interest rate and housing price / long-term interest rate (in logarithms)) have the expected signs of the coefficients and the interest rate and u_t are significant. In contrast, France has no significant explanatory variables, which does not allow a proper interpretation of the estimated equation.

The main results arising from the cointegration analysis and error correction models reveal the asymmetric responses in different countries under study. France is in the extreme case of the three studied, although it has passed the proposed unit root test, the error correction models do not provide relevant information that reveals long-term relationships. In the Netherlands, the rate of long-term convergence in the model that relates the real housing price and real interest rate is comparatively the highest of all the results found. For its part, in Spain both variables are cointegrated in all the models analyzed, although those that use the long-term interest rate and logarithms got the best results.

This mixed evidence reinforces the idea that there is no single housing market, but geographically segmented markets. This segmentation is determined by different factors: institutional, cultural, demographic, regulations (urban planning, taxation, etc.). It is also important to note that the financial systems of countries that are part of the EMU are not fully integrated. In particular, financial markets and banks do not play a neutral role in the transmission of monetary impulses. Hence, the heterogeneity of financial systems and their regulations, constitutes one of the factors contributing to accentuate the asymmetries in the transmission of monetary policy effects on the housing prices.

5. CONCLUSIONS

The empirical evidence that emerges from our analysis allows to conclude that Spain is the country where there is a greater relationship between interest rates and housing prices along the proposed models. These results are consistent with those of Restoy et al. (2006) according to which the available empirical evidence supports the view that the interest rate is a key variable to explain recent house price developments in Spain.

Our results also suggest that the ECB has limited ability to directly influence the price of assets through interest rate and, by extension, to control the creation of speculative bubbles in housing markets. Although the transmission of changes in interest rates for monetary policy to real interest rates of the different EMU countries was comparable, the final impact on real economic activity can be very heterogeneous. One of the reasons that might explain this heterogeneity is differences across countries in the relationship between real interest rates and housing prices. From this point of view, our analysis provides a piece of evidence suggesting the existence of differences in monetary policy transmission across countries in the euro area.

Regarding the implications for the ECB, the implementation of the single monetary policy is hampered not only by the difficulties to control real interest rates, but also by the added difficulty of controlling its effect on the markets for certain types of assets, since the link between interest rates and asset prices in general, and housing prices in particular, is uncertain. This would be a technical reason that would help explain why central banks should not react to the formation of bubbles in asset markets.

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