El Clasico of Housing: Bubbles in Madrid and Barcelona’s Real Estate Markets

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Abstract

This paper contributes to the housing bubble literature by analysing rental and sales price dynamics in Spain's two largest urban centres—Madrid and Barcelona—between May 2007 and December 2024. Using monthly data from Idealista.com, Spain's leading real estate platform, we detect the presence of price bubbles in both markets, assess their key determinants, and explore contagion effects across cities and segments. Our results show that while only a few bubbles emerged, they were of substantial duration. We also find evidence of contagion, with rental bubbles consistently preceding sales bubbles, underscoring the pivotal role of rental markets in driving price surges. Among the key determinants, higher hotel stays are associated with a reduced probability of housing bubbles, suggesting that more hotel-based tourists may help stabilise real estate markets in both urban centres. Rising interest rates and the availability of housing certificates are also linked to lower bubble risk. Conversely, increasing resident numbers significantly raise the likelihood of positive bubbles, whereas higher unemployment dampens it. These findings offer critical insights for housing policy in major urban areas.

JEL Classification: R31; G12; E44.

Keywords: Bubbles; Local Projections; Contagion; Real Estate Markets.

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1. Introduction

There is widespread agreement among economists and policymakers that the housing market plays a pivotal role in the onset of financial crises (see Leamer, 2007; Bernanke, 2008; Reinhart and Rogoff, 2009; and Brunnermeier and Oehmke, 2013, among others), with housing bubbles attracting particular attention, especially in the aftermath of the Great Recession of 2008-2009. While the influential work of Case and Shiller (2003) marked a significant advance in our understanding of price dynamics in housing markets, the model developed by Phillips *et al.* (2011, 2015a, 2015b) made it possible to identify and time speculative bubbles and to assess their potential contagion effects (Greenaway-McGrevy and Phillips, 2016).

Housing sale and rental price bubbles can be justified through a combination of rational (economic and financial) and irrational (behavioural) indicators. One of the primary signs is the growing disconnect between property prices and fundamental economic variables such as household income and gross domestic product (Himmelberg *et al*, 2005). When housing prices rise much faster than wages or economic growth, it suggests that factors beyond actual demand are driving valuations (Frayne *et al*, 2022). Additionally, a prolonged period of low interest rates and expansive credit conditions encourages borrowing and increases speculative real estate investment (Martín *et al*., 2021). Easy access to financing can artificially inflate demand, pushing prices upward and contributing to bubble formation. This is particularly evident in major urban centres, where housing supply is often physically constrained, making the market less responsive to shifts in demand. Another important indicator is the divergence between sales prices and rental values. When the price-to-rent ratio grows excessively, it may point to a decoupling from fundamental housing returns and reflect speculative dynamics (Kholodilin *et al.*, 2018). In such cases, buyers may be motivated more by expectations of future price appreciation than by rental yield or utility value. Moreover, the growing presence of speculative investors, who purchase properties not for personal use but to profit from future resale or rental income, reinforces the risk of overheating (Bayer *et al.*, 2011). This behaviour is often accompanied by market exuberance, including herd behaviour and overconfidence, where buyers act out of fear-of-missing-out rather than rational assessment (Zheng *et al*, 2017).

Much of the empirical literature has concentrated on identifying bubbles and determining their timing and duration, often without considering the interplay between markets (Phillips *et al.*, 2011, 2015a, 2015b; Engsted and Pedersen, 2015). Several studies have explored the existence of housing bubbles (Agnello and Schuknecht, 2011; Engsted *et al*., 2016; Chen and Xie, 2017, Zhang *et al.*, 2024). We contribute to this literature studying the rental and sales price bubble dynamics in Spain's two largest urban centres—Madrid and Barcelona—, assessing their key determinants, and exploring contagion effects across cities and markets. Addressing these issues are crucial for understanding the emergence of bubbles and price exuberance in increasingly integrated housing markets.

Several reasons justify focusing on the Spanish housing market as an economically interesting case. Firstly, Spain experienced one of the most significant housing bubbles in the early 2000s, culminating in the 2008 Global Financial Crisis (Estrada *et al.,* 2009). The bursting of this bubble led to a severe economic recession, a banking crisis, and a long-lasting impact on the housing market (Neal and García-Iglesias, 2013). Moreover, the housing bubble problem in Spain has resurfaced in recent years, witnessing a strong recovery in housing prices, particularly in major cities like Madrid and Barcelona (see, e.g., Banco de España, 2024; and Lajer Baron *et al*., 2024) to the extent that Barcelona has come to be known as "ground zero" for housing problems in Europe.[1] Indeed, according to CaixaBank Research (2025), in 2024, the Spanish real estate market gained momentum, particularly in the second half of the year, mainly due to falling interest rates. This was coupled with several factors that kept housing demand strong, including significant migration flows, strong job market, and strong foreign housing demand. Meanwhile, while the supply of new housing is beginning to rise, it remains insufficient to meet the high demand. This imbalance between strong demand and limited supply has been driving up house prices in recent years. In that context, in January 2025, according to the Barometer of the Spanish Centre for Sociological Research (CIS), housing was once again the first problem that worried Spaniards, quickly approaching to the historical maximum level of 2008. This concern is grounded in stark realities. According to the Bank of Spain (Banco de España, 2024), from 1996 to 2022, the ratio of home prices to household income surged by 50%. This upward trend, coupled with increasingly stringent mortgage lending conditions since 2008 Global Financial Crises, has pushed homeownership further out of reach. Consequently, demand for rental housing has intensified, leading to a steep and sustained rise in rental prices—particularly since 2014. Therefore, rising rental prices have forced many households to spend an unsustainably high portion of their income on housing. According to the OECD[2], a household is considered overburdened if it spends more than 40%

[1] See *"City of Lost Homes: Barcelona's housing crisis"*, front page of *The New York Times,* April 2, 2025.
[2] https://www.oecd.org/en/topics/sub-issues/affordable-housing.html#:~:text=The%20burden%20of%20housing%20costs,their%20disposable%20income%20on%20rent.

of its disposable income on housing and in Spain, this applies to 40% of tenants (Banco de España, 2024). The burden is especially severe among low-income households: three out of four tenants in the lowest income quintile are overburdened by housing costs. In this context, investigating whether new bubbles are forming or if the market is stabilising presents an opportunity to study the long-term consequences of the previous bubble and examine whether the same conditions for a new bubble are emerging.

Secondly, Spain's housing market is noticeable by notable regional differences, particularly between large urban centres such as Madrid and Barcelona, and smaller regions across the country (see, e.g., Nicodemo and Raya, 2012; and López-Rodríguez and de los Llanos- Matea, 2019). Exploring how market forces operate in Spain's two largest cities can help to understand how market dynamics work differently in different urban areas.

Thirdly, Spain has a history of both strong regulatory frameworks and significant political interventions in the housing market (Andrews *et al*., 2011). So, even though it is beyond the scope of our analysis, examining housing bubbles in Spain offers an indirect way to assess the effectiveness of public policies, such as housing subsidies, credit policies, and tax incentives, and how they may have contributed to or mitigated the formation of price bubbles.

Lastly, the Spanish housing market is deeply interlinked with the banking sector (Fernandez and Aalbers, 2016). Many factors that fuelled Spain's housing bubble, such as easy access to credit, the role of financial institutions, and the securitisation of mortgage loans, are key to understanding the devastating effects of the 2008 Global Financial Crisis in the Spanish economy (Bonshoms-Guzmán, 2023). Investigating the dynamics of housing bubbles in Spain can provide a better understanding of how financial markets and housing interact, which is crucial for both policymakers and financial analysts.

In this paper, we analyse the dynamics of rental and sales prices across various districts in Madrid and Barcelona from May 2007 to December 2024. Using monthly data sourced from Idealista.com, Spain's leading real estate platform, we employ the common bubble detection method proposed by Chen *et al*. (2023), which builds on the framework developed by Phillips *et al*. (2011, 2015a, 2015b), to investigate the presence of price bubbles in both markets. Our analysis reveals that while only three to four bubbles emerged during the sample period, they were notably persistent, lasting an average of 29 months. In examining the key determinants of housing price bubbles, we find that higher levels of hotel stays are associated with a reduced probability of bubble formation. This suggests that more tourists choosing hotel accommodations may contribute to stabilizing real estate markets in urban centres. Several factors may explain this relationship. First, when hotel capacity is insufficient to meet rising tourist demand (i.e., if an increase in hotel stays cannot cover the increase in tourism), the overflow may be absorbed by the private residential sector—mainly through short-term rentals—thereby increasing demand and exerting upward pressure on housing prices. Second, revenues generated from hotel taxes and tourism-related business levies are often earmarked for public goods such as transportation infrastructure and affordable or social housing initiatives. A decline in these revenue streams may constrain municipal budgets, thereby limiting the capacity to invest in housing supply expansion or improvements to transportation infrastructure that could enhance access to more affordable areas with lower housing demand pressure. Third, institutional and private investors often regard the hotel sector as a relatively low-volatility, professionally managed vehicle for capturing returns from urban tourism. However, when income from this sector declines—such as through a reduction in hotel stays—capital may be reallocated to higher-yield segments like residential real estate, thereby contributing to upward pressure on housing prices, especially in cities where the fundamental appeal to both tourists and investors remains strong, and the housing supply is limited. Rising interest rates and the availability of housing certificates are also found to be linked to lower bubble risk. In contrast, an increase in the resident population significantly raises bubble risk, whereas higher unemployment tends to suppress it. These results remain robust when using alternative proxies for the determinants. Leveraging the local projections method of Jordà (2005), we further show that most of these effects are long-lasting. Finally, we explore contagion patterns across cities and market segments, finding that rental bubbles consistently precede sales bubbles, highlighting the critical role of rental markets in fuelling broader price dynamics.

The results of this study have important implications for several stakeholders. For academics and policymakers, examining these phenomena within the Spanish context provides valuable insights into the dynamics of housing bubbles and their macroeconomic effects, while also revealing structural vulnerabilities in the real estate sectors of developed and, in particular, European economies (European Systemic Risk Board, 2024). For urban planners and local housing authorities, the findings offer evidence on the consequences of specific urban patterns. Notably, measures aimed at restricting the number of visitors to major urban centres may inadvertently increase the likelihood of housing price bubbles, given the stabilising effect that tourism staying in hotels appears to exert on the local economy and consequently on housing markets.[3] Conversely, policies that incentivise the relocation of residents to areas with lower housing demand, or that promote the issuance of housing certificates, may contribute to a reduction in bubble risk.

The paper proceeds as follows. Section 2 outlines the econometric framework to detect common bubbles, determinants of bubble occurrence and bubble contagion. Section 3 presents our data. In Section 4, we report the empirical results. Finally, Section 5 summarises the findings and offers some concluding remarks.

2. Methodology

2.1 Common bubble detection

Traditional ex-post methods for detecting asset price bubbles have faced persistent econometric challenges.[4] As Evans (1991) demonstrates, the widely used unit root and cointegration tests proposed by Diba and Grossman (1988) are prone to failure when bubbles periodically collapse, rendering them unable to distinguish between stationary price processes and those characterised by episodic explosiveness. To address these limitations, Phillips *et al*. (2011, 2015a, 2015b; hereafter PSY) introduced a new class of recursive right-tailed Augmented Dickey-Fuller (ADF) tests—the supremum, generalised supremum, and backward supremum ADF tests—designed to detect phases of mild explosiveness in asset prices. This framework represents a major advancement, enabling real-time identification of bubble episodes and overcoming key shortcomings of earlier approaches. The PSY methodology has since been widely adopted across diverse asset classes, including equities (Bohl *et al*., 2013; Phillips et al., 2015a; Escobari *et al*., 2017), real estate markets (Jiang *et al*., 2015; Greenaway-McGrevy and Phillips, 2016; Engsted *et al*., 2016; Hu and Oxley, 2018a; Tsai and Lin, 2022; Zhang et *al*., 2024; Hansen *et al*., 2024), dual-market studies of stocks and housing (Deng *et al*., 2017; Hu and Oxley, 2018b), commodities (Etienne *et al.*, 2014; Fan et al., 2024) and emerging markets such as cryptocurrencies (Bouri *et al*., 2019; Gronwald, 2021; Shahzad *et al*., 2022).
The PSY bubble detection methodology offers distinct advantages over earlier approaches. First, it avoids reliance on restrictive assumptions about the nature of explosive price dynamics,

[3] Our analysis indicates that increased tourism accommodated through hotel stays contributes to stabilising real estate markets in the cities under study. Nonetheless, we do not discount the potential for short-term rental platforms, such as Airbnb, to destabilise housing price bubbles. Consequently, policy interventions aimed at regulating tourism in short-term holiday apartments may be justified. However, it is important to note that due to the unavailability of comprehensive data on short-term rentals, this study does not empirically assess their impact on housing price bubbles.
[4] Gürkaynak (2008) offers a review of early studies on asset price bubbles. Hu's (2023) literature review focuses on the theoretical and empirical contributions related to right-tailed unit root tests.

enhancing both its accessibility and practical implementation. Second, it is firmly grounded in the limit theory of mildly explosive processes (Phillips and Magdalinos, 2007), allowing it to effectively capture the behaviour of periodically collapsing bubbles—a feature frequently observed in financial markets. As a result, the method significantly reduces the risk of false positives and enables precise dating of the emergence and collapse of bubble episodes. Moreover, its flexibility allows for broad applicability across competing theories of speculative bubbles, encompassing models of rational asset price deviations, herding behaviour among irrational traders, information asymmetries in financial markets, and rational reactions to shifts in economic fundamentals.

Following Chen *et al.* (2023), we extract the common bubbles across different districts and markets in Madrid and Barcelona. To implement this methodology, we first compute the first principal component of the price indices for each market (rental and sales) and city (Madrid and Barcelona), using data from all districts within each region (see Section 3 below).[5] Then, we apply PSY methodology to time these common bubbles.

The framework of PSY is based on ADF regressions with varying window lengths. Defining r_1 as the starting point and r_2 as the end point, the following regression is run recursively,

$$\Delta p_t = \alpha_{r_1,r_2} + \beta_{r_1,r_2} p_{t-1} + \sum_{k=1}^{K} \gamma_{r_1,r_2}^{k} \Delta p_{t-k} + \varepsilon_t, \qquad (1)$$

where p_t is the log price of an asset at time *t* and $\Delta p_t = p_t - p_{t-1}$. K is the maximum lag order and ε_t is the residual. The coefficient of interest is β_{r_1,r_2} from which the ADF test statistic is calculated as $ADF_{r_1,r_2} = \beta_{r_1,r_2}/s.e.(\beta_{r_1,r_2})$, with $s.e.(\beta_{r_1,r_2})$ being the standard errors of β_{r_1,r_2}. Defining $r_{w0} = 0.01 + 1.8/\sqrt{T}$, where T is the sample size, as the minimum required window size and fixing the end point r_2, the starting point can vary between the first observation until $r_2 - r_{w0} + 1$ in such a way that there are $r_2 - r_{w0} + 1$ ADF t-statistics for a fixed r_2. We employ a lag order of one in Equation (1), i.e., $K = 1$, to remove any serial correlation in the price series.

PSY defines the supremum ADF (SADF) test as the supremum of all the $r_2 - r_{w0} + 1$ ADF t-statistics for a fixed r_2, i.e., $SADF_{r_2} = Sup_{r_1 \in [1, r_2 - r_{w0} + 1]} ADF_{r_1,r_2}$. Varying the end point r_2

[5] We use separate price indices for rental and sales markets rather than relying on the sales-to-rental (or price-to-rent) ratio. This approach allows us to capture better the distinct price bubble dynamics within each market. Our focus is on understanding the specific behaviour of sales and rental prices rather than on whether a bubble is unexpected or rationally anticipated. Sections 4.2 and 4.3 will further address this distinction when examining the determinants of these bubbles. Additionally, analysing the two markets separately enables us to investigate potential contagion effects between the sales and rental markets as in Section 4.4.

between r_{w0} and T, a set of $T - r_{w0} + 1$ SADF statistics are calculated from a backward expanding window (BSADF). The origination ($\tilde{r}_{1e}$) and end days ($\tilde{r}_{1f}$) of the explosive episode are defined as follows,

$$\tilde{r}_{1e} = inf_{r_2 \in [r_{w0}, T]}\{r_2 : SADF_{r_2} > cv_{r_2}^{\rho}\},$$
$$\tilde{r}_{1f} = inf_{r_2 \in [\tilde{r}_{1e}+h, T]}\{r_2 : SADF_{r_2} < cv_{r_2}^{\rho}\}, \tag{2}$$

where $cv_{r_2}^{\rho}$ is the ρ% critical value of the BSADF statistic based on r_2 observations[6], and h is the minimum bubble length, which indicates that an explosive episode must last at least h periods (e.g., months) to be considered a bubble. The BSADF test is employed as our principal methodology, as it facilitates the precise identification and date-stamping of bubble episodes.

Finally, we choose a conservative minimum bubble length of 6 months to capture episodes of price deviation. Additionally, we set the threshold ρ% to 95%. Recognising that prices may not consistently increase during bubble episodes and following the framework of Etienne *et al.* (2014), we define a positive bubble as a period in which the average price of the bubble episode exceeds the initial price at the onset of the episode, and a negative bubble as a period in which the average price falls below the initial price.

2.2 Assessing the determinants of bubbles occurrence.

To analyse the potential factors behind the occurrence of bubbles, we use a multinomial logit model (see e.g., Etienne *et al.*, 2015; or Fan *et al.*, 2024). We employ a categorical variable, B_t, which takes a value of 1 when there is a positive bubble, 2 when there is a negative bubble, and 0 when the market is in a non-bubble state. This can be expressed as follows,

$$B_i = \begin{cases} 0, when\ a\ non-bubble\ occurs \\ 1, when\ a\ positive\ bubble\ occurs \\ 2, when\ a\ negative\ bubble\ occurs \end{cases}. \tag{3}$$

The model to estimate is the following,

[6] The critical value sequence of the BSADF statistics is obtained from a Monte Carlo simulation with 2,000 replications. We thank Prof. Shuping Shi for providing the MATLAB codes to calculate the critical values.

$$\Pr\left(y_{i,t} = B_i \middle| \boldsymbol{x}_{i,t}, \alpha, \boldsymbol{\beta}_j, \varepsilon_{i,t}\right) = F\left(y_{i,t} = B_i \middle| \alpha + \boldsymbol{\beta}_j \cdot \boldsymbol{x}_{i,t} + \varepsilon_{i,t}\right) =$$
$$\frac{1}{1 + \sum_{j=1}^{2} \exp\left(\alpha + \boldsymbol{\beta}_j \cdot \boldsymbol{x}_{i,t} + \varepsilon_{i,t}\right)} \; if\ B_i = 0$$
$$\frac{\exp\left(\alpha + \beta_{B_i} \cdot x_{i,t} + \varepsilon_{i,B_i}\right)}{1 + \sum_{j=1}^{2} \exp\left(\alpha + \boldsymbol{\beta}_j \cdot \boldsymbol{x}_{i,t} + \varepsilon_{i,t}\right)} \; if\ B_i > 0, \tag{4}$$

where $\boldsymbol{x}_{i,t}$ is a vector of independent variables for the *i*-th city at time *t*, $\varepsilon_{i,t}$ are the residuals and $\{\alpha, \boldsymbol{\beta}_j\}$ are the coefficients to estimate.

2.3 Local projections approach

In light of the importance of anticipating the emergence of house price bubbles, we further analyse the estimated impulse response functions using the local projections methodology introduced by Jordà (2005). Local projections provide an intuitive and tractable framework, relying on the estimation of multinomial logistic regressions over multiple forecast horizons *h* (see e.g., Jordà, 2023; Jordà and Taylor, 2025, for recent surveys). In particular, we modify the multinomial logistic regression specified in Equation (4) by shifting the dependent variable forward by *h*={0, 1, 2, …, 24} months,

$$\Pr\left(y_{i,t+h} = B_i \middle| \boldsymbol{x}_{i,t}, \alpha_h, \boldsymbol{\beta}_{j,h}, \varepsilon_{i,t+h}\right) = F\left(y_{i,t+h} = B_i \middle| \alpha_h + \boldsymbol{\beta}_{j,h} \cdot \boldsymbol{x}_{i,t} + \varepsilon_{i,t+h}\right) =$$
$$\frac{1}{1 + \sum_{j=1}^{2} \exp\left(\alpha_h + \boldsymbol{\beta}_{j,h} \cdot \boldsymbol{x}_{i,t} + \varepsilon_{i,t+h}\right)} \; if\ B_i = 0$$
$$\frac{\exp\left(\alpha_h + \beta_{B_i,h} \cdot x_{i,t} + \varepsilon_{i,B_{i,},t+h}\right)}{1 + \sum_{j=1}^{2} \exp\left(\alpha_h + \boldsymbol{\beta}_{j,h} \cdot \boldsymbol{x}_{i,t} + \varepsilon_{i,t+h}\right)} \; if\ B_i > 0. \tag{5}$$

Once we estimate the multinomial logit regressions for all the horizons, h, we plot the cumulated estimated coefficients, $\boldsymbol{\beta}_{j,h}$, and its confidence bands.

2.4 Bubble contagion

Finally, to analyse bubble contagion between cities and market segments we adopt the non-parametric regression with time-varying coefficients developed by Greenaway-McGrevy and Phillips (2016). This approach employs rolling windows combined with local kernel regressions to detect contagion dynamics between pairs of price series.

Consider two markets, A and B. The non-parametric regression model proposed by Greenaway-McGrevy and Phillips (2016) is given by:

$$\tilde{\beta}_{B,t} = \delta_{t,T}\tilde{\beta}_{A,t-d} + \varepsilon_t, \tag{6}$$

where $\tilde{\beta}_{k,t} = \hat{\beta}_{k,t} - \frac{1}{T-w+1}\sum_{t=w}^{T}\hat{\beta}_{k,t}$, and $\hat{\beta}_{k,t}$ represents the rolling estimation of the coefficient in Equation (1) for a fixed window of length w, between $[r_1, r_2]$ with $r_1 = t - w + 1$ and $r_2 = t$, d is a non-negative delay parameter that captures the lag in market contagion from the market A to the market B, and ε_t are the residuals.

The time varying coefficient $\delta_{t,T}$ is estimated by local kernel regression, such that

$$\hat{\delta}_{t,T} = \hat{\delta}(r; s, d) = \frac{\sum_{j=w+d}^{T} K_{sj}(r)\tilde{\beta}_{B,j}\tilde{\beta}_{A,j-d}}{\sum_{j=w+d}^{T} K_{sj}(r)\tilde{\beta}_{A,j-d}^{2}} \tag{7}$$

where $K_{sj}(r) = \frac{1}{s}K\left(\frac{j/T-r}{s}\right)$, $K(\cdot) = (2\pi)^{-1/2}e^{-\frac{1}{2}(\cdot)^2}$ is a Gaussian kernel, s is the bandwidth, and r is the fraction date (i.e., r=$\{(w+d)/T, (w+d+1)/T, \dots, T/T\}$ where each of these values are plugged into Equation (7) one by one to capture the time-varying evolution of $\hat{\delta}_{t,T}$. If $\hat{\delta}_{t,T} > 0$, the two real estate markets are connected, indicating potential bubble contagion, where the larger $\hat{\delta}_{t,T}$, the stronger the contagion. Conversely, $\hat{\delta}_{t,T} < 0$, the markets are not connected, implying no bubble contagion.

Without loss of generality, we set $w = r_{w0}$ as the fixed window. The kernel bandwidth (s) is optimised following the method proposed by Bowman and Azzalini (1997), while the delay parameter (d) is set to one month. Unreported results show that the choice of these parameters does not affect the qualitative findings.

3. Data

We use estimates of average rental and sales prices in euros per square metre provided by Idealista.com, one of Spain's largest and most recognised real estate portals.[7] The data covers twenty-two districts in Madrid (Arganzuela, Barajas, Carabanchel, Centro, Chamartín,

[7] Specifically, we utilised monthly estimates of the average residential prices for properties listed on the online real estate portal Idealista.com, categorised into sales and rental transactions, offering a complete perspective on different market segments. Its broad coverage makes it a representative source of real estate market prices in different country regions, allowing for timely and reliable estimates. The estimated prices show strong correlations with other real estate market indicators, such as the quarterly price per square meter of free-market housing published by the Ministry of Transport, Mobility and Urban Agenda, as well as the regional quarterly Housing Price Index and the annual Rental Housing Price Index at the municipal level, both provided by the National Institute of Statistics. It is important to note that the data processing approach developed by Idealista.com mitigates biases stemming from marketing practices or changes in the composition of listed properties over time (e.g., variations in the number of units by property type), and instead, the alternative available indicators do not offer details by district, nor are they available monthly, nor do they cover a period as broad as the one studied in this paper.

Chamberí, Ciudad Lineal, El Encinar de los Reyes, Fuencarral, Hortaleza, Latina, Moncloa, Moratalaz, Puente de Vallecas, Retiro, Salamanca, San Blas, Tetuán, Usera, Vicálvaro, Villa de Vallecas, and Villaverde) and ten districts in Barcelona (Ciutat Vella, Eixample, Gràcia, Horta-Guinardó, Les Corts, Nou Barris, Sant Andreu, Sant Martí, Sants-Montjuïc, and Sarrià-Sant Gervasi), where most districts span the period from May 2007 to December 2024.

Since our district-level house price data are unbalanced, we implement two powerful and complementary approaches to construct a robust data matrix without missing values, thereby maximising the length of the sample. First, we use the multiple imputation techniques developed by King *et al.* (2001), which approximate missing data and provide more accurate estimates. Second, we apply the simultaneous nearest-neighbour predictors introduced by Fernández-Rodríguez *et al.* (1999), which infer omitted values based on patterns identified in other concurrent time series. These procedures effectively infer missing values by recognising patterns in related time series, ensuring no valuable information is overlooked. Together, these strategies enable us to construct a comprehensive and accurate dataset from May 2007 to December 2024 without losing observations and leading to insightful conclusions.

[Insert Figure 1 and Table 1 here]

Figure 1 illustrates the evolution of rental and sales price indices across all districts of Madrid and Barcelona, as well as the city-wide averages. Despite substantial variation in price levels, the price dynamics exhibit similar patterns across districts within each city and market. Table 1 presents the average prices and standard deviations by district. Notably, both rental and sales prices are, on average, higher in Barcelona than in Madrid. However, if we analyse in more detail, we can see that sales price dispersion between districts is higher in Madrid than in Barcelona. Thus, the price per square metre in the most expensive district of Madrid (Salamanca, 5,183.12€ per square metre) is higher than that of the most expensive district of Barcelona (Sarrià-Sant Gervasi, 4,860.86€). Then, there are also two districts in Madrid (Chamberí, 4,757.52€ and Chamartín, 4,736.65€) with a price per square metre higher than that of the second most expensive district in Barcelona (Les Corts, 4,705.46€). At the other end of the ranking, we can observe that Madrid's most affordable districts also have lower prices than Barcelona's. Concretely, in six districts of Madrid (Vicálvaro (2,332.85€), Latina (2,276.15€), Carabanchel (2,219.72€), Usera (2,082.39€), Puente de Vallecas (1,962.89€) and Villaverde (1,846.4€)), one can found lower sale prices than in the most affordable district of Barcelona (Nou Barris, 2,372.22€).

Although not as pronounced, a similar pattern is observed in the rental market. The city center is the most expensive district to rent a house both in Madrid (Centro, 16.98€ per square metre) and Barcelona (Ciutat Vella, 16.98€). However, the price of the second most expensive district to rent a house in Barcelona (Sarrià-Sant Gervasi, 15.50€) is lower than the second (Salamanca, 16.90€) and third (Chamberí, 16.27€) highest-priced districts in Madrid. Again, at the other end of the ranking, we can also observe that the most affordable districts present lower rental prices in Madrid than in Barcelona. Concretely, eleven districts in Madrid (San Blas, Barajas, Puente de Vallecas, Usera, Latina, Carbanchel, Villa de Vallecas, Moratalaz, Villaverde, and Vicálvaro) have rental prices lower than those of the most affordable district to rent a house in Barcelona (Nou Barris, 11.36€).

Using these disaggregated data from various districts, we analyse the real estate market dynamics through the first principal component (PC1) of the price indices for a city's districts. This approach presents several advantages compared to relying on a single, generalised index for the entire city. First, it reduces dimensionality, condensing complex data into a singular indicator that effectively captures price dynamics citywide. Second, PC1 integrates the variability across districts, reducing distortions caused by heterogeneity. Third, by leveraging data from all districts, PC1 provides a more comprehensive representation of overall market conditions than a generalised index, which may overlook local nuances. Lastly, PC1 identifies shared patterns or trends across districts, such as economic changes or market dynamics, that might be more difficult to detect with a general index. Empirically, these PC1's captures a significant portion of price variations, explaining the variance between 85% (sales market in Barcelona) and 97% (rental market in Barcelona). This high explanatory power confirms that price indices within each region and market are highly integrated. Henceforth, we use the first principal components for each city and market in our analysis.

4. Results

4.1 Price bubbles in rental and sales markets

Table 2 and Figure 2 report the results of the bubble detection analysis using the PSY approach explained in Section 2.1.

[Insert Table 2 and Figure 2 here]

Table 2 reports the statistics of the BSADF test results, using a conservative minimum window length of six months (unreported results indicate that the qualitative findings hold for both 1- and 3-month minimum bubble duration thresholds). The first row presents the number of bubble episodes identified across the markets under study. The results indicate that the incidence of bubbles is relatively low, with each market experiencing between three and four bubble episodes over the nearly 20-year sample period.[8] The rental market in Barcelona displays a one more bubble than Madrid's. Conversely, the sales market reveals the opposite pattern. Regarding the number of months characterised by bubbles and their proportion relative to the total sample size (second and third rows in Table 2, respectively), we find that both are larger in Madrid than in Barcelona, being the total number of months with bubbles in the rental market in Madrid 107 months (representing 57.84% of the sample period), while the rental market in Barcelona experiences bubbles for a total of 79 months (42.70% of the sample period). Focusing on the case of the sales market, we observe that the total number of months with bubbles in Madrid is 122 months (equivalent to 65.95% of the sample period), whereas, in Barcelona, the total is 92 months (49.73% of the sample period). These figures contrast with findings in other asset classes, where bubbles typically account for a small fraction of the sample period (see, e.g., Fan *et al.*, 2024). However, these results are consistent with the real estate literature, which also reports extended periods of bubble episodes (see, e.g., Greenaway-McGrevy and Phillips, 2016; Gomez-Gonzalez *et al.*, 2018; and Phillips and Shi, 2020). The fourth and fifth rows of Table 2 differentiate between positive and negative bubbles. Our findings reveal higher number of months with positive bubbles in both the rental and sales markets in Madrid than Barcelona, with 76.64% versus 55.70% in the rental market and 60.66% versus 54.35% in the sales market, without major differences in the number of months with negative bubbles between both cities. Finally, the last row of Table 2 presents data on the duration of bubble events across different markets. On average, bubble events in the rental market of Madrid last longer, with an average duration of 35.67 months, compared to 19.75 months in Barcelona. In contrast, the sales market in both Madrid and Barcelona shows similar bubble duration, with averages of 30.50 and 30.67 months, respectively. Overall, the average bubble duration is relatively long, lasting approximately 29 months.

Figure 2 plots the detected bubbles in both markets and cities over the sample period, which includes the BSADF statistic (black line), the critical values (black dash line), the average house price index (red line) and the bubble period identified in grey. Panel A reveals that, in Madrid's rental market, the BSADF statistic detects an initial episode of a negative bubble between April 2012 and April 2014, as well as two subsequent episodes of positive bubbles

[8] Note that the first 15 months of observations are excluded due to the minimum window length required by the bubble detection methodology.

spanning from September 2015 to May 2020 and from January 2023 to the end of the sample. Instead, for Barcelona, Panel B presents evidence of a negative bubble episode in the rental market covering the period March 2011-January 2014 and three episodes of positive bubbles (July 2015 to February 2016, June 2016 to December 2017, and August 2023 to the end of the sample). Turning to the case of the sales market, Panel C suggests the existence of an episode of negative bubble in Madrid between June 2011 and May 2015 and three episodes of positive bubbles (June 2016 to May 2020, March 2022 to August 2022, and February 2023 to the end of the sample) while panel D indicates that, for Barcelona, the BSADF statistic identifies an episode of negative bubble that lasted from April 2011 to September 2014 and two episodes of positive bubbles extending from July 2015 to October 2018 and from March 2024 to the end of the sample. Interestingly, the emergence and onset of these bubbles do not align perfectly across markets and urban centres, providing a compelling argument for studying these markets separately rather than aggregating them into a single real estate market price index.

The identified episodes of negative bubbles largely coincide with the sharp downturn in the Spanish real estate market following the expansionary phase, which culminated in 2008 with the Global Financial Crisis and the severe impact it had on the Spanish real estate sector (Martín *et al*., 2021). Notably, the findings indicate that negative bubbles were of longer duration in the sales markets, suggesting that rental markets are more insulated from significant price declines. The episodes of positive bubbles reflect a rapid appreciation in housing prices that outpaced economic fundamentals, suggesting that valuations were driven more by expectations of capital gains than by intrinsic value (Raya *et al.*, 2014). These episodes were further fuelled by a renewed influx of both domestic and international investors, including institutional buyers and real estate investment trusts, stimulated by historically low interest rates and favourable credit conditions. Additionally, limited land availability and regulatory constraints on new construction contributed to supply-side pressures. The sharp rebound in housing prices in early 2023, driven by pent-up demand, increased household savings, and continued access to favourable financing, further reinforced these speculative dynamics. We will study more in detail the determinants of these bubble episodes in the next section.

4.2 Determinants of bubbles

Following the housing literature, we include city-specific control variables in Equation (4), see Section 2.2, where we are limited to the availability of the city-specific information. Building on the findings of Campbell *et al.* (2009) and Shi (2017), we consider variables that reflect overall economic conditions, such as interest rates, population growth, tourists, unemployment rates, and housing supply, as potential determinants of the occurrence of bubbles. Specifically, we control for the annual growth in the number of hotel stays, the annual growth in housing certifications, changes in EU interest rates, the annual growth in the number of residences, and the annual unemployment rate where all these variables, except the EU interest rates, are at the city level. By using annual growth measures, we eliminate the effects of seasonal variations and remove the unit root, allowing us to work with deseasonalised, stationary variables. Table 3 presents the variables definition and their sources.

[Insert Table 3 here]

All continuous variables are winsorised at the 1st and 99th percentiles to mitigate the influence of outliers. Furthermore, we normalise these controls to facilitate interpretation across the diverse set of explanatory variables. Table 4 presents the estimates from the multinomial logistic regression, with robust t-statistics reported in parentheses.[9]

[Insert Table 4 here]

The following findings can be drawn from Table 4. First, increases in tourists choosing hotel accommodation, reduce the probability of both positive and negative bubbles, except for the sales market in Madrid which is not affected by it. However, this finding appears to contradict recent public demonstrations against mass tourism in major European cities, particularly Barcelona.[10] Several factors may explain why limiting the number of hotel accommodation stays may be detrimental to real estate price stability. First, when hotel capacity is insufficient to meet rising tourist demand (i.e., if an increase in hotel stays cannot cover the increase in tourism), the overflow may be absorbed by the private residential sector—mainly through short-term rentals—thereby increasing demand and exerting upward pressure on housing prices. Second, revenues generated from hotel taxes and tourism-related business levies are often earmarked for public goods such as transportation infrastructure and affordable or social housing initiatives. A decline in these revenue streams may constrain municipal budgets, thereby limiting the capacity to invest in housing supply expansion or improvements to transportation infrastructure that could enhance access to more affordable areas with lower housing demand pressure. Third, institutional and private investors often regard the hotel sector as a relatively low-volatility, professionally managed vehicle for capturing returns from urban

[9] We use the mlogit command in Stata 18 with robust standard errors to obtain these results.
[10] See e.g., https://www.cnbc.com/2024/10/14/after-anti-tourism-protests-spain-receives-record-number-of-travelers.html and https://www.euronews.com/travel/2025/04/08/another-summer-of-disruption-spains-anti-tourism-protests-reignite-ahead-of-easter-break.

tourism. However, when income from this sector declines—such as through a reduction in hotel stays—capital may be reallocated to higher-yield segments like residential real estate, thereby contributing to upward pressure on housing prices, especially in cities where the fundamental appeal to both tourists and investors remains strong, and the housing supply is limited.

Short-term rentals include mainly those associated with tourism or student purposes. Regarding tourism short-term rentals, we should recall that in recent decades, tourism has experienced significant growth, with urban tourism showing particularly pronounced trends. Between 2009 and 2018, the average number of visitors to the 162 most popular cities worldwide increased by approximately 6.5% annually (see MasterCard, 2019), and despite challenges like fluctuating exchange rates, climate concerns and varying levels of affordability, the travel sector is still breaking boundaries (see MasterCard, 2024). Concretely, according to Mastercard Global Destination Cities Index[11], in 2019, Barcelona ranked 17th after Milan and ahead of Palma de Mallorca (Spain), and Mastercard's ranking of the 10 trending markets over the past 12 months ending March 2024 placed Spain in fifth position (after Japan, Ireland, Romania and Italy). As a result, short-term rental platforms like Airbnb have emerged in response to the rising demand for urban tourism. These platforms facilitate the overlap between the tourism and housing markets by enabling residential property owners to participate in the hospitality sector. This trend not only caters to the growing influx of visitors but also transforms traditional housing dynamics in city environments.[12] Unfortunately, since the Airbnb website[13] provides data for both Barcelona and Madrid but not for an extensive period such as the one studied (May 2007-December 2024), we could not include this variable in our study. However, García-López *et al*. (2020) examine data on both rents and sales prices and combine these data with information on the location of Airbnb activity within Barcelona between April 2015 and February 2018. Their analysis shows that Airbnb activity in Barcelona has increased rents and sales prices, with larger effects on sales prices than on rents.

[11] The Mastercard Global Destination Cities Index ranks 200 cities based on third-party research and proprietary analysis regarding the total number of international overnight visitor arrivals and cross-border spending by these same visitors in the destination cities over the previous year.

[12] Although PricewaterhouseCoopers (2024) indicated that in 2023, short-term rentals in Spain only accounted for 0.34% of the total housing stock and therefore, they did not show a relevant impact on national price levels or changes in municipal prices, the Government of Catalonia (https://portaldogc.gencat.cat/utilsEADOP/PDF/9339/2068659.pdf) estimated that in the third quarter of 2024, temporary rentals registered a sharp increase of 37.5% compared to the same quarter of the previous year due to a shift in rental supply away from regulated long-term leases toward temporary contracts, which were exempt from the control rent policy that was introduced in March 2024.

[13] http://insideairbnb.com/about

With regard to short-term rentals for studies purposes, we should acknowledge that, according to the European Commission, Spain is the main recipient of Erasmus students.[14] Concretely, Spain, Italy and Germany are the main destinations chosen by students signing up for the Erasmus Program, and Spain ranks first with about 143,000 students hosted during 2022 (being Barcelona and Madrid the main receiving cities for students), the last year for which official data has been collected.[15] Therefore, the stabilising effect of hotel-based visitors on the real estate markets in Madrid and Barcelona may underestimate the possible triggering effect that short-term rental visitors (for holiday or study purposes) could have on the likelihood of price bubbles. We leave this question open for future research.

Second, more house certificates reduce the probability of a negative bubble in Barcelona markets. This could reflect that the growth number of certificates is slower than the demand for houses, and therefore, there is a lower probability of negative bubbles. It may also indicate some asymmetry in the housing market, which may be less prone to price declines than increases in the face of a change in supply. In this sense, at present, the supply of new housing is still insufficient to meet the high demand in Spain, and this mismatch is indeed driving up house prices (see CaixaBank Research, 2025).

Third, increases in interest rates are associated with decreases in the probability of a positive bubble in both markets and cities. This result is expected, given the negative relationship between interest rates, credit mortgage costs, and house prices. In fact, with the beginning of the normalisation of interest rates in 2024, the demand for housing was reactivated, and house prices picked up again in Spain (see CaixaBank Research, 2025 and Lajer Baron *et al*., 2024). Concretely, Lajer Baron *et al*. (2024) find that following the tightening of monetary policy in the euro area, which entailed a deterioration in financing conditions, a significant decline in the relative weight of externally financed house purchases was observed from 2022 onwards, with the ratio standing at below 45% in 2023. However, the most recent data points to a recovery in the relative weight of mortgage financing in house purchases, with a ratio of 48% in July 2024, reflecting the improvement in mortgage financing conditions.[16]

[14] https://ec.europa.eu/eurostat/databrowser/view/EDUC_UOE_MOBS03__custom_4490028/bookmark/table?lang=en&bookmarkId=8fc0b290-d9ef-4506-bea6-4bdac63d9413

[15] Unfortunately, these data are only available annually, and 2022 is the last year for which there is official data.

[16] Recently, Lee (2024) found that, in the United States, a one-percentage-point increase in interest rates is associated with a 5.5% rise in rental prices and, consequently, sales prices among liquidity-constrained landlords. This finding was also highlighted by *The Economist* (2025), which suggests that higher interest rates price potential homeowners out of the market. Unable to afford a home, they are forced to rent instead. Moreover, landlords with variable-rate mortgages have swiftly passed on the higher costs to tenants. Given the lack of data

Fourth, increases in residents strongly rise the probability of positive bubbles and decrease the probability of negative bubbles in both markets and cities. This result is also expected as higher housing demand, higher prices and therefore, a higher probability of a positive bubble (see e.g., Hansen *et al.*, 2024). In this regard, Cuadrado *et al.*, (2024) highlight that Spain has become one of the EU's leading immigrant-receiving countries in the most recent period. In particular, in 2022, it recorded one of the highest rates of foreign inflows per thousand inhabitants in the EU, even ahead of Germany, and ranked in the middle –below Germany and above France and Italy– in the share of the foreign population residing in the country (17.1%). In absolute terms, Spain ranked fourth among destination countries with the highest number of permanent immigrants in 2022, behind the United States, Germany, and the United Kingdom (see OECD, 2023).

Finally, increases in unemployment rates decrease the likelihood of positive bubbles and, for the rental market in Madrid, increase the likelihood of negative bubbles. This is an anticipated result, as higher unemployment typically discourages home purchases and may prompt individuals to seek more affordable rental options.

As a robustness to this analysis, Table 5 presents an alternative model incorporating city-specific variables closely related to those variables used in Table 4. In particular, we include the annual growth in hotel overnight stays, the annual increase in the number of housing units, changes in the 3-month EU interbank interest rate, the annual growth rate of immigration, and the annual growth in affiliations to the Spanish Social Security system.

[Insert Table 5 here]

The results of the multinomial logistic regression using these alternative variables, presented in Table 5, are generally consistent with those reported in Table 4. Specifically, increases in the number of hotel overnight stays stabilise the markets (with the exception of a higher probability of negative bubbles in the rental market of Barcelona), higher interest rates reduce the likelihood of positive bubbles, and increases in both immigration and social security affiliations enhance the likelihood of positive bubbles.

4.3 Local projections results

So far, we have studied the variables associated *contemporaneously* with the occurrence of house price bubbles, but anticipating house price bubbles is crucial. As explained in Section

on property owners, we are unable to differentiate the impact of rising interest rates between high- and low-liquidity-constrained owners.

2.3, we also examine the impulse response functions estimated using local projections of Jordà (2005) to shed light on these patterns.

We use the same independent variables as in Equation (4) that have been used in the previous Section. Note the multinomial logistic regression results for h=0 (Equation (5) in Section 2.3) coincide in with those of Table 4.

[Insert Figures 3 here]

Figures 3 illustrate local projections capturing the effect of a one-standard-deviation shock to each variable on the probability of a positive or negative bubble in each city (Madrid or Barcelona) and market (rental or sales). Overall, we find that the relationships observed contemporaneously in Table 4 mostly remain persistent over the following two years, as shown in Figure 3. The key findings drawn from these figures are as follows. First, the stabilising effect of visitors (hotel overnight stays) on both positive and negative bubbles proves to be quite persistent. This finding confirms the previous results that restricting the number of visitors in major urban centres could have a detrimental impact on the housing market.

Second, the effects of house certification on positive bubbles are not entirely clear, as they vary across markets and cities. For example, in the rental market of Madrid, the likelihood of a positive bubble increases in the first year following a rise in certifications, though this effect is transitory. Conversely, in the sales market of Barcelona, the probability of a positive bubble decreases after 24 months, as housing supply catches up with rising demand. However, it appears that an increase in house certification generally reduces the probability of a negative bubble in both markets and cities.

Third, increases in interest rates reduce the probability of a positive bubble, but this effect is transitory and fades after a few months. Interestingly, the transitory impact of rising interest rates on positive bubbles lasts longer in the sales market than in the rental market. This may reflect the greater flexibility of the rental market in adapting to interest rate changes, compared to the relative stability of the sales market. Instead, increases in interest rates do not affect the probability of negative bubbles.

Fourth, increases in the number of residents raise (reduce) the probability of a positive (negative) bubble, although this effect dissipates after two years. Notably, the effect on positive bubbles lasts longer in the rental market than in the sales market in Barcelona, suggesting that new residents primarily target the rental housing market rather than the sales market. This finding aligns with recent reports from PricewaterhouseCoopers (2024) and Banco de España (2024), which identify immigrants and young people as the main renters. Together with the significant migration Spain has experienced in recent years, this helps explain the prolonged impact of increases in residents on the likelihood of positive bubbles in the rental market.

Finally, increases in the unemployment rate have a persistent negative effect on the probability of positive bubbles, with no significant impact on the probability of negative bubbles. This finding suggests that prolonged periods of unemployment adversely affect the local economy, thereby making positive bubble-like housing prices highly unlikely in such environments.

4.4. Bubbles contagion

In the previous sections, we analysed the determinants of real estate price bubbles in both urban centres (Madrid and Barcelona). While we identified the variables that explain these bubbles, we did not explore the interactions between the bubbles in these two markets and cities. In this section, we investigate whether contagion exists between these markets and cities.

The results of the bubble contagion analysis are presented in Figure 4. This figure displays the contagion results for both the rental and sales markets in Madrid and Barcelona, as represented by $\hat{\delta}_{t,T}$ in Equation (7). Positive values indicate that the two real estate markets are interconnected, suggesting potential bubble contagion, while negative values signify no connection between the markets, implying the absence of bubble contagion. To enhance the visual appeal, we highlight in grey the periods with the strongest bubble contagion—those corresponding to the highest positive decile of $\hat{\delta}_{t,T}$ across all market pairs.

[Insert Figure 4 here]

Our results reveal an intriguing finding: the strongest contagion primarily flows from the rental to the sales markets. While high contagion does not necessarily indicate the presence of a bubble, our analysis shows that during the most recent positive bubble in 2024, contagion occurred from the Madrid rental market to both the Barcelona and Madrid sales markets (Panels G and J, respectively), and from the Barcelona rental market to both the Madrid and Barcelona sales markets (Panels H and K, respectively). Therefore, our results suggest that in both cities, the rental market is the primary driver of price increases. At certain price levels, the appeal of renting diminishes for tenants, prompting them to consider purchasing a home, which in turn boosts demand in the sales market, and consequently the sales prices. This finding is significant, as it implies that housing policies should primarily focus on the rental market—a focus that is already being pursued in current policy efforts.

In this sense, the Spanish Law 12/2023 of 24 May 2023 on the Right to Housing[17] includes a progressive increase in the social rental stock among their objectives, with public-private collaboration playing a more prominent role in its development. The stimulus to private rental supply is articulated in the form of greater tax incentives for individuals who rent housing with price reductions in the so-called *stressed* areas. Moreover, it also sets out measures to reduce tenants' effort with existing contracts. Specifically, new limitations are introduced on annual rent increases and the possibility of establishing rent control measures in stressed areas if decided by the Autonomous Regional Governments with competence in this area and within the price range set by the central government (see Banco de España, 2024[18]).

For example, the Autonomous Government of Catalonia (where Barcelona is located), who already introduced rent control policies in late 2020 that remained in effect for a year and a half, reinstated rent control measures in March 2024 under the above-mentioned Spanish Law. The first phase of rent controls in Catalonia (it covers the period 2020-2022) offered a valuable opportunity for policy evaluation, though findings were sometimes contradictory (see Jofre-Monseny *et al*., 2023; Kholodilin, 2022; and Monràs and García-Montalvo, 2022). However, while the second phase (from March 2024) may present more relevant results for consideration, comprehensive evaluations are not yet available. Nevertheless, concerns about partial compliance with the policy have been frequently expressed in the media. A key issue appears to be a shift in rental supply away from regulated long-term leases toward temporary contracts, exempt from the policy. Concretely, the Government of Catalonia[19] estimated that in the third quarter of 2024, temporary rentals registered a sharp increase of 37.5% compared to the same quarter of the previous year. Consequently, since closing this gap was critical to preserving the intended benefits of rent regulation and preventing further shifts in the rental market away from long-term residential leases (see IEB, 2024), the Government of Catalonia has recently approved an executive order (2/2025)[20] that will be passed as a draft law to

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[17] https://www.boe.es/eli/es/l/2023/05/24/12/

[18] In addition, measures to support young people's demand for housing in the form of rental subsidies and public guarantees for purchasing housing have also been articulated.

[19] https://portaldogc.gencat.cat/utilsEADOP/PDF/9339/2068659.pdf

[20] https://portaljuridic.gencat.cat/ca/document-del-pjur/?documentId=1007372&validity=2077549&traceability=01&language=es

regulate short-term rental contracts and limit the current conditions (with free prices) to those for tourist or recreational use.

Lastly, within markets, we have found contagion from Madrid to Barcelona both in the rental and the sales market (see Panels D and L, respectively), but not the other way round. These periods lasted mostly during late 2019 and the first months of the COVID-19 pandemic in 2020. Several factors can explain this contagion episode. Both cities are closely connected economically and demographically, with price trends in one city often influencing the other due to investor movement and migration. Investors treat both markets as complementary, and price increases in Madrid often lead to expectations of similar trends in Barcelona. Additionally, the scarcity of affordable housing in Madrid pushed some buyers and investors to consider Barcelona, increasing demand and driving prices upward. Both cities experienced similar disruptions during the early pandemic, such as reduced supply and market uncertainty, synchronising their housing market behaviour. Finally, the European Central Bank's monetary policies, including low interest rates and financial stimulus, provided similar conditions in both cities, further fuelling the price contagion.

5. Conclusions

In this study, we examine the dynamics of rental and sales prices across various districts in Madrid and Barcelona from May 2007 to December 2024. Utilising monthly data from Idealista.com, Spain's leading real estate platform, we apply the common bubble detection method proposed by Chen *et al*. (2023), which builds on the framework established by Phillips *et al*. (2011, 2015a, 2015b), to identify potential price bubbles in both market segments and cities. Our analysis reveals that while only three to four bubbles emerged during the sample period, they were notably persistent, with an average duration of 29 months. When investigating the key drivers of these bubbles, our findings indicate that a lower likelihood of housing bubbles is associated with more visitors choosing hotel accommodation, suggesting that increased hotel tourism helps stabilise housing markets in both cities. Lower bubble risk is also found to be linked to rising interest rates and greater availability of housing certificates. In contrast, an increase in the resident population significantly heightens positive bubble likelihood, while higher unemployment tends to dampen it. These results remain consistent when alternative proxies for the determinants are used. Utilising the local projections method of Jordà (2005), we further demonstrate that most of these effects have long-lasting implications. Finally, we explore contagion patterns across cities and market segments, uncovering that rental bubbles consistently precede sales bubbles, underlining the critical role of rental markets in driving broader price dynamics.

We believe that our paper offers an interesting and relevant case study for several stakeholders. For academics and policymakers, analysing these phenomena within the Spanish context offers valuable insights into the dynamics of housing bubbles and their macroeconomic impact, while also highlighting structural vulnerabilities within the real estate sectors of developed and, particularly, European economies (European Systemic Risk Board, 2024). Indeed, real estate markets are integral to the functioning of the economy and have significantly influenced the evolution of the financial system (European Central Bank, 2009; European Systemic Risk Board, 2015). For urban planners and local housing authorities, the results provide evidence on the consequences of specific urban trends. Notably, measures that restrict the influx of visitors to major urban centres may inadvertently increase the likelihood of housing price bubbles, given the stabilising effect that hotel-based tourism appears to exert on the local economy and, consequently, on housing markets. On the other hand, policies that encourage the relocation of residents to areas with lower housing demand or promote the issuance of housing certificates could help mitigate bubble risk.

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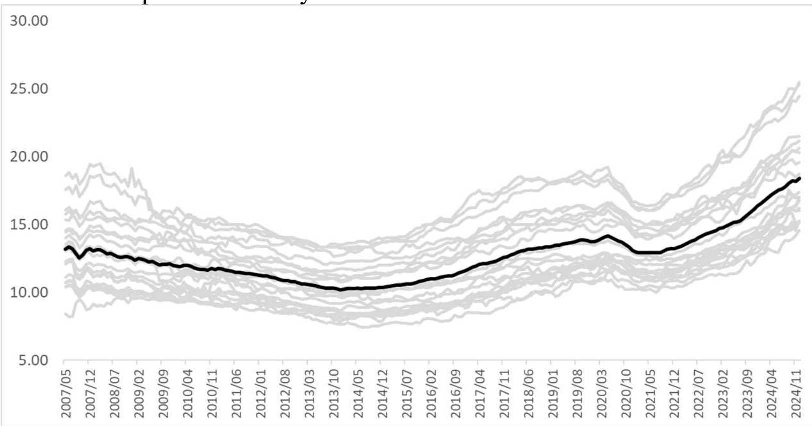
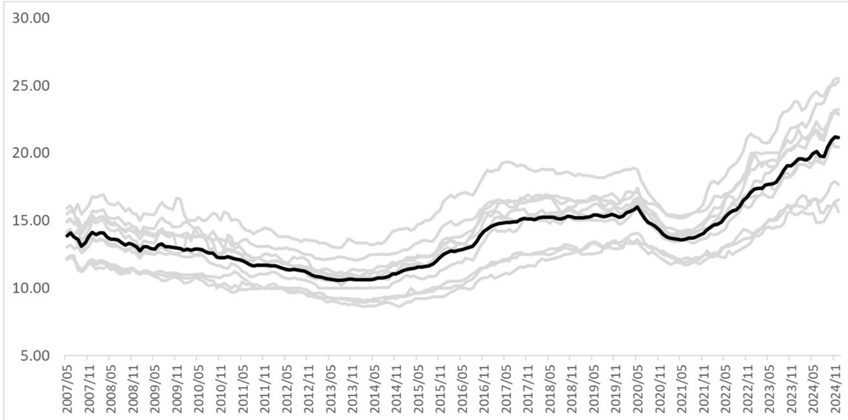
Figure 1. Rental and sales prices for Madrid and Barcelona

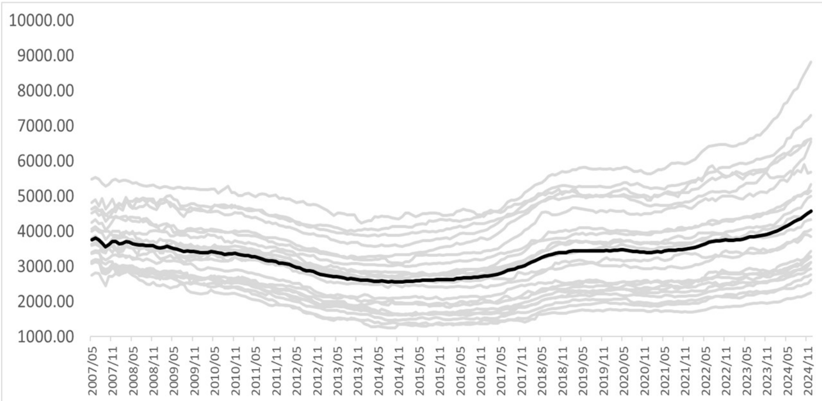
This figure plots the rental and sales prices for Madrid and Barcelona. The black line represents the average prices across districts and the grey lines are the prices at district level. The sample is from May 2007 to December 2024.



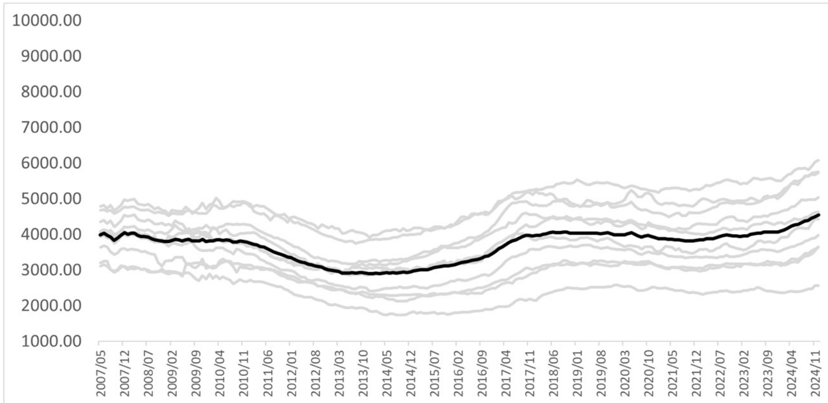
Panel A: Rental market in Madrid



Panel B: Rental market in Barcelona



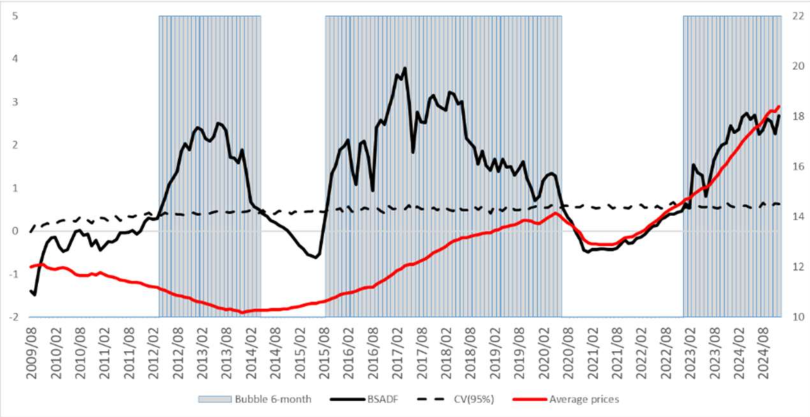
Panel C: Sales market in Madrid



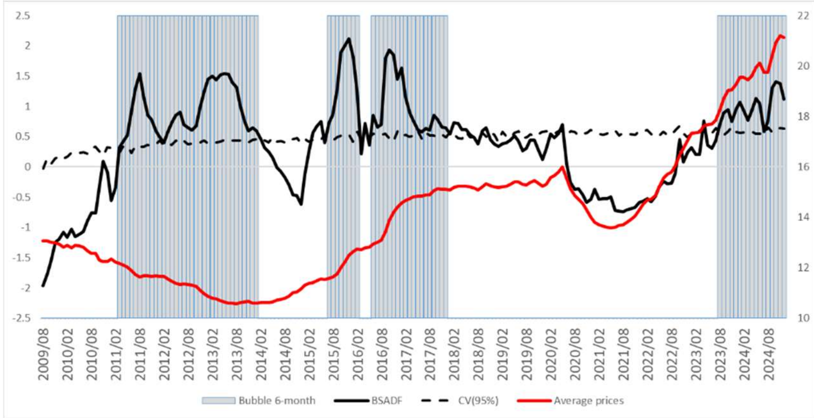
Panel D: Sales market in Barcelona

Figure 2. Bubbles in rental and sales markets

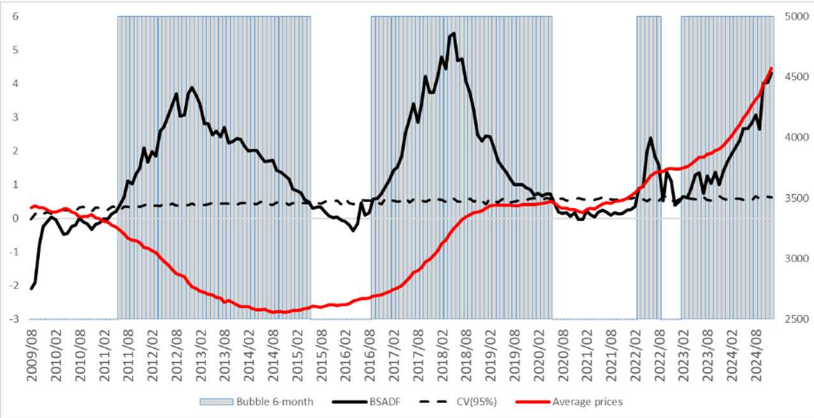
This figure plots the results of bubble detection tests for rental and sales markets in both Madrid and Barcelona (using the minimum bubble length of 6 months) with bubble episodes shaded in grey. The average price is in the solid red line, and the BSADF statistic in the solid black line. We also report the Monte Carlo critical values for significance at the 5% level in the dash black line. The sample period is from August 2009 to December 2024.



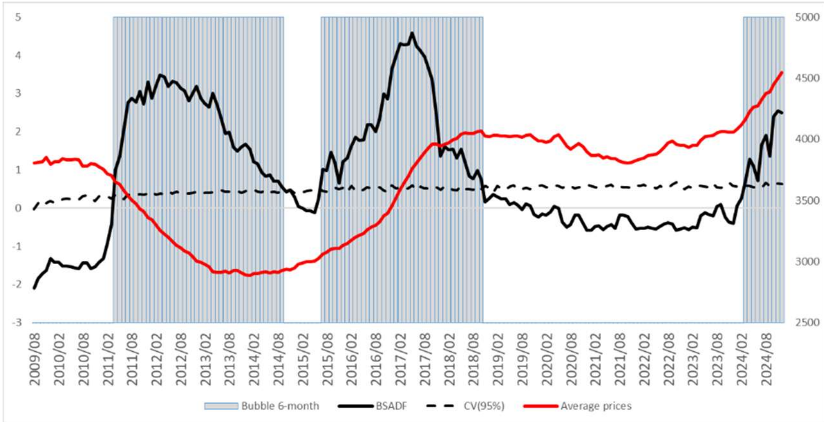
Panel A: Rental market in Madrid



Panel B: Rental market in Barcelona



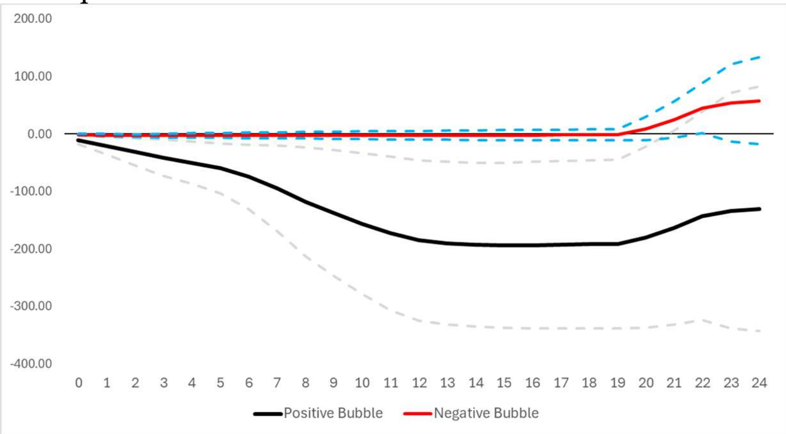
Panel C: Sales market in Madrid



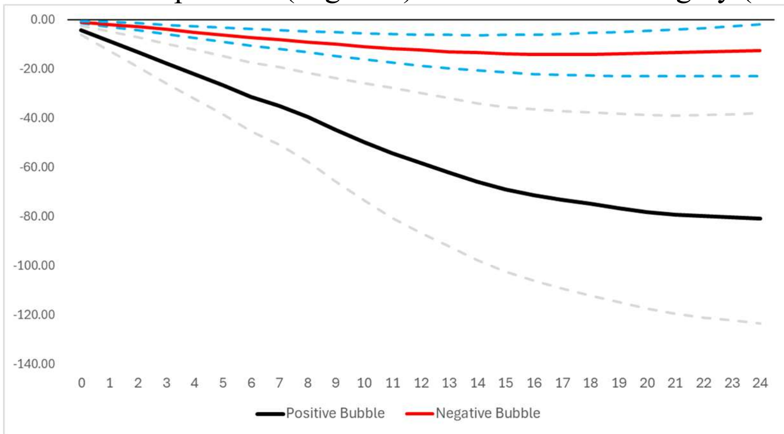
Panel D: Sales market in Barcelona

Figure 3.a Local projections impulse-response: Shocks to hotel-based visitors

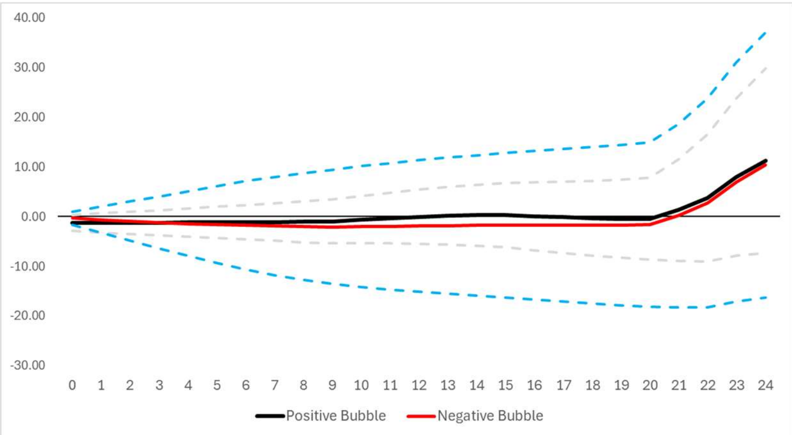
This figure plots the local projection estimates to one standard-deviation shock in hotel-based visitors on positive (black line) and negative (red line) bubble episodes from zero to 24 months ahead. The 95% confidence bands for positive (negative) bubbles are in dash grey (blue) lines.



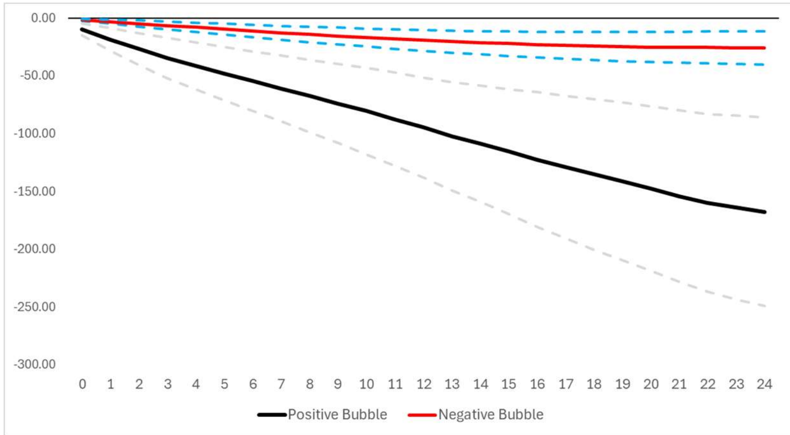
Panel A: Rental market in Madrid



Panel B: Rental market in Barcelona



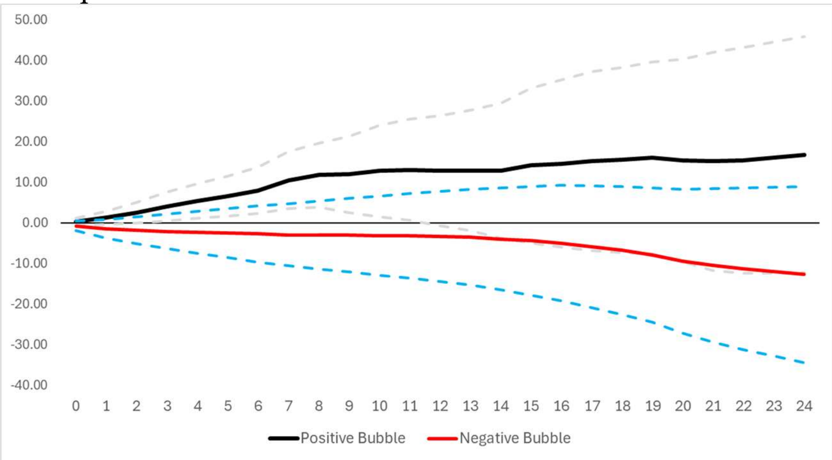
Panel C: Sales market in Madrid



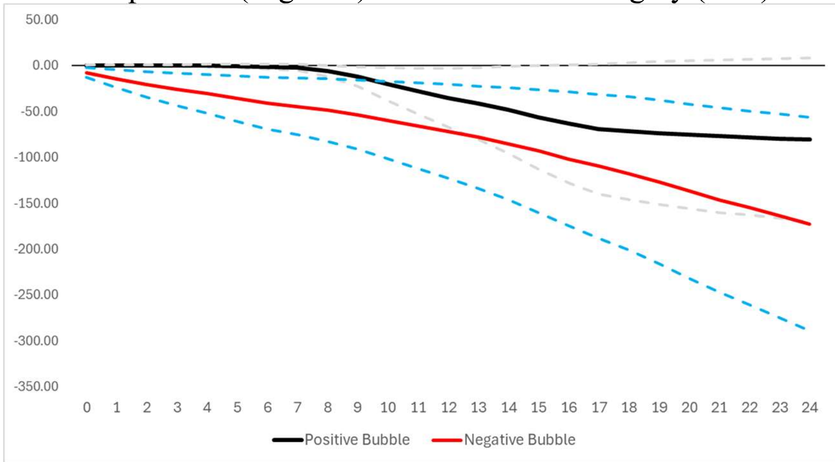
Panel D: Sales market in Barcelona

Figure 3.b Local projections impulse-response: Shocks to house certification

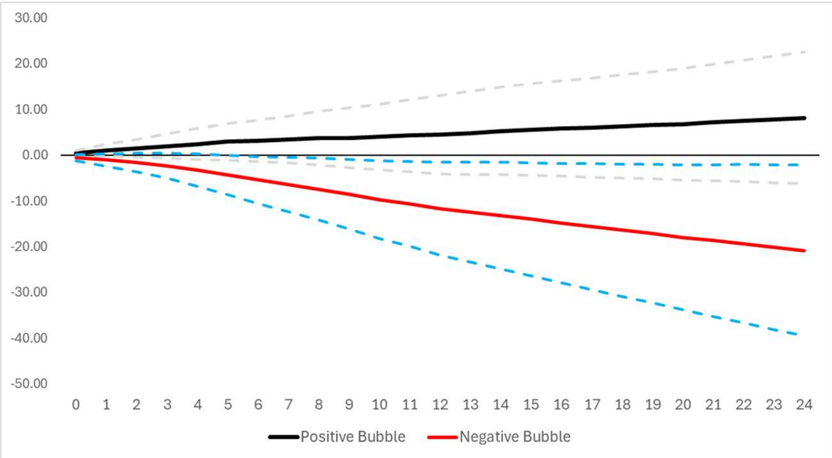
This figure plots the local projection estimates to one standard-deviation shock in house certification on positive (black line) and negative (red line) bubble episodes from zero to 24 months ahead. The 95% confidence bands for positive (negative) bubbles are in dash grey (blue) lines.



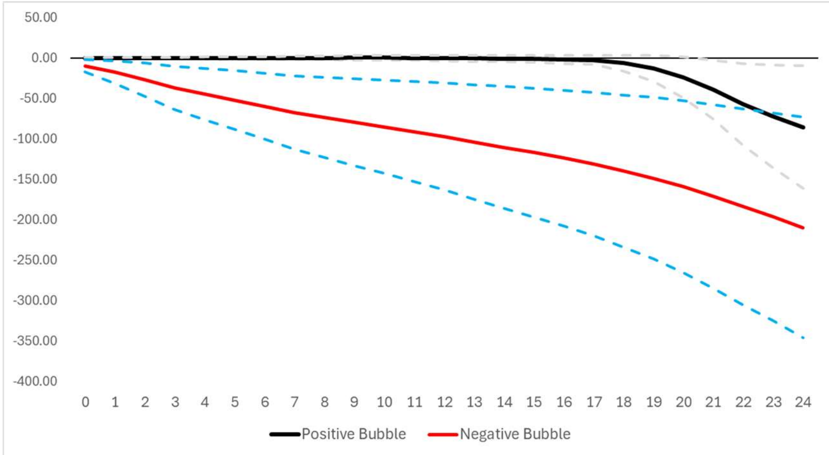
Panel A: Rental market in Madrid



Panel B: Rental market in Barcelona



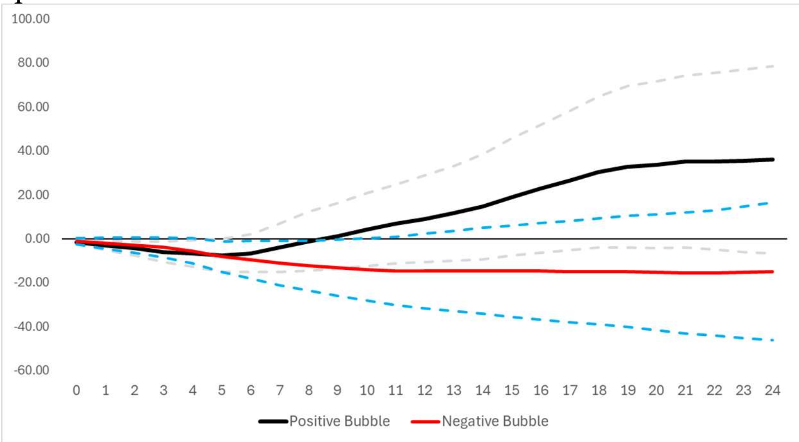
Panel C: Sales market in Madrid



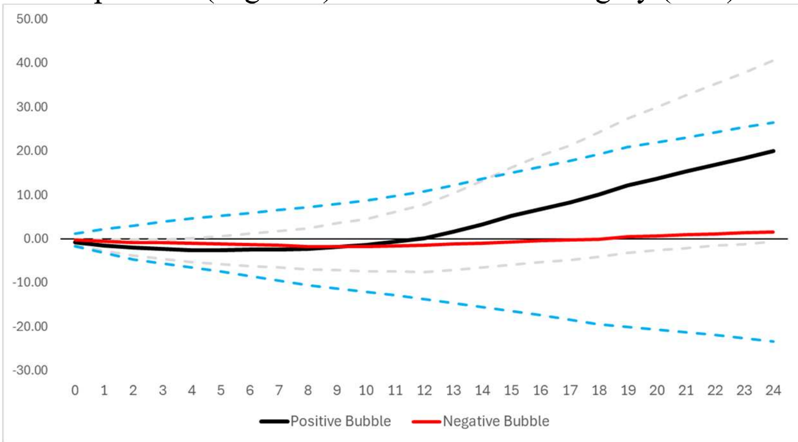
Panel D: Sales market in Barcelona

Figure 3.c Local projections impulse-response: Shocks to EU interest rates

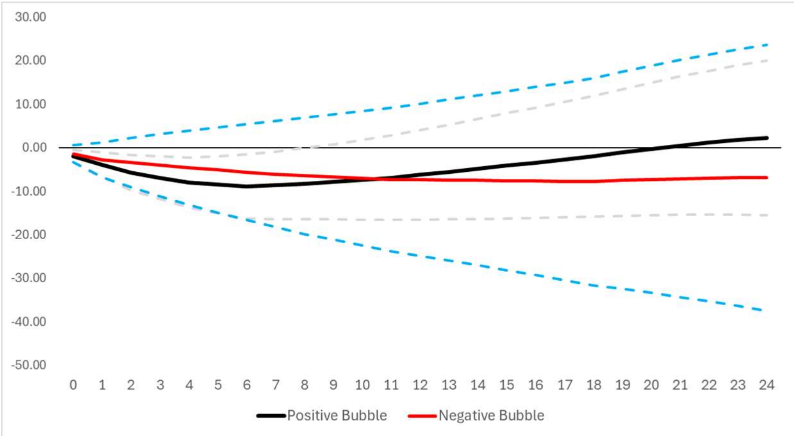
This figure plots the local projection estimates to one standard-deviation shock in EU interest rates on positive (black line) and negative (red line) bubble episodes from zero to 24 months ahead. The 95% confidence bands for positive (negative) bubbles are in dash grey (blue) lines.



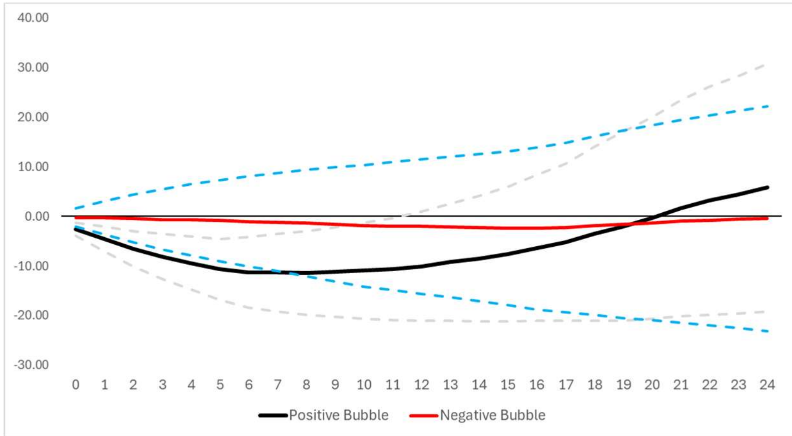
Panel A: Rental market in Madrid



Panel B: Rental market in Barcelona



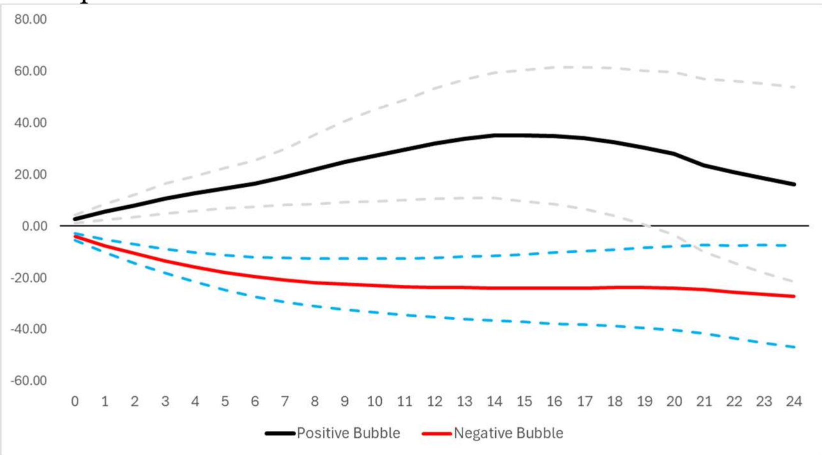
Panel C: Sales market in Madrid



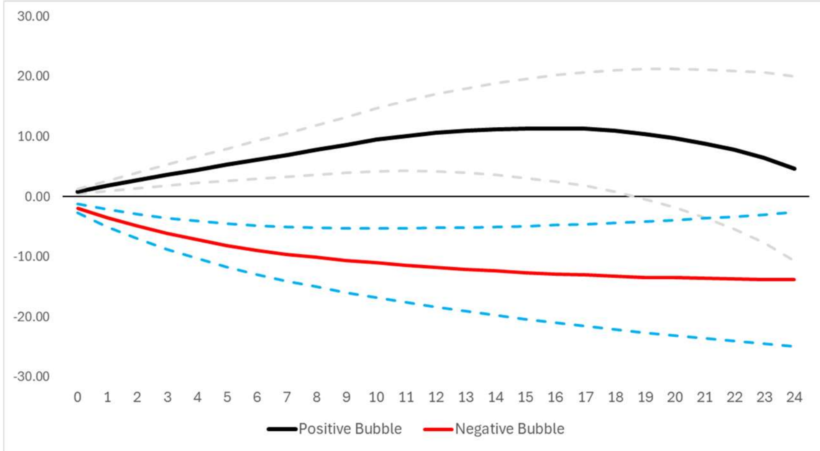
Panel D: Sales market in Barcelona

Figure 3.d Local projections impulse-response: Shocks to resident population

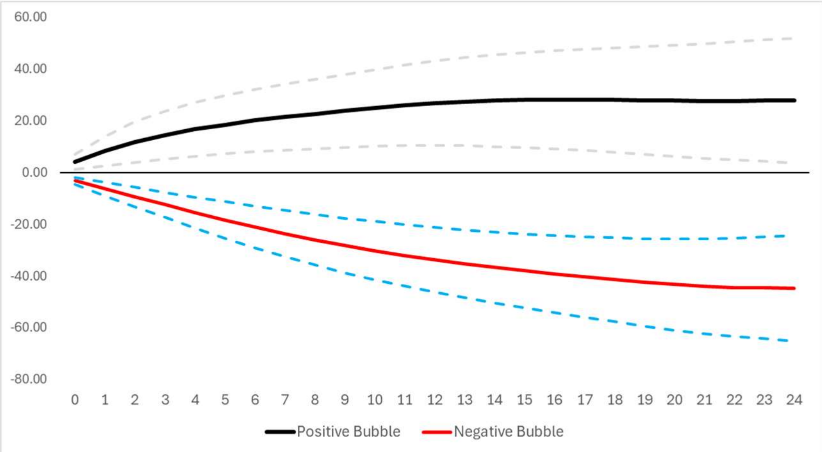
This figure plots the local projection estimates to one standard-deviation shock in resident population on positive (black line) and negative (red line) bubble episodes from zero to 24 months ahead. The 95% confidence bands for positive (negative) bubbles are in dash grey (blue) lines.



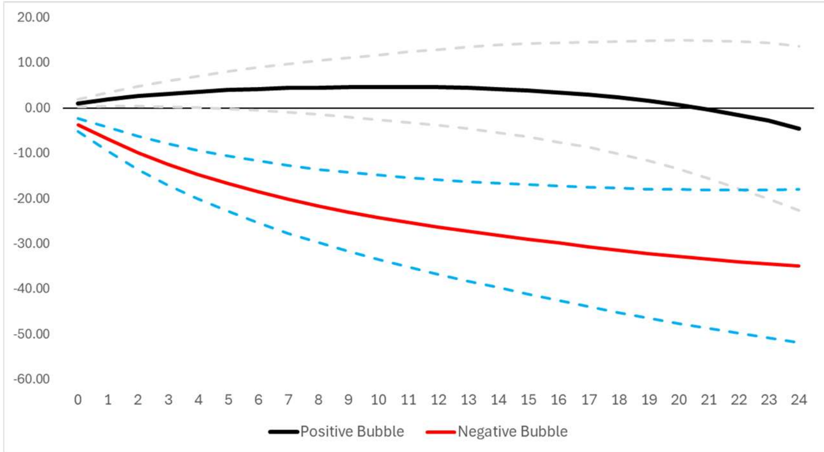
Panel A: Rental market in Madrid



Panel B: Rental market in Barcelona



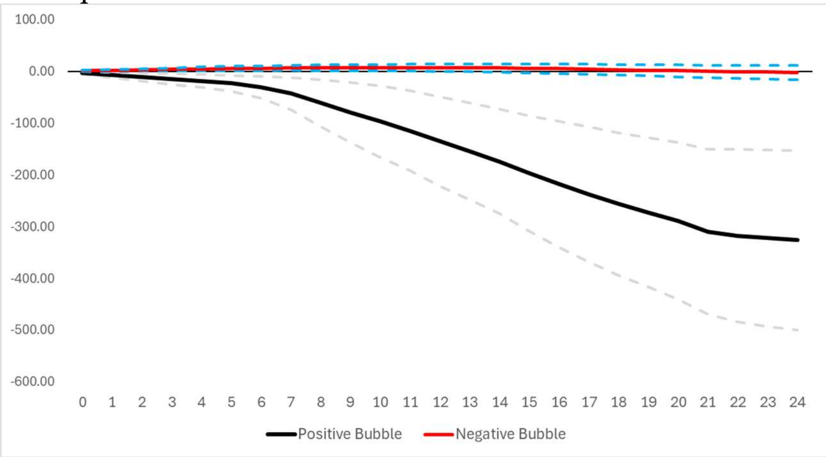
Panel C: Sales market in Madrid



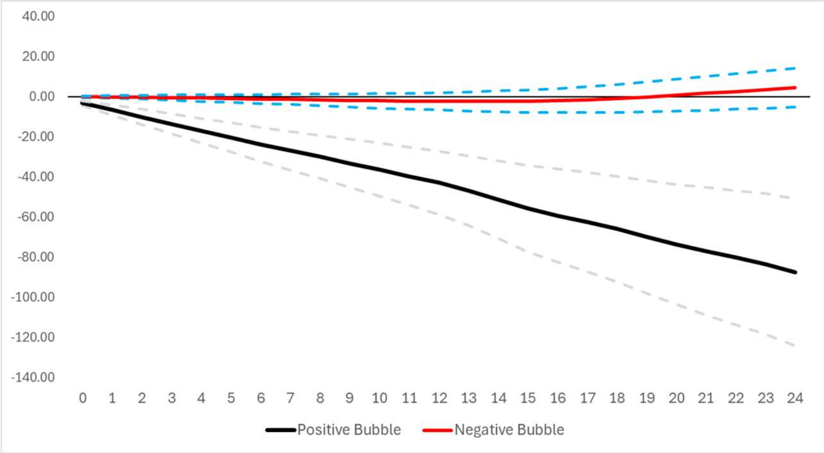
Panel D: Sales market in Barcelona

Figure 3.e Local projections impulse-response: Shocks to unemployment rate

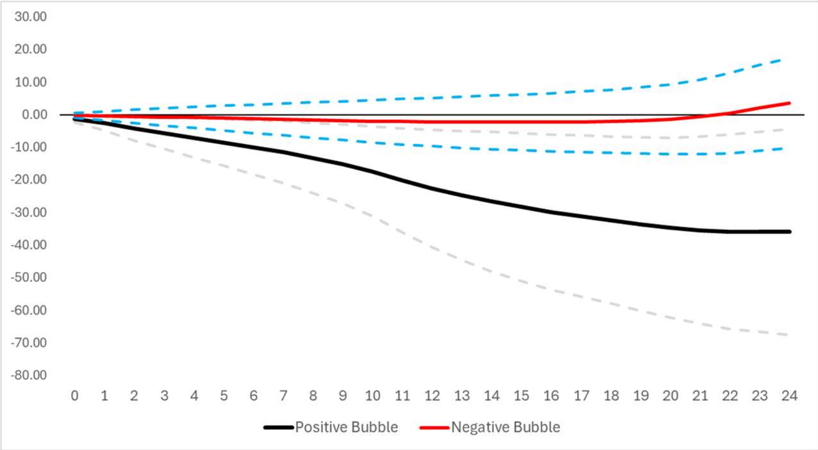
This figure plots the local projection estimates to one standard-deviation shock in unemployment rate on positive (black like) and negative (red line) bubble episodes from zero to 24 months ahead. The 95% confidence bands for positive (negative) bubbles are in dash grey (blue) lines.



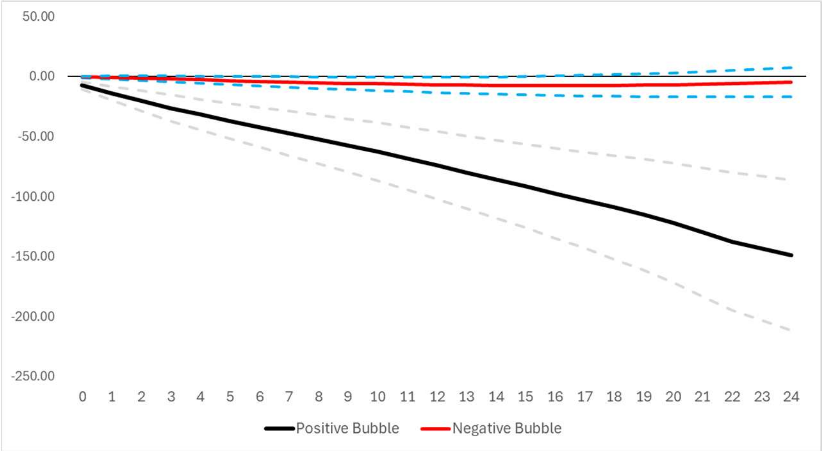
Panel A: Rental market in Madrid



Panel B: Rental market in Barcelona



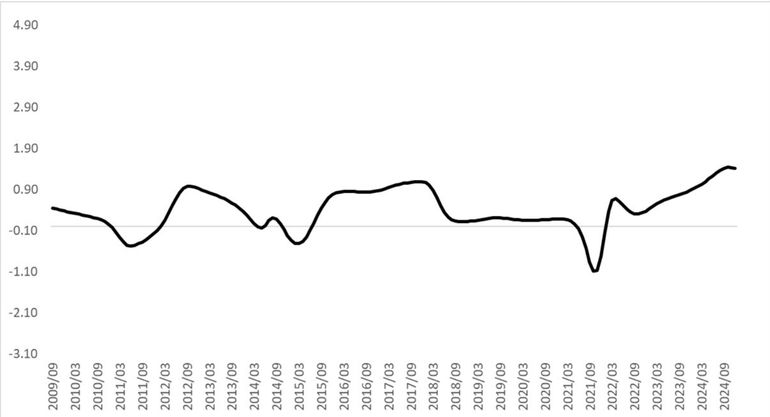
Panel C: Sales market in Madrid



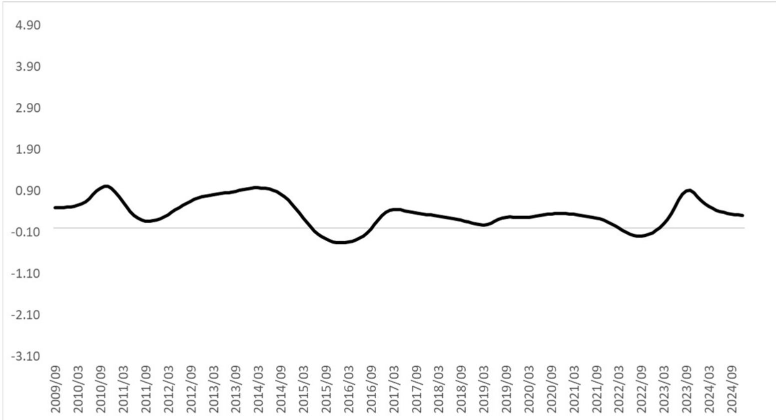
Panel D: Sales market in Barcelona

Figure 4. Bubbles contagion in rental and sales markets

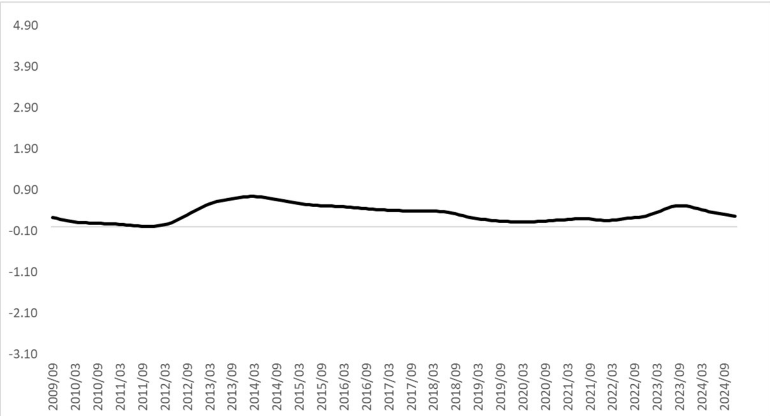
This figure plots the results of bubble contagion for rental and sales markets in both Madrid and Barcelona as represented by $\hat{\delta}_{t,T}$ in Equation (7). The periods shaded in grey corresponds to the highest positive decile of $\hat{\delta}_{t,T}$ across all market pairs. The arrows represent where the contagion comes from. The sample period is from August 2009 to December 2024.



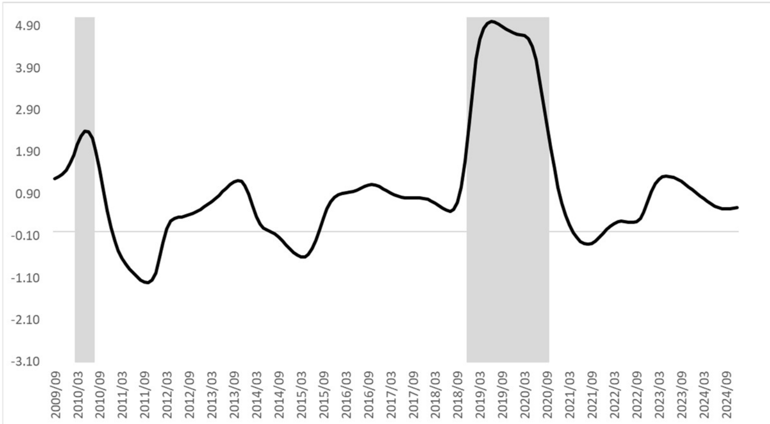
Panel A: Rental market in Barcelona ➔ Rental market in Madrid



Panel B: Rental market in Madrid ➔ Sales market in Madrid

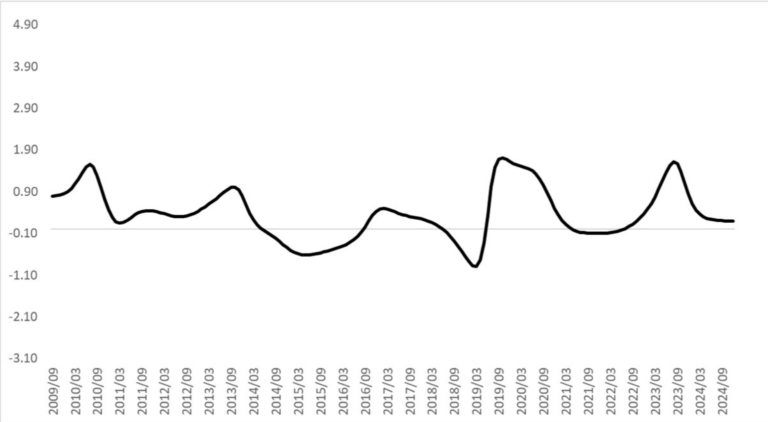


Panel C: Sales market in Barcelona ➔ Rental market in Madrid

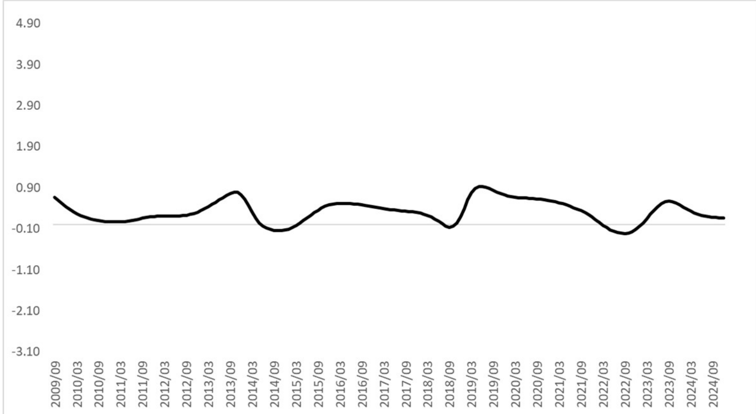


Panel D: Rental market in Madrid ➔ Rental market in Barcelona

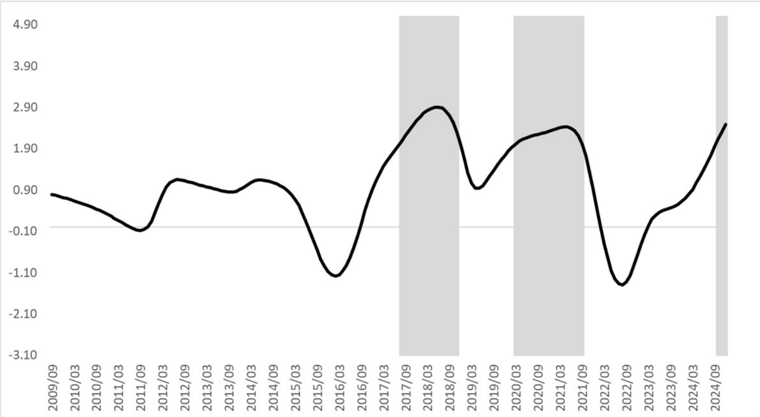
Cont. Figure 4. Bubbles contagion in rental and sales markets



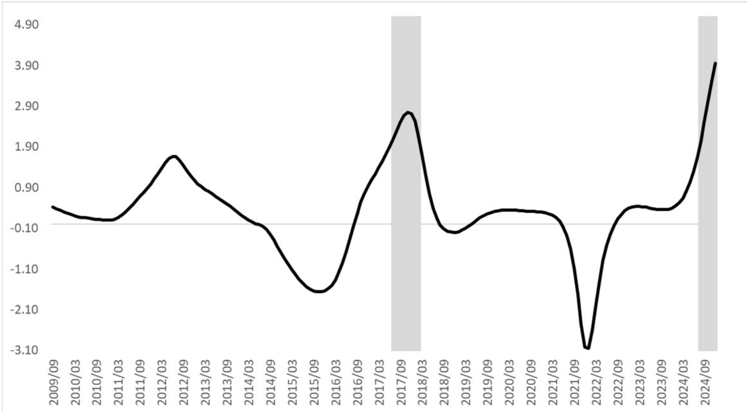
Panel E: Sales market in Madrid ➔ Rental market in Barcelona



Panel F: Sales market in Barcelona ➔ Rental market in Barcelona

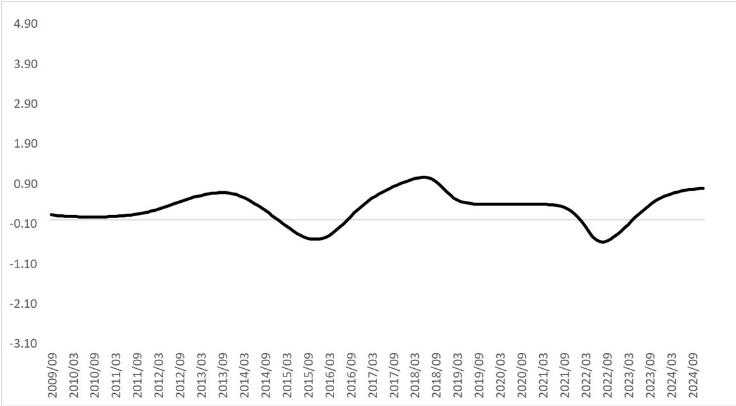


Panel G: Rental market in Madrid ➔ Sales market in Madrid

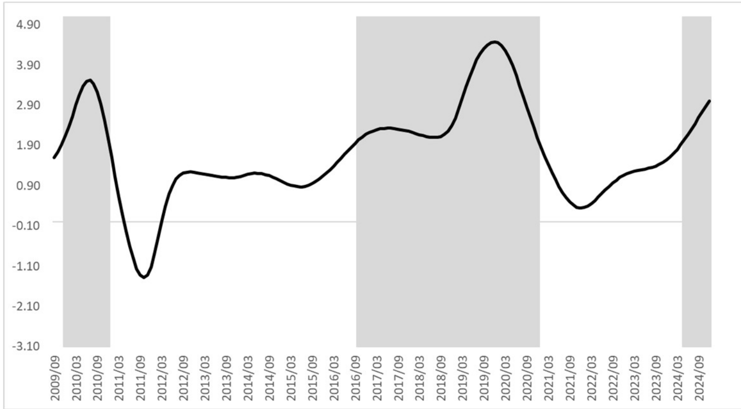


Panel H: Rental market in Barcelona ➔ Sales market in Madrid

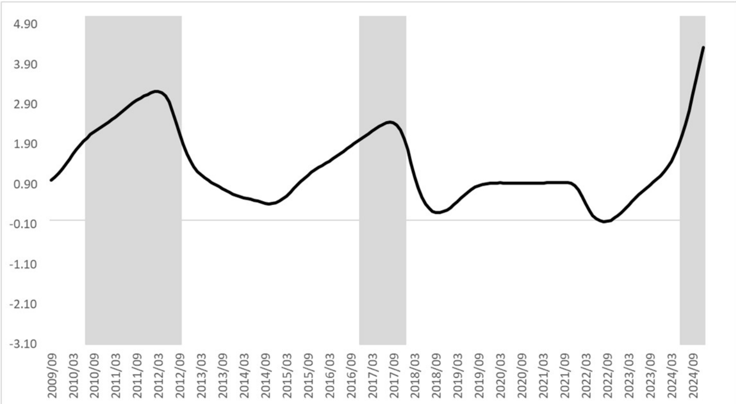
Cont. Figure 4. Bubbles contagion in rental and sales markets



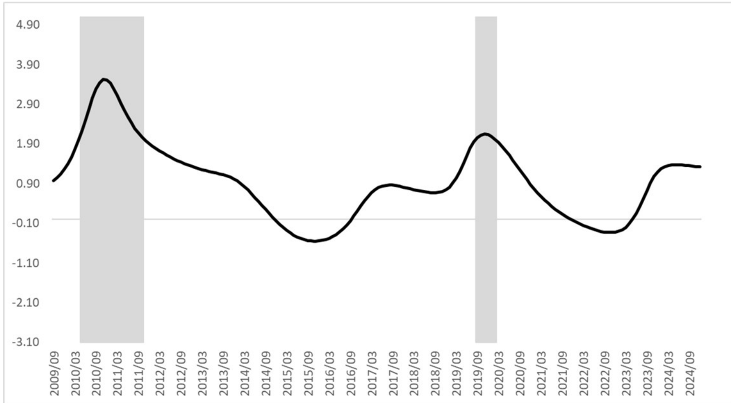
Panel I: Sales market in Barcelona ➔ Sales market in Madrid



Panel J: Rental market in Madrid ➔ Sales market in Barcelona



Panel K: Rental market in Barcelona ➔ Sales market in Barcelona



Panel L: Sales market in Madrid ➔ Sales market in Barcelona

Table 1. Descriptive statistics

This table reports the mean and standard deviation of the rental and sales market prices (in euros per square metre) per district in Madrid (Panel A) and Barcelona (Panel B), respectively. The sample period is from May 2007 to December 2024.

	Panel A: Madrid					Panel B: Barcelona			
	Rental		Sales			Rental		Sales	
	Mean	Std.	Mean	Std.		Mean	Std.	Mean	Std.
Arganzuela	13.62	2.24	3612.94	623.40	Ciutat Vella	16.98	2.95	3912.81	478.11
Barajas	11.31	1.26	3082.78	336.69	Eixample	15.02	3.20	4307.02	634.27
Carabanchel	10.66	1.78	2219.72	422.41	Gràcia	14.51	2.72	3889.84	547.15
Centro	16.98	2.67	4355.98	802.90	Horta Guinardó	11.83	2.07	2955.08	383.22
Chamartín	14.84	2.05	4736.65	633.39	Les Corts	14.12	2.23	4705.46	384.18
Chamberí	16.27	2.52	4757.52	852.28	Nou Barris	11.36	1.87	2372.22	383.44
Ciudad Lineal	12.36	1.77	2973.95	390.21	Sant Andreu	11.84	1.90	2882.79	366.90
Encinar de los Reyes	14.68	1.52	5020.78	408.12	Sant Martí	14.73	2.98	3599.57	388.56
Fuencarral	11.44	1.57	3320.09	380.99	Sants-Montjuïc	13.43	2.55	3294.70	474.99
Hortaleza	12.06	1.39	3452.49	429.02	Sarrià-Sant Gervasi	15.50	2.49	4860.86	582.77
Latina	10.71	1.97	2276.15	417.79					
Moncloa	13.60	1.99	3739.98	501.73					
Moratalaz	10.18	1.60	2457.30	376.65					
Puente de Vallecas	10.90	1.91	1962.89	459.11					
Retiro	14.67	2.26	4131.07	709.76					
Salamanca	16.90	2.71	5183.12	1034.15					
San Blas	11.33	1.48	2617.16	392.15					
Tetuán	14.29	2.23	3397.62	546.10					
Usera	10.74	1.97	2082.39	447.28					
Vicálvaro	9.86	1.34	2332.85	467.85					
Villa de Vallecas	10.35	1.49	2414.92	337.35					
Villaverde	9.99	1.84	1846.40	428.26					
Average	*12.62*	*1.84*	*3271.58*	*466.77*	*Average*	*13.93*	*2.46*	*3678.04*	*423.48*

Table 2. Bubble occurrences

This table reports the statistics of bubble occurrences. The number of bubbles refers to those lasting at least six months in the rental and sales markets of Madrid and Barcelona. The sample period is from August 2009 to December 2024.

	Rental market in Madrid	Rental market in Barcelona	Sales market in Madrid	Sales market in Barcelona
Number of bubbles	3	4	4	3
Number of bubble months	107	79	122	92
Number of bubble months (in %)	57.84	42.70	65.95	49.73
Number of months with positive bubbles	82	44	74	50
Number of months with negative bubbles	25	35	48	42
Average length of bubbles (in months)	35.67	19.75	30.50	30.67

Table 3. Variables definition and source

This table defines the variables used in multinomial logistic regressions. The sources are included in the last column.

Variable	Description	Source
Hotel-based visitors	The annual growth rate in the number of people registered at hotel establishments per city.	National Institute of Statistics (INE): Hotel occupancy survey
House certifications	The annual growth rate in the issuance of housing construction permits per city.	Ministry of Transport and Sustainable Mobility
EU interest rate	Changes in the ECB's interest rate for its primary refinancing operations.	European Central Bank (ECB)
Resident population*	The annual rate of growth in the resident population per city.	National Institute of Statistics (INE): Population Figures
Unemployment	The annual growth rate in the number of individuals officially registered as unemployed per city.	State Public Employment Service (SEPE)
Overnight stays	The annual rate of growth in the number of nights spent by a person in a hotel establishment per city.	National Institute of Statistics (INE): Hotel occupancy survey
House numbers	The annual rate of growth in the number of houses issued completion certificates per city.	Ministry of Transport and Sustainable Mobility
3-month interbank rate	Changes in the 3-month Spanish interbank interest rates.	Bank of Spain
Immigration*	The annual growth rate of immigration per city.	Ministry of Inclusion, Social Security and Migration
Affiliation Social Security	The annual rate of growth in the number of affiliations to the Social Security system per city.	Ministry of Inclusion, Social Security and Migration

*Quarterly series are interpolated into monthly.

Table 4. Determinants of price bubbles

This table presents the estimates from the multinomial logistic regression in Equation (4). Positive (negative) represents the probability of positive (negative) bubbles. The independent variables are defined in Table 3. All continuous variables are standardised and winsorised at the {1%, 99%}. Robust t-statistics are reported in parenthesis. ***, **, and * represent significant levels at the 1%, 5% and 10%, respectively. The sample is from August 2009 to December 2024.

	Rental market in Madrid		Rental market in Barcelona		Sales market in Madrid		Sales market in Barcelona	
	Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative
Hotel-based visitors	-10.407***	-0.936**	-4.102***	-0.853***	-1.231	-0.323	-9.581***	-1.501***
	(-2.69)	(-1.99)	(-4.20)	(-3.47)	(-1.52)	(-0.46)	(-3.75)	(-3.22)
House certifications	0.414	-0.682	0.247*	-7.604***	0.440	-0.490	0.010	-9.603**
	(0.95)	(-1.13)	(1.82)	(-2.86)	(1.26)	(-1.43)	(0.08)	(-2.47)
EU interest rate	-1.582***	-1.062	-0.769**	-0.219	-1.895***	-1.364	-2.518***	-0.223
	(-3.14)	(-1.54)	(-2.31)	(-0.30)	(-2.62)	(-1.33)	(-3.73)	(-0.24)
Resident population	2.857***	-4.087***	0.891***	-1.923***	4.142***	-3.266***	1.066***	-3.759***
	(3.53)	(-6.06)	(4.05)	(-4.97)	(2.80)	(-4.86)	(2.63)	(-5.03)
Unemployment	-3.166**	0.976**	-3.225***	0.020	-1.342**	-0.177	-7.256***	-0.359
	(-2.46)	(2.11)	(-4.98)	(0.11)	(-2.43)	(-0.49)	(-4.60)	(-1.01)
Constant	-2.444***	-5.724***	-2.532***	-4.250***	-0.986***	-2.522***	-4.608***	-5.370***
	(-2.52)	(-5.85)	(-6.40)	(-4.45)	(-3.51)	(-5.18)	(-3.85)	(-3.58)
Pseudo R^2	0.64		0.37		0.60		0.61	
Observations	184		184		184		184	

Table 5. Determinants of price bubbles: alternative variables

This table presents the estimates from the multinomial logistic regression in Equation (4). Positive (negative) represents the probability of positive (negative) bubbles. The alternative independent variables are defined in Table 3. All continuous variables are standardised and winsorised at the {1%, 99%}. Robust t-statistics are reported in parenthesis. ***, **, and * represent significant levels at the 1%, 5% and 10%, respectively. The sample is from August 2009 to December 2024.

	Rental market in Madrid		Rental market in Barcelona		Sales market in Madrid		Sales market in Barcelona	
	Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative
Overnight stays	-10.926***	0.595*	-1.750***	0.551***	-1.491***	-0.045	-20.968***	0.010
	(-4.03)	(1.86)	(-4.99)	(2.93)	(-3.47)	(-0.26)	(-2.91)	(0.06)
House numbers	0.052	-0.282	1.816**	0.589	0.207	-0.379	1.677	1.420
	(0.10)	(-0.45)	(2.17)	(0.09)	(0.74)	(-0.97)	(0.51)	(0.30)
3-Month Interbank Rate	-4.026***	-0.706	-2.783***	-0.260	-2.330***	-2.285***	-9.142***	-1.256**
	(-3.73)	(-1.33)	(-3.35)	(-0.49)	(-3.29)	(-3.66)	(-3.19)	(-2.09)
Immigration	4.569***	-0.074	1.344***	-0.016	3.284***	0.377	3.287***	-0.246
	(3.82)	(-0.38)	(2.94)	(-0.07)	(4.59)	(1.57)	(3.13)	(-1.08)
Affiliation Social Security	10.212***	-2.493***	4.413***	-2.311***	4.062***	-0.577**	14.118***	-1.134***
	(4.54)	(-3.39)	(4.65)	(-6.47)	(2.86)	(-2.19)	(3.82)	(-4.21)
Constant	-4.324	-3.556	-3.419	-2.548	-1.234	-0.237	-13.971	-1.051
	(-3.63)	(-4.05)	(-4.58)	(-2.40)	(-1.40)	(-0.76)	(-3.32)	(-1.43)
Pseudo R^2	0.69		0.47		0.49		0.55	
Observations	179		179		179		179	

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