Regulating Short-Term Rentals: Quasi-Experimental Evidence From Mallorca

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Abstract

This paper investigates the impact of short-term rental (STR) regulations on peer-to-peer plat- forms in Mallorca between 2017 and 2019. Using a monthly panel dataset of Airbnb listings, the study analyzes a zoning-based regulatory framework that varied across municipalities, including a full ban on apartment-based STRs in Palma. The paper employs a difference-in-differences (DiD) approach comparing Mallorca with Girona, alongside a spatial regression discontinuity design (RDD) around Palma's boundary. Results indicate that the regulation decreased active listings by 2.8–4.5 percentage points and raised average room prices by 1.5–7.6 percent, particu- larly in dense tourist areas. The RDD analysis shows an even sharper effect: listings just inside Palma's border were 17.5 percentage points less likely to stay active and had a 24.4 percent price increase compared to adjacent, unregulated zones. Because listings across the boundary are highly comparable, the price rise is attributed to reduced market competition. Overall, the findings highlight two regulatory mechanisms: the composition effect—selective exit of lower-end listings, and the competition effect—higher prices due to reduced competition. These results offer strong causal evidence that STR regulations reshape local markets by contracting supply, increasing prices, and shifting demand spatially, emphasizing the need to consider spillovers and equilibrium responses in policy design.

1. Introduction

Over the past decade, the rise of online STR platforms such as Airbnb and Booking has significantly reshaped P2P accommodation markets. Platforms allow owners to generate income from idle or underused housing stock. In just a few years, low barriers to entry have led to an extraordinary market expansion, raising concerns about how this phenomenon is affecting rental prices, over- tourism, and local labor markets. Social movements, such as residents' associations and housing activists, and the hotel industry have contributed to public debates and regulatory controversies. As a response, city councils, and regions have designed and implemented regulations to control or manage STR and the role played by the commercializing platforms. While much of the existing literature focuses on major urban centers, less is known about the impact of STR regulation in regions where tourism plays a dominant economic role.

Mallorca, the largest of Spain's Balearic Islands, provides a valuable case study. Tourism accounts for more than 40% of the regional GDP, and STR activity expanded rapidly in the years preceding regulation. Between 2015 and 2018, tourist rental revenues rose by over 350% while long- term rents stagnated (Yrigoy (2019)), prompting concerns over affordability and local displacement (Benitez-Aurioles and Tussyadiah (2020)). In response, the Balearic government implemented a set of zoning-based restrictions between 2017 and 2019, culminating in a municipal-level ban on apartment-based STRs in Palma. These policies sought to reduce market pressure on long-term housing while preserving the region's attractiveness to tourists.

This paper evaluates the causal effects of these regulations on two STR market outcomes, the number of property listings operating in the market and its price. Two complementary empirical strategies are employed. First, between-region analysis, where a difference-in-differences approach compares trends in individual listings and prices in Mallorca relative to Girona—a region with simi- lar tourism exposure but no comparable regulation during the study period. Second, a within-region analysis, where a spatial regression discontinuity design leverages Palma's municipal boundary as a policy cutoff, enabling comparisons of listings just inside versus outside the regulated area. This approach offers the advantage of comparing properties that are more alike in terms of characteristics and location, thereby enhancing the credibility of the causal estimates at the regulatory boundary. The results show that STR regulations in Mallorca reduced the number of active listings by approximately 4%, with stronger effects in high-density tourist zones. Prices per room rose between 1.5% and 7.6%, depending on model specification, suggesting that remaining operators may have benefited from reduced competition and a shift in market composition. The within-region analysis supports these findings: properties just inside Palma's boundary were 17.5 percentage points less likely to remain active, yet exhibited a 24.4 percent increase in price per room compared to those just outside. These price effects point to a dual selection mechanism shaped by regulatory dynamics. In the difference-in-differences framework, average prices increase, reflecting the selective exit of lower- value or informal listings across Mallorca. The regression discontinuity design reveals a localized version of the same mechanism: despite supply contraction inside Palma, the listings that persist

are likely higher-value or more professional, driving up observed prices. These aligned patterns highlight how regulatory intensity can shape both the quantity and quality of STR supply across spatial contexts.

This dual adjustment mechanism can be interpreted through two regulatory effects that are of- ten overlooked by policymakers: the composition effect and the competition effect. The composition effect refers to the endogenous selection of listings that remain in the market post-regulation—those with higher quality, more amenities, or greater host professionalism—while lower-tier listings are more likely to exit. This shift alters the distribution of observable attributes in the market and par- tially explains rising prices. The competition effect, on the other hand, captures how a reduction in supply increases market power for the remaining listings, particularly in the presence of inelastic or slow-to-adjust demand. Our empirical design enables us to identify both effects: the difference-in- differences strategy reveals aggregate outcomes consistent with a supply contraction that dispropor- tionately removes lower-value units, while the spatial RDD provides more precise identification by holding constant housing characteristics across the Palma boundary. In this context, the increase in prices within Palma cannot be attributed solely to compositional upgrading—since housing stock on either side of the boundary is highly comparable—but rather to reduced competition among suppliers. This suggests that the spatial displacement of listings to neighboring municipalities relieves regulatory pressure locally while tightening market conditions inside the treated area. These findings underscore the importance of accounting for indirect and equilibrium effects when designing housing market interventions.

This paper builds on two strands of literature. First, it relates to research studying the determi- nants of prices in P2P short-term rental (STR) platforms, particularly Airbnb. A growing body of work examines the determinants of pricing using hedonic price models to estimate how observable listing characteristics influence nightly rates. This literature identifies key attributes—location, size, number of bedrooms and bathrooms, maximum guest capacity, and host professionalism—as major predictors of price (e.g., Wang and Nicolau, 2017; Li et al., 2015; Guttentag, 2015). These studies contribute to understanding market valuation mechanisms in the STR sector and provide methodological grounding for our analysis. Following the hedonic pricing literature, our empirical strategy controls for observable housing attributes and location to isolate the causal effect of regu- latory exposure on listing outcomes. However, while existing work focuses on the price formation process in competitive settings, our contribution is to evaluate how a regulatory shock alters both the quantity and composition of supply, and thereby affects observed prices through changes in market structure and product quality.

Second, this work contributes to the growing literature on the effects of STR platforms on market structure, competition, and policy spillovers. Previous research has shown that the entry of platforms like Airbnb reduces hotel prices and revenues (Zervas et al., 2017; Farronato and Fradkin, 2022; Schaefer and Tran, 2020; Rossi-Hansberg et al., 2019), and raises concerns about housing affordability and displacement in major tourist destinations (Barron et al., 2020; Garcia-L´opez et al., 2020). More recently, scholars have examined how STR regulation shapes market outcomes

through spatial spillovers and supply-side responses. For example, Koster et al. (2021) exploit a spatial RDD design around the Los Angeles city boundary to estimate how STR bans affect long- term rents. Similarly, studies in cities like Barcelona (Garcia-L´opez et al., 2020), New York (Li et al., 2019), and Amsterdam (Koch et al., 2021) highlight how local regulations shift STR activity toward adjacent jurisdictions or toward higher-quality listings. Our analysis contributes to this debate by using both DiD and spatial RDD approaches to document how regulation in Mallorca, and especially in Palma, reduced STR supply while generating upward pressure on prices—suggesting spatial substitution and compositional sorting as key mechanisms.

The results have direct relevance for policymakers in tourism-intensive regions weighing the trade-offs of STR regulation. By documenting the mechanisms through which such policies operate—namely, supply contraction and selection effects—this paper offers insight into how regulatory design can influence both housing accessibility and tourism market structure.

2. Legal framework

The regulation of short-term vacation rentals in Mallorca, particularly through the Plan de Intervención en Ámbitos Turísticos (PIAT) adopted in 2018 by the Consell de Mallorca, represents a structured response to mounting concerns over tourism saturation, housing affordability, and en vironmental degradation. The legal framework reflects a shift in regional planning that seeks to reconcile the economic benefits of tourism with the preservation of local communities and natural heritage de Mallorca (2018b).

The 2018 PIAT established a zoning system that classified the island into differentiated land use areas—urban, rural, and protected zones—each subject to specific regulatory conditions for vacation rental activity. This zoning was accompanied by quantitative limits on the number of tourist places, restrictions based on the typology of the dwelling (single-family vs. multifamily), and seasonal constraints in certain areas. Enforcement is coordinated by the Consell de Mallorca, while the Palma City Council (Ajuntament de Palma) introduced stricter local ordinances within its jurisdiction, becoming the first Spanish city to impose a general ban on short-term rentals in apartments (multifamily housing) in 2018 de Palma (2018).

In urban areas of Palma, the commercialization of short-term rentals in multifamily dwellings was completely prohibited. This measure was motivated by the rapid transformation of residential neighborhoods into tourist enclaves, which had generated public pressure over rising rents and the displacement of local residents. However, the rental of single-family homes remained permissible, subject to compliance with legal requirements such as obtaining a plaza tur´ıstica (tourist license), satisfying habitability and zoning standards, and being listed on the Registro Insular de Empresas, Actividades y Establecimientos Tur´ısticos de les Illes Balears (2018).

Outside Palma, the PIAT permitted more flexibility but imposed nuanced restrictions depending on the classification of the land. In Suelo Rústico Común (SRC), which represents general rural land not under special protection, short-term rentals were allowed in single-family homes year-round.

In multifamily dwellings located in these areas, rentals were allowed for a maximum of 60 days per year, contingent upon the owner's residence in the dwelling during that period de Mallorca (2018b). In contrast, Suelo Ru´stico Protegido (SRP)—which includes zoning categories like Z1, Z1.2, Z2, Z2.2, Z2.3, Z3, Z4, Z4.2, Z4.3, and ZE—was generally excluded from vacation rental eligibility. These are environmentally sensitive zones protected for ecological, agricultural, or landscape value. In these areas, all forms of short-term rentals were banned to safeguard the integrity of the island's natural environment and reduce urbanization pressure in protected landscapes de Mallorca (2018a). In sum, Mallorca's regulatory approach aimed to balance the socio-economic contributions of tourism with long-term sustainability goals. The PIAT framework not only restricted supply in saturated or vulnerable areas but also instituted a system of environmental and territorial zoning that prioritized the general interest of residents over speculative use of housing. The resulting constraints on rental activity were enforced through mandatory licensing, strict eligibility criteria, and the imposition of fines for noncompliance Vacaciones España (2020); de Mallorca (2018b).

3. Data and Descriptive Statistics

Monthly information about all properties listed at Airbnb website between January 2017 and De- cember 2019 for Mallorca and Girona is employed for this study. The sample period is delimited, avoiding distortions from the COVID-19 pandemic. The study relies on proprietary data collected and distributed by AirDNA, a consulting firm that continuously scrapes several short-term rental platforms.

The dataset contains detailed information on each property's location, daily availability, booking dates and durations, as well as average price levels. First step was to construct a panel data set of all properties at monthly basis during the sample period. To measure entry and exit in Airbnb platform a variable n prop is created, it takes the value one if the accommodation is listed at least one day a month and zero otherwise. A significant number of properties are listed in the platform for a few days and over the summer season making the data noisy. To reduce noise a variable n prop 100a is generated, it takes the value one if the accommodation is listed at least one hundred days a year and zero otherwise. The two measurements of listing propensity approximate the probability of a property being in the market.

Micro-data on housing transactions from AirDNA are employed to complement the main dataset. This data source includes detailed information on the average daily rate in U.S. dollars (adrusd). A derived variable, price per room, is computed by dividing the average daily rate by the number of bedrooms in each accommodation. Additionally, a range of property-level characteristics is in- cluded, such as property type, number of bedrooms, number of bathrooms, and maximum guest capacity. In line with the regulatory focus on multifamily housing, the sample is restricted to en- tire apartments and comparable property types. Listings that do not represent full units—such as private rooms, shared accommodations, or other non-apartment categories—are excluded to ensure alignment with the scope of the policy intervention. Ancillary variables such as geolocation (latitude and longitude), town, zoning classification, and municipality are also sourced from AirDNA. Observations with missing values for key variables—such as price, zoning code, host ID, or property code—are excluded from the analysis to preserve data integrity.

This dataset structure supports a dual empirical strategy. First, a between-region analysis ex- ploits variation across two Spanish autonomous communities—comparing Mallorca with Girona—to estimate the average effect of regulation over time. Second, a within-region analysis focuses on the sharp geographic boundary of Palma, leveraging local spatial variation to estimate highly granular treatment effects. This two-pronged approach ensures robustness and allows for complementary identification strategies.

To facilitate the heterogeneity analysis, regulatory zones are classified as geographical areas subject to distinct regulatory regimes within Mallorca. The zoning system, introduced by the PIAT, divides the island into nine areas with varying restrictions, as elaborated in Section 4.4.1.

The dataset exhibits marked seasonality, driven by Mallorca's tourism calendar, with significant surges in activity during the summer months and low levels during the winter. To address these cyclical fluctuations, time fixed effects are incorporated into the empirical model to control for seasonality.

3.1 Between-Region Descriptives

To provide a comparative backdrop for the between-region difference-in-differences (DiD) strategy, Table 1 presents descriptive statistics for Mallorca (treated) and Girona (control) before and after the 2018 STR regulation. Girona was not subject to any comparable policy intervention during the study period. The table includes two measures of market activity: listing propensity and average price per room (in USD), each calculated for two thresholds of supply engagement—properties listed more than one day per month and those listed more than 100 days per year. All differences in means are tested using t-tests with standard errors clustered at the municipality level, and p-values are reported using the conventional significance notation: $p < 0.01$***, $p < 0.05$**, $p < 0.1$*.

Table 1: Summary Statistics

	Before Treatment			After Treatment		
	Girona	Mallorca	Difference	Girona	Mallorca	Difference
Supplied more than 1 day per month:						
Listing propensity	0.82	0.82	0.0043	0.75	0.78	-0.03
Price per room (USD)	72.51	82.61	-10.10	72.18	85.50	-13.32
Supplied more than 100 days per year:						
Listing propensity	0.75	0.73	0.02	0.68	0.61	0.07

Note: Listing propensity is defined as n_prop. The price per room is in USD.

In the pre-treatment period, we observe no statistically significant difference in listing propensity across Mallorca and Girona. Specifically, among properties active at least one day per month, the average listing propensity is 82.31% in Girona and 81.88% in Mallorca. The difference of 0.0043 is statistically insignificant ($p = 0.7095$), based on a t-test clustered at the municipality level (219 clusters in Girona and 53 in Mallorca). This supports the common trends assumption, indicating similar baseline behavior across both regions before the regulation. In contrast, the average price per room is significantly higher in Mallorca even before the policy was implemented. Girona listings averaged $72.51 while Mallorca listings averaged $82.61 — a difference of −$10.10, which is statistically significant at the 1% level ($p = 0.0036$). This pre-existing price gap reflects structural differences between the two markets, which will be accounted for in the fixed-effects specifications used in the DiD analysis. In the post-treatment period, listing propensity declines in both regions, but more sharply in Girona (from 0.82 to 0.75) than in Mallorca (from 0.82 to 0.78).

However, when focusing on high-intensity listings (those available over 100 days per year), the decline is steeper in Mallorca (from 0.73 to 0.61), consistent with a regulatory-induced contraction among more commercial hosts.

Overall, Table 1 indicates similar pre-treatment listing activity across regions, but post-regulation patterns diverge—supporting early evidence of selective exit and price effects in Mallorca's STR market.

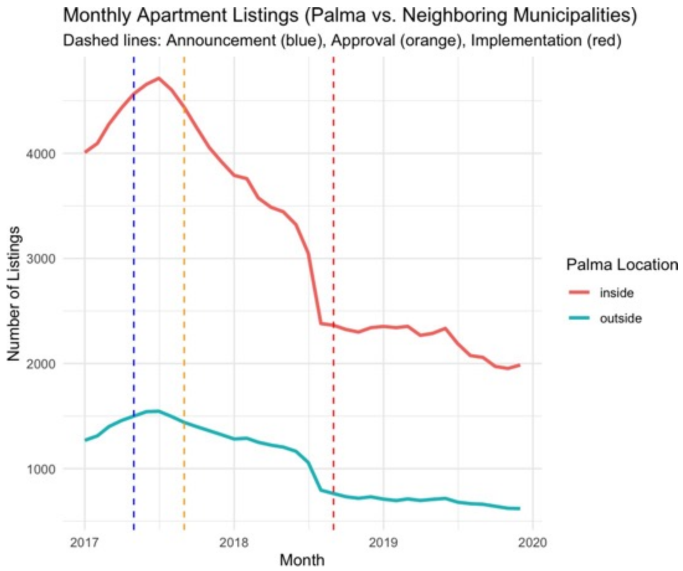
3.2 Within-Region Descriptive Statistics and Spatial RDD Setup

Building on the island-wide comparisons described above, the within-region analysis zooms in on the most intensively regulated area—Palma—to assess localized effects of the policy. Beyond the regional comparison, the analysis focuses on the capital of the Balearic Islands and its neighbor- ing municipalities to identify localized policy effects. The Palma City Council enacted the most restrictive STR regulation in Spain in 2018, banning short-term rentals in multifamily dwellings regardless of zoning category. This intervention created a natural spatial discontinuity between treated and untreated areas.

In 2017, Palma accounted for 52,015 Airbnb listings, while the rest of Mallorca hosted 197,945. By 2019, listings within Palma dropped to 26,172, while the rest of the island increased to 220,939. This divergence indicates a contraction of the STR supply concentrated within the regulated zone. To minimize heterogeneity and increase identification precision, the dataset is restricted to Palma and its neighboring municipalities: Algaida, Llucmajor, Santa Maria del Camí, Bunyola, Marratx´ı, Valldemossa, Calvi`a, Puigpunyent, Esporles, and Santa Eugènia. These areas share similar housing characteristics and are subject to the same regional PIAT regulation but did not implement Palma's blanket ban.

Figure 1 plots the evolution of monthly apartment listings in Palma (red line) and neighboring municipalities (blue line) from January 2017 to December 2019. The timeline of regulatory mile- stones—announcement (May 2017), approval (September 2017), and implementation (September 2018)—is marked with vertical dashed lines. Listings in both areas increased prior to 2017. After policy announcement, a gradual decline is observed within Palma, followed by a sharp drop post-implementation. In contrast, listings in the surrounding municipalities remained relatively stable.

Figure 1: Monthly Apartment Listings (Palma vs.Neighboring Municipalities)



This pattern motivates the use of a spatial regression discontinuity design (RDD) to estimate the causal impact of the STR ban. The RDD compares properties located just inside versus just outside the Palma municipal boundary, using geographic distance as the running variable. The sample is restricted to listings within a 2-kilometer bandwidth on either side of the boundary.

Treatment status is assigned based on location relative to the boundary: properties inside Palma are treated, while those outside serve as controls. The main outcomes of interest are (i) price per room, capturing revenue potential, and (ii) n prop 100a, indicating sustained market participation. Table 2 summarizes pre- and post-policy listings by treatment status. Before the regulation, 26,577 multifamily listings were observed inside Palma and 1,680 in the neighboring municipalities.

Post-regulation, these counts fell to 14,300 and 788, respectively. The sharper decline within the treated zone provides preliminary evidence of the policy's impact.

Table 2: Number of Apartment Listings within 2km of Palma Border. Before and After Policy Implementation

Period	Inside Palma	Outside Neighbors
Pre (Before Sep 2018)	26,577	1,680
Post (After Sep 2018)	14,300	788

To illustrate the evolution of STR activity over time and space, we present summary statistics on the number of apartment listings across Palma and its surrounding municipalities. These pat- terns suggest spatial and temporal dynamics consistent with anticipatory responses to regulation and supply shifts. For a more detailed breakdown of listings by municipality and year, refer to Appendix A, particularly Tables A1 to A3, which provide additional disaggregated statistics.

The richness of the data allows both for a broad policy impact evaluation using difference-in- differences at the regional level, and for a focused, high-resolution regression discontinuity analysis at the municipal boundary. The following section begins with the between-region DiD approach.

4. Between-Region Impact: Difference-in-Difference Approach

4.1 Pre-trends analysis

To quantify the impact of the 2018 Balearic regulation on STR listings and prices, this study imple- ments a difference-in-differences (DiD) model using Girona as a control group. Girona constitutes a valid counterfactual, as it was not subject to any STR-related regulatory changes between 2017 and 2019. Visual inspection of pre-treatment trends and formal statistical tests support the parallel trends assumption for both supply and price outcomes. The treatment date is set to September 2017, coinciding with the official approval of the Palma STR regulation, as no significant anticipa- tory behavior or pre-trend divergence is detected prior to this point.[1]

Table 3: Difference-in-Differences Estimates: Supply and Price Outcomes

Outcome Variable	Treatment	ATET	Std. Err.	Parallel Trends (p-val)	Anticipation Effects (p-val)
3*Listing Propensity	treatmenta	-0.0438	0.0101	0.2521	0.0658
	treatments	-0.0487	0.0104	0.5647	0.0384
	treatmentp	-0.0420	0.0116	0.0003	0.0000
3*Price per Room	treatmenta	0.1661	0.0196	0.0016	0.0141
	treatments	0.0803	0.0107	0.0049	0.0000
	treatmentp	0.0549	0.0077	0.0000	0.0000

Notes: Robust standard errors clustered at the municipality level.

The DiD coefficients report the average treatment effect on the treated (ATET).

The parallel trends test evaluates whether pre-treatment linear trends are statistically Equivalent across treated and control regions.

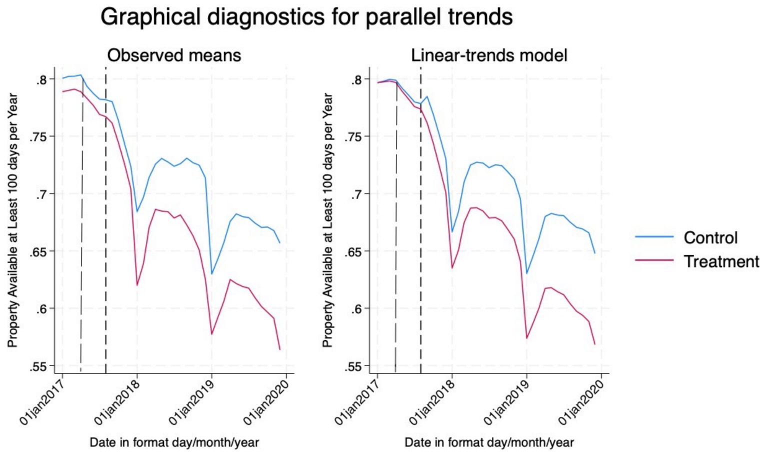
The anticipation effects test examines whether the treatment group responded prior to the regulation's implementation, potentially biasing estimates.

Significance levels: ***p < 0.01, **p < 0.05, *p < 0.1.

Table 3 presents the main DiD estimates. For listing propensity—defined as a binary indicator for whether a property is listed at least 100 days per year—the average treatment effect on the treated (ATET) is estimated at -0.0487, with a standard error of 0.0104. This corresponds to a statistically significant 4.87 percentage point decline in STR listings in Mallorca following the introduction of the regulation.

[1] [1]The parallel trends assumption is tested using the stat ptrends procedure, which fails to reject the null hypothesis of equal pre-treatment trends across treated and control groups. This supports Girona's validity as a counterfactual region.

Figure 2: Effect of STR Regulation on Listing Propensity (n prop 100a)



To ensure the credibility of the difference-in-differences (DiD) estimates, it is essential to eval- uate two core identification assumptions: (i) the presence of parallel pre-treatment trends between the treated and control groups, and (ii) the absence of anticipation effects prior to the policy implementation.

Figure 2 displays the temporal evolution of the supply proxy variable n prop 100a—indicating whether a listing is active for more than 100 days per year—for both Mallorca (treated) and Girona (control). The two vertical dashed lines correspond to the policy announcement in May 2017 and its formal approval in September 2017. Visual inspection suggests that both regions follow similar trajectories prior to the intervention, providing preliminary support for the parallel trends assumption.

This visual evidence is corroborated by a formal pre-treatment F-test, which yields a statistic of F = 0.33 with an associated p-value of 0.5647[2]. The inability to reject the null reinforces the assumption that, absent the policy, both regions would have evolved similarly in terms of STR supply.

Furthermore, to examine whether property owners in Mallorca adjusted their behavior prior to the policy's enforcement—a potential violation of the no-anticipation assumption—a Granger causality test is employed. The test yields an F-statistic of 2.16 with a p-value of 0.0384[3]. While the test suggests mild evidence of anticipatory behavior, the absence of a clear pre-treatment divergence in the graphical trends supports the interpretation that the regulation's approval in September 2017 constitutes a valid timing threshold for treatment.

In terms of price dynamics, Figure 3 presents the logged average price per room for both Mallorca and Girona. Following the regulation, prices in the treated region rise relative to the control.

[2] [2]The pre-treatment F-test evaluates the null hypothesis of equal linear trends across treatment and control groups. A non-significant result (p = 0.5647) indicates that pre-policy trends are statistically indistinguishable, validating the use of Girona as a counterfactual.

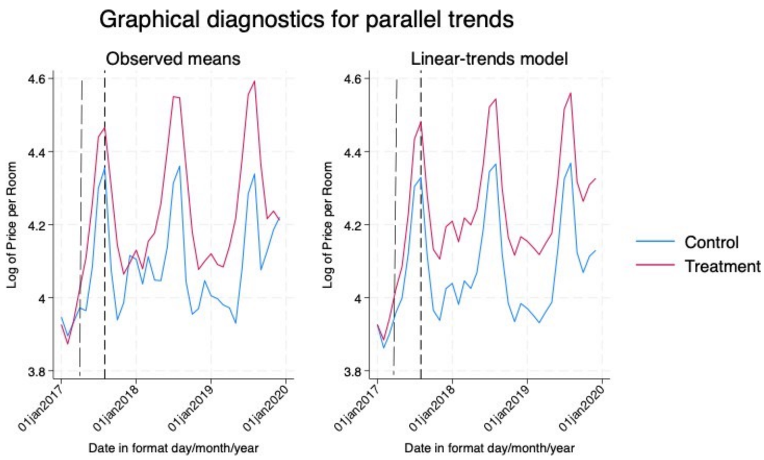
[3] [3]The Granger test examines whether outcome trends in the treatment group changed systematically in advance of treatment assignment. Although the result is marginally significant at the 5% level, the absence of any visible discontinuity or behavioral shift in Figure 2 mitigates concerns about substantial anticipation effects.

The DiD results reported in Table 3 estimate an increase of 8.03% (coefficient = 0.0803; standard error = 0.0107), indicating a statistically significant price effect likely driven by supply contraction.

However, the validity of the parallel trends assumption for this outcome is less clear. A pre- treatment F-test returns a statistic of F = 8.06 and a p-value of 0.0049, leading to a rejection of the null hypothesis of equivalent trends[4]. Given this limitation, a complementary event study analysis is employed in the following section to further investigate the timing and persistence of the price effect.

Finally, the possibility of pre-treatment behavioral changes in price setting is also assessed using a Granger causality test. The result yields a highly significant F-statistic of 52.45 and a p-value of 0.0000[5]. While this test points to the presence of anticipatory adjustments in pricing, visual evidence in Figure 3 and subsequent event study plots remain crucial to interpreting the magnitude and timing of the observed effects.

Figure 3: Effect of STR Regulation on Price per Room (Log)



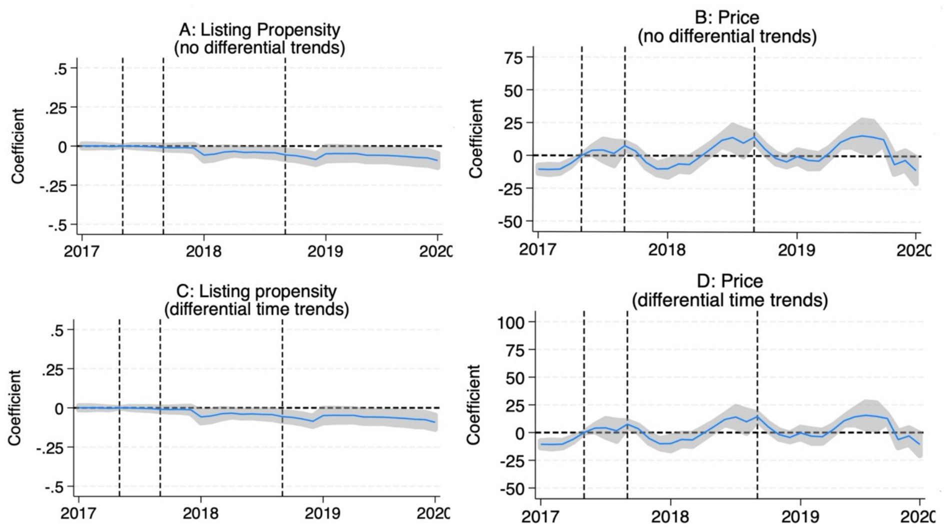
[4] The rejection of parallel trends in the pricing outcome suggests that the control and treatment groups were already diverging in their price trajectories prior to the policy. This necessitates the use of an event study design as a robustness check to examine dynamic effects and account for possible trend differentials.

[5] 5This result formally rejects the null of no anticipation effects in prices. Nevertheless, the event study framework provides a more nuanced, time-specific evaluation of such dynamics, especially when combined with graphical evidence of pre-treatment trends.

4.2 Event Study Analysis

To assess the dynamic effects of the regulation, we estimate event study models using repeated cross-sectional data. This approach allows us to evaluate how listing propensity and price per room evolved in response to the policy intervention. We consider two specifications: one without differential time trends and another that accounts for potential pre-existing differences in trends, Figure 4 shows the Event Study Plots.

Figure 4: Event Study Plots: Repeated Cross-Section



Our baseline event study specification for the Event Study Plots without differential trends is given by:

$$Y_{it} = \beta_0 + \sum_{k \neq -1} \beta_k D_{k,it} + X'_{it}\delta + \varepsilon_{it}, \tag{1}$$

where Y_{it} denotes the outcome variable (listing propensity or price per room) for unit i at time t. $D_{k,it}$ are event-time dummies indicating periods relative to the policy intervention, normalized to zero in the period immediately preceding the intervention. X'_{it} represents a vector of controls (e.g., property characteristics such as number of rooms or amenities) and ε_{it} is the error term. This specification assumes that, absent the intervention, Mallorca and Girona would have followed parallel trends.

To relax the parallel trends assumption, we extend the model by including a differential time trend:

$$Y_{it} = \beta_0 + \sum_{k \neq -1} \beta_k D_{k,it} + X'_{it}\delta + \tau T_{it} + \varepsilon_{it}, \tag{2}$$

where T_{it} represents a unit-specific linear time trend and τ captures differential pre-treatment trends between Mallorca and Girona. By incorporating T_{it}, we allow for potential pre-existing differences in trends between the treated and control groups, ensuring the robustness of our estimates. Figure 4 presents the event study estimates for listing propensity and price per room. The three vertical dashed lines correspond to key policy milestones: the announcement in May 2017, its approval in September 2017, and its enforcement in September 2018.

For listing propensity, the event study estimates show no statistically significant differences between Mallorca and Girona at any of the three treatment dates, reinforcing the credibility of Girona as an appropriate control group.

Regarding price per room, we observe significant differences between Mallorca and Girona be- fore May 2017, suggesting some divergence prior to the intervention. However, between May 2017 and September 2017, the confidence interval includes zero, indicating no statistically significant differences in price trends during this period. Similarly, from September 2017 to September 2018, observed differences are minimal and not systematically divergent. These results support the valid- ity of the parallel trends assumption, confirming that Girona serves as a reasonable counterfactual for identifying the causal impact of the regulation.

4.3 DiD Analysis

To evaluate the impact of the 2018 Balearic regulation on short-term rental supply and pricing, we employ both repeated cross-sectional and panel data estimation strategies. This dual approach facilitates a comparison that underscores the role of unobserved, time-invariant heterogeneity in shaping estimated treatment effects.

The repeated cross-section model follows:

$$y_{imt} = \gamma_m + \gamma_t + z_{imt}\beta + D_{mt}\delta + \epsilon_{imt}, \tag{3}$$

where y_{imt} is the outcome variable, the listing propensity, defined as ***n_prop_100a***, which measures whether a property is listed for at least 100 days per year on Airbnb, and the price, defined as the logarithm of price per room. The variable D_{mt} is the treatment indicator, capturing the effect of the regulation implemented in September 2017. The vector z_{imt} includes property-level covariates (e.g., number of bathrooms, bedrooms, and maximum guest capacity), while γ_m and γ_t capture municipality and time fixed effects, respectively.

The panel data model employs a Two-Way Fixed Effects (TWFE) specification:

$$y_{imt} = \gamma_i + \gamma_t + z_{imt}\beta + D_{mt}\delta + \epsilon_{imt}, \tag{4}$$

where γ_i denotes property-specific fixed effects, controlling for time-invariant unobserved heterogeneity.

Table 4 presents the DiD results for the cross-section and panel data analyses, respectively. The repeated cross-section analysis shows a significant reduction in the probability of properties being listed for over 100 days per year, with an ATET of -0.0450. This suggests a 4.5 (p.p) reduction in supply due to regulation. The parallel trends assumption holds, and no anticipation effects are detected. The panel data analysis, which controls for unobserved property-specific characteristics, indicates a smaller but still significant ATET of -0.0282. This suggests a 2.82 (p.p) contraction in supply, indicating that lower-quality listings were more likely to exit the market following regulation.

Table 4: Difference-in-Differences Results for Listing Propensity and Price

Outcome Variable	Treatment	Data Type	Coefficient	Std. Err.	95% Confidence Interval
		Listing Propensity (n_prop_100a)			
ATET	Treatment S	Cross-Sectional	-0.0450	0.0111	[-0.0669 , -0.0232]
ATET	Treatment S	Panel Data	-0.0282	0.0094	[-0.0467 , -0.0097]
		Price (log_price_per_room)			
ATET	Treatment S	Cross-Sectional	0.0759	0.0114	[0.0535 , 0.0985]
ATET	Treatment S	Panel Data	0.0150	0.0117	[-0.0080 , 0.0381]

Notes: Standard errors are clustered at the municipality level. Cross-sectional results refer to repeated cross- sectional data, while panel data results account for individual fixed effects. Confidence intervals are in the last two columns.

The larger reduction in the cross-section results reflects the aggregate impact of regulation, capturing both observed and unobserved factors. The smaller effect in the panel data suggests that lower-quality or less competitive listings were more likely to exit, as the model controls for property- specific characteristics. This aligns with the economic intuition that regulation disproportionately affects less profitable listings. Turning to price effects, the treatment leads to an increase in the log of price per room. The repeated cross-section model estimates a 7.59% price increase on average, while the panel estimate is more conservative at 1.5%. The discrepancy arises from selection effects: the cross-sectional model captures both the direct regulatory impact and the composition effect, so the exit of lower-quality, lower-priced properties, whereas the panel model accounts for unobserved, time-invariant characteristics, (e.g., the views of the property, having a pool or a garden, etc). This finding underscores the importance of controlling for property-specific heterogeneity.

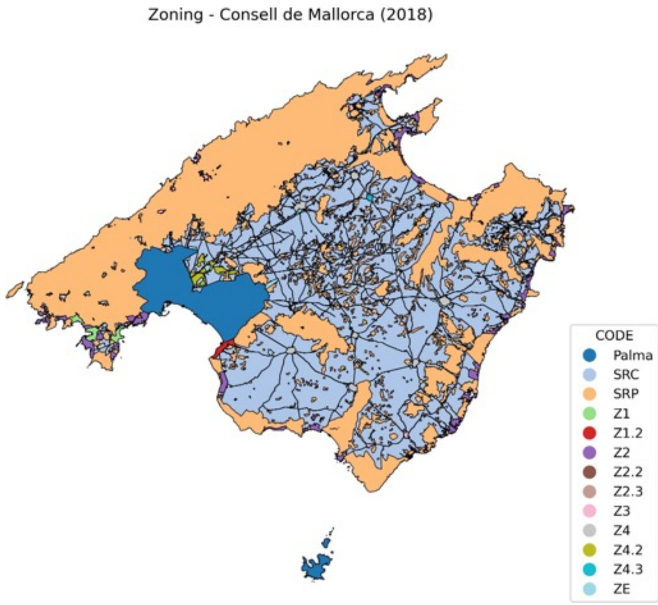
Overall, the results imply that there is a composition effect, the regulation may have induced lower-quality properties to leave the market, thereby increasing the average price observed in the cross-sectional data. By controlling for unobserved heterogeneity, the panel data model provides a more precise estimate of the treatment effect on prices[6].

4.4 Heterogeneity Analysis

In this section, we examine the differential effects of the 2018 regulation, focusing on two key sources of variation: (i) the zoning-based restrictions imposed across different land categories, and (ii) the type of property affected, namely single-family homes versus multifamily dwellings. Both dimensions offer insight into how local regulatory stringency and structural housing characteristics shape market outcomes[7].

[6] All variables are interpreted on average, ceteris paribus.
[7] In the DiD and heterogeneity analysis, Palma is included as part of the treated group. However, the RDD isolatesPalma's unique regulatory regime from its immediate surroundings to identify high-resolution local effects.

Figure 5: Zoning in Mallorca (2018)
Own elaboration in Python



4.4.1 Zoning

For analytical tractability, the initial nine zoning categories (Figure 5) are consolidated into four broader zones while assuming a uniform treatment effect. Zone 1 corresponds to Suelo Rústico Común (SRC), Zone 2 to Suelo Ru´stico Protegido (SRP), Zone 3 groups various protected areas, and Zone 4 represents Palma. Treatment variables are constructed by interacting these zone indicators with the regulatory intervention implemented in September 2018.

The regression results in Table 5 examine the impact of zoning regulations on two outcomes: the log of price per room and the proportion of properties listed for more than 100 days per year. The difference-in-differences (DiD) estimation follows:

$$Y_{it} = \beta_0 + \sum_{k=1}^{K} \beta_k X_{kit} + \sum_{z=1}^{Z} \delta_z Z_{z,it} + \sum_{d=1}^{D} \gamma_d \mathbb{1}(\mathrm{Date} = d) + \epsilon_{it}. \quad (5)$$

where Y_{it} is the outcome of interest, X_{kit} includes continuous property characteristics (e.g., bathrooms, bedrooms and maximum number of guests), $Z_{z,it}$ captures categorical effects (e.g., zoning), and 1(Date = d) denotes time fixed effects.

Table 5 indicates that the regulation led to a 28.1% increase in price per room, suggesting a supply contraction. Larger properties tend to have lower prices per room, while higher bathroom counts and guest capacity correlate with higher prices. Zoning effects vary: SRC (Zone 1) shows a marginally significant 4% lower price per room than SRP (Zone 2), whereas protected areas (Zone 3) exhibit a 14.5% decrease. Palma (Zone 4) shows a slight price premium (3.3%).

Table 5: Regression Results for Zoning in Mallorca

Variables	**Log Price per Room**	**Proportion of Properties Listed > 100 Days**
Bedrooms	-0.301*** (0.015)	-0.007 (0.005)
Bathrooms	0.220*** (0.010)	0.012*** (0.003)
Maximum Guests	0.055*** (0.005)	0.009 (0.006)
Treatment Effect	0.281*** (0.015)	-0.230*** (0.017)
Zoning: Zone 1	-0.040* (0.022)	-0.003 (0.007)
Zoning: Zone 3	-0.145*** (0.028)	0.017 (0.011)
Zoning: Zone 4	0.033* (0.019)	-0.093*** (0.014)
Observations	335,527	791,138
R-squared	0.284	0.033
Clusters	53	53
F-statistic	4929.26	1203.30
Root MSE	0.436	0.455

Notes: Robust standard errors clustered at the municipal level are in parentheses. *** p<0.01, ** p<0.05,* p<0.1.

Regarding listing propensity, the treatment effect is significantly negative, reducing the share of properties listed for over 100 days by 23 (p.p). While bedrooms and guest capacity show no significant effects, more bathrooms increase the likelihood of extended listings. Palma sees a significant 9.3 (p.p) drop in long-term listings, potentially reflecting stricter enforcement[8].

Overall, the regulation appears to have effectively curtailed short-term rental supply, particu- larly in Palma, leading to increased prices per room and reduced listing durations.

4.4.2 Property Type

The zoning analysis highlighted the pronounced effect of regulation in Palma. To further investigate the heterogeneity in regulatory impact, we examine the differential effects on single-family houses (homes) and multifamily dwellings (apartments) across the four zones. Figure 6 provides a visual representation of the spatial distribution of listings, while Table 6 presents the regression estimates.

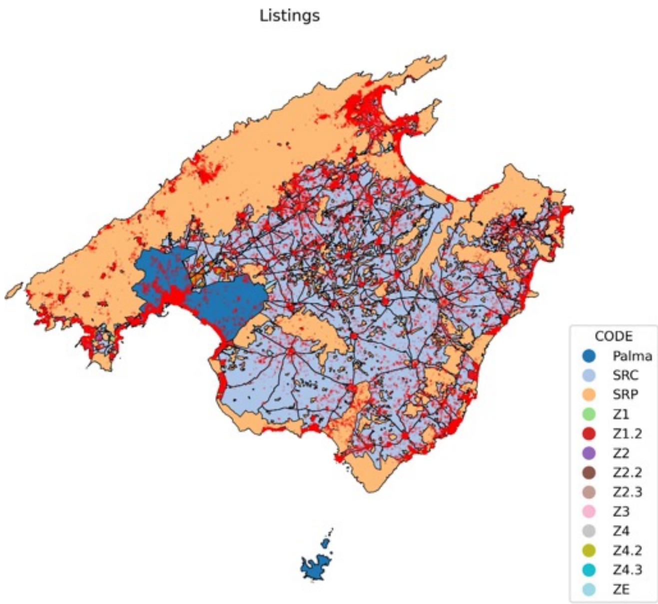
We estimate the effect of regulation on listing propensity (n_prop_ 100a) and the log of price per room (log_price_per_room) using the following repeated cross-section specification:

$$Y_{it} = \beta_0 + \sum_{k=1}^{K} \beta_k X_{kit} + \sum_{z=1}^{Z} \delta_z Z_{z,it} + \sum_{d=1}^{D} \gamma_d \mathbb{1}(\text{Date} = d) + \theta_1 S_{it} + \theta_2 M_{it} + \epsilon_{it}. \tag{6}$$

where Y_{it} is the outcome of interest for unit i at time t, X_{kit} denotes property-level control variables, and $Z_{z,it}$ captures categorical effects such as zoning. Time fixed effects are included via 1(Date = d), while S_{it} and M_{it} are binary indicators for single-family and multifamily properties, respectively. Standard errors are clustered at the municipality level.

[8] All variables are interpreted on average, ceteris paribus.

Figure 6: Listings in Mallorca
(2018) Own elaboration in Python



The results indicate a substantial decline in the likelihood of properties being listed for more than 100 days post-regulation. The treatment effect is negative and statistically significant at the 1% level for both homes (−0.2303) (p.p) and apartments (−0.2451) (p.p) , suggesting that the intervention effectively reduced short-term rental supply across property types. Among property characteristics, the number of bathrooms exhibits a positive and significant effect on listing propensity for both homes (0.0122) (p.p) and apartments (0.0153) (p.p), indicating that properties with more amenities are more likely to remain active in the market. Maximum guest capacity is positively associated with listing propensity but is only significant for apartments, suggesting that larger apartments are more resilient to regulatory constraints.

The regulation induced a significant increase in prices for both property types, with the log of price per room rising by 28.3% for homes and 29.15% for apartments. This price surge is consistent with a contraction in supply following regulatory enforcement. The number of bedrooms negatively affects price per room, reflecting a diminishing marginal price effect for larger properties. Conversely, the number of bathrooms and maximum guest capacity have positive and significant effects, indicating that higher-end amenities command price premiums.

The zoning dummies reveal notable spatial heterogeneity. Properties in protected areas (Zone 3) experience a significant reduction in price per room, whereas Zone 4 (Palma) exhibits a negative effect on listing propensity but no significant price change. These findings suggest that regulatory stringency interacts with local market conditions to shape short-term rental outcomes.

These results underscore the regulatory trade-off: while the policy successfully reduced short-term rental listings, it also led to a significant increase in prices for the remaining supply. The impact is consistent across property types, though larger apartments appear more resilient[9].

Table 6:Effect of Regulation on Listing Propensity and Price per Room for Homes and Apartments

	Home (Unifamiliar House)		Apartment (Multifamiliar House)	
Variables	Listing Propensity	Price	Listing Propensity	Price
Bedrooms	-0.0069	-0.2949***	-0.0084**	-0.3127***
	(0.0054)	(0.0151)	(0.0042)	(0.0145)
Bathrooms	0.0122***	0.2175***	0.0153***	0.2291***
	(0.0032)	(0.0100)	(0.0029)	(0.0090)
Max Guests	0.0086	0.0545***	0.0098*	0.0601***
	(0.0062)	(0.0046)	(0.0058)	(0.0044)
Treatment (Post-Regulation)	-0.2303***	0.2830***	-0.2451***	0.2915***
	(0.0173)	(0.0151)	(0.0170)	(0.0142)
Zone 1	-0.0032	-0.0416*	-0.0043	-0.0459**
	(0.0074)	(0.0220)	(0.0073)	(0.0216)
Zone 3	0.0164	-0.1507***	0.0181	-0.1609***
	(0.0118)	(0.0265)	(0.0114)	(0.0252)
Zone 4	-0.0940***	0.0140	-0.0986***	0.0172
	(0.0182)	(0.0192)	(0.0175)	(0.0184)
Home (Unifamiliar)	-0.0035	-0.0616***	-	-
	(0.0160)	(0.0123)		
Apartment (Multifamiliar)	-	-	0.0150	-0.0778***
			(0.0179)	(0.0148)
Constant	0.7479***	1.3829***	0.7598***	1.4122***
	(0.0258)	(0.0296)	(0.0243)	(0.0280)
Observations	791,138	335,527	801,429	342,738
R-squared	0.0329	0.2873	0.0338	0.2942
Clusters (Municipalities)	53	53	53	53

While the difference-in-differences strategy captures island-wide average effects of the regulatory intervention, it aggregates both Palma-specific restrictions and broader zoning regulations under the PIAT framework. To isolate the sharp impact of Palma's municipal ban—arguably the most stringent component of the 2018 regulation—the next section employs a more spatially granular identification strategy. By focusing exclusively on the Palma boundary, the regression discontinuity design (RDD) complements the between-region estimates with high-resolution causal inference based on geographically proximate control units.

[9] 9All variables are interpreted on average, ceteris paribus.

5. Within-Region Impact: Spatial Regression Discontinuity De- sign (RDD)

Having established the between-region effects of the 2018 Balearic STR regulation using a difference- in-differences framework, we now turn to a finer spatial quasi-experimental approach: a sharp spatial regression discontinuity design (RDD). This method exploits the exogenous policy cutoff created by Palma's municipal boundary to estimate local treatment effects of the STR ban on multifamily dwellings. This method has the advantage of comparing dwellings that are more similar on one side and the other along Palma border.

Palma implemented Spain's most stringent STR restriction in 2018, prohibiting rentals in mul- tifamily buildings regardless of zoning status. Unlike the DiD specification, which relies on Girona as a control region, the RDD approach contrasts treated listings in Palma with control properties located just outside its municipal boundary. These neighboring units share regional characteris- tics such as language, infrastructure, and tourism exposure, but are exempt from Palma's ban on apartment-based STRs. This sharp contrast makes the local policy cutoff a credible source of exogenous variation.

The legal boundary of the municipality thus functions as a natural, spatially sharp threshold: properties just inside the city limits are subject to the ban (treated), while those just outside—in neighboring municipalities—are not (controls). This regulatory discontinuity allows for causal identification, under the standard continuity assumption that potential outcomes vary smoothly at the boundary absent treatment.

To isolate these effects, we restrict the sample to apartment listings located within a 2-kilometer radius on either side of Palma's boundary, mirroring the setup described in the within-region descriptives section. All properties are geolocated and assigned a running variable based on distance to the municipal limit—negative values denote listings inside Palma, positive values outside.

As in the between-region analysis, the focus is on two primary outcomes: price per room, a proxy for price, and n prop 100a, a proxy for supply.

5.1 Estimation Strategy

To identify the causal effect of Palma's short-term rental (STR) ban on local market outcomes, we implement a sharp spatial regression discontinuity design (RDD). The research design exploits the administrative boundary of Palma de Mallorca, which defines treated units as properties located within Palma and control units as those in contiguous municipalities just outside the city boundary. Let Y_i denote the outcome of interest for property i, and $D_i \in \{0, 1\}$ be a binary treatment indicator equal to one if the property lies within Palma. The running variable X_i is the signed distance to the boundary, with negative values indicating treatment and positive values indicating control. The parameter of interest is the average treatment effect at the cutoff:

$$\tau = \lim_{x \downarrow 0} \mathbb{E}[Y_i \mid X_i = x] - \lim_{x \uparrow 0} \mathbb{E}[Y_i \mid X_i = x]. \tag{7}$$

Estimation is based on local linear regression within an optimal bandwidth ***h***, following the standard approach in Imbens and Lemieux (2008). The functional form is:

$$\tau = \lim_{x \downarrow 0} \mathbb{E}[Y_i \mid X_i = x] - \lim_{x \uparrow 0} \mathbb{E}[Y_i \mid X_i = x]. \tag{7}$$

where τ captures the discontinuity in the conditional expectation of the outcome at the policy threshold. The treatment effect is estimated as the difference in expected outcomes on either side of the cutoff, as shown in Equation (7). In our setting, the first term corresponds to the control group (properties just outside Palma), while the second term represents the treated group (properties just inside Palma). Thus, a negative estimate of τ implies that the outcome is higher for treated units than for controls[10].

An important practical challenge arises from the presence of mass points in the running variable due to the granularity of geographic data. Many listings share identical distance values, particu- larly in urban zones like Palma. These mass points can distort inference and lead to suboptimal bandwidth selection. To address this, we apply a uniform jitter of ±0.5 meters:

$$\tilde{X}_i = X_i + \eta_i, \quad \eta_i \sim \text{Uniform}(-0.5, 0.5), \tag{9}$$

which preserves local ordering while breaking exact ties. For a more detailed breakdown of mass points by municipality, refer to Appendix A, particularly Table A7, which provides additional information.

Lastly, to address right-skewness in price levels and facilitate percentage-based interpretation, we estimate an additional specification using the log of price per room as the outcome:

$$\log(Y_i) = \alpha + \tau_{\log} D_i + \beta_1 X_i + \beta_2 D_i \cdot X_i + \varepsilon_i. \tag{10}$$

The coefficient τ_{log} provides the proportional change in the outcome at the policy threshold.

[10] Bandwidths are selected using the MSE-optimal rule. The estimation is implemented via the rdrobust package in R, using a triangular kernel for local weighting. Standard errors are robust to heteroskedasticity.

5.2 Results

This section presents the estimated effects of Palma's short-term rental (STR) regulation, using the September 1, 2017 approval date as the treatment cutoff. We define the regulation date when the Palma STR ban was officially passed and publicly communicated. As shown in Appendix A.3, RDD estimates remain consistent when using the later implementation date (September 1, 2018), but the market response begins immediately after approval[11]. The analysis focuses on two key outcomes: price per room and listing propensity and are visualized in Figures 7 and 8. Full numerical results appear in Table 7.

Panel A of Table 7 summarizes the estimated discontinuities in price per room across multiple specifications. The baseline model, which uses raw distance to the Palma municipal boundary as the running variable, indicates that listings just inside Palma are associated with a €19.80 increase in average price per room relative to those just outside. Correcting for mass points via random jittering yields a slightly smaller effect of €18.97, confirming robustness.

To interpret magnitudes in proportional terms, be consistent with the between,-region analysis, we estimate the log-transformed model for price. The implied effect is a 24.4 percent increase in price per room at the cutoff, statistically significant at the 1 percent level. This result suggests that, conditional on location near the boundary, STR units that remained inside Palma after the ban command systematically higher prices. A plausible mechanism is compositional sorting: higher- value units may be more likely to stay active under the regulatory constraint, while marginal or informal listings exit.

Covariate-adjusted estimates that control for observable listing features (bedrooms, bathrooms, guest capacity) remain statistically significant but slightly attenuated. The adjusted price gap remains economically relevant at €14.26 in levels and 19.4 percent in logs. These patterns indicate that observable characteristics do not fully explain the price discontinuity, supporting a causal interpretation based on policy exposure.

Panel B reports results for listing propensity, defined as whether a property is listed for at least 100 days in a given year. The STR ban is associated with a 17.4–17.5 percentage point decline across unadjusted models. The covariate-adjusted specification yields a slightly smaller but still significant drop of 15 percentage points. This is consistent with a supply contraction: fewer listings remain active under stricter regulation.

Figures 7 and 8 visually confirm these discontinuities. A clear jump in price per room is observed at the Palma boundary in Figure 7, with listings just inside Palma exhibiting higher values than neighboring control units. In contrast, Figure 8 shows a sharp drop in listing density inside the boundary. This suggests a twofold dynamic: selective retention of higher-end units inside Palma and

[11] This supports our interpretation of anticipatory adjustment and motivates the use of the approval date as the primary treatment threshold.

displacement of marginal supply to nearby unregulated municipalities[12].

These local discontinuity results are broadly consistent with the patterns observed in the between-region analysis comparing Mallorca to Girona. In the DiD framework, we found that the STR regulation led to a general contraction in supply alongside an increase in average price per room. This aggregate price increase was interpreted as the result of upward selection—namely, the selective exit of lower-tier or informal listings, leaving behind a more professional or higher-quality host base.

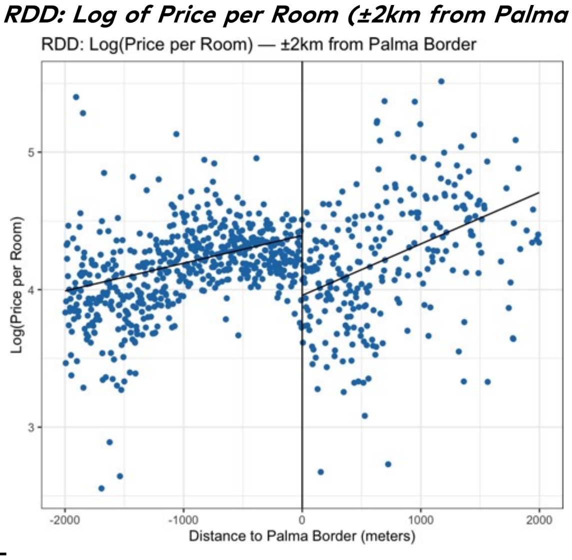
The RDD estimates around Palma's boundary mirror this mechanism in a more granular, spatially localized setting. Although the price increase is observed within a narrow band rather than island-wide, the regulation induced a drop in supply and a simultaneous improvement in the quality composition of the remaining STR stock. Hence, the local and regional results reinforce each other, both pointing toward a compositional response to policy that tightens supply and elevates average prices among surviving listings.

Table 7: RDD Estimates of Palma STR Regulation on Price and Supply (±2km Bandwidth)

Panel	Specification	Effect	Std. Error	95% CI
4*A. Price per Room	Raw Distance (EUR)	−19.803	1.924	[−23.574, −16.032]
	Jittered Distance (EUR)	−18.971	2.313	[−23.505, −14.437]
	Log Price (log points)	−0.244	0.034	[−0.310, −0.178]
	Covariate-adjusted (log points)	−0.194	0.030	[−0.253, −0.135]
3*B. Listing Persistence	Raw Distance (pp)	0.174	0.019	[0.136, 0.212]
	Jittered Distance (pp)	0.175	0.023	[0.131, 0.219]
	Covariate-adjusted (pp)	0.150	0.023	[0.105, 0.195]

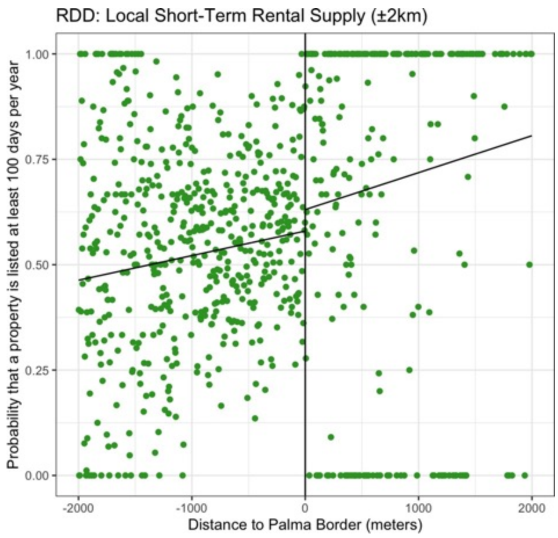
Notes: Estimates based on local linear regressions with triangular kernel and MSE-optimal bandwidth selection via rdrobust. Covariate-adjusted models include controls for number of bedrooms, bathrooms, and guest capacity. Price outcomes are reported in euros or log points; listing persistence is the probability of being active 100 days/year. All effects are significant at the 1 percent level.

Figure 7: RDD: Log of Price per Room (±2km from Palma Border)



[12] Negative values of the running variable indicate properties located inside the municipal boundary of Palma and thus subject to the short-term rental (STR) ban. Positive values correspond to properties in neighboring municipal- ities, which serve as the control group and are unaffected by the regulation. The threshold at zero denotes the legal boundary of Palma, which constitutes the policy cutoff.

Figure 8: RDD: Listing Propensity (±2km from Palma Border)



6. Robustness Checks

6.1 Between-region

To ensure the validity of our findings, we extend our analysis by leveraging panel data and estimating event study specifications in this alternative framework. While our primary analysis employs a repeated cross-sectional model, the panel data approach allows us to control for unit-specific fixed effects, potentially mitigating concerns related to unobserved heterogeneity. The event study specification in the panel setting is given by:

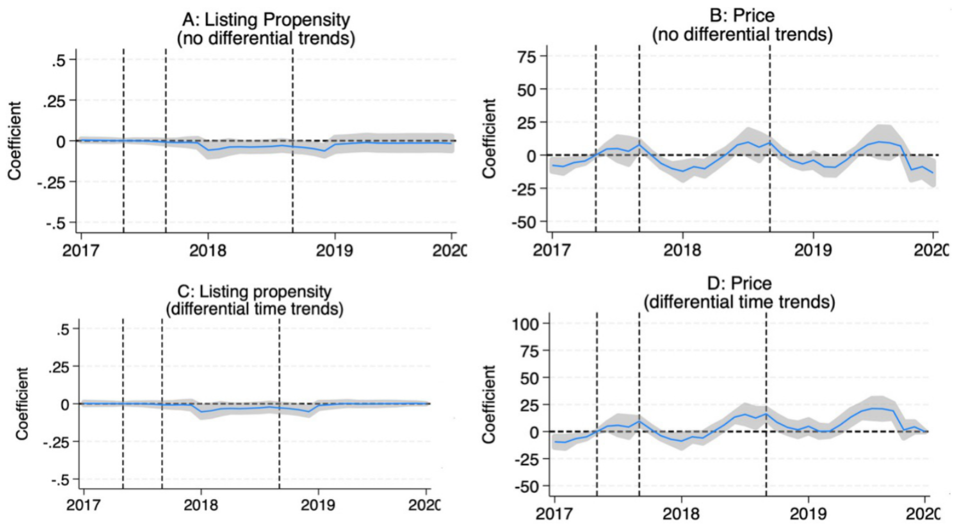
$$Y_{it} = \alpha_i + \gamma_t + \sum_{k \neq -1} \beta_k D_{k,it} + X'_{it}\delta + \varepsilon_{it} \tag{11}$$

where Y_{it} denotes the outcome variable, such as listing propensity or price per room. The term α_i captures property-specific fixed effects, controlling for time-invariant characteristics, while γ_t accounts for time fixed effects common to all units. The coefficients β_k trace the dynamic effects of the policy over time, with $D_{k,it}$ representing event-time dummies normalized to zero in the reference period. The vector X' includes control variables such as property attributes to account for compositional changes, and ε_{it} is the idiosyncratic error term.

Figure 9 presents event study estimates for listing propensity and price per room, incorpo- rating key policy dates: announcement (May 2017), approval (September 2017), and enforcement (September 2018). For listing propensity, estimates confirm no significant pre-trends between Mallorca and Girona, supporting our identification strategy. Post-announcement, we observe a relative decline in listings in Mallorca, consistent with cross-sectional results.

To address potential differential pre-trends, we estimate an alternative specification with property- specific linear trends:

Figure 9: Event Study Plots: Panel



$$Y_{it} = \alpha_i + \gamma_t + \sum_{k \neq -1} \beta_k D_{k,it} + X'_{it}\delta + \tau T_{it} + \varepsilon_{it} \tag{12}$$

where T_{it} represents a property-specific trend, allowing for differential trajectories in the treated and control groups prior to the intervention. This specification ensures that any observed post-treatment effects are not driven by pre-existing trends.

Regarding price per room, the panel-based event study further supports our earlier findings. While some pre-treatment deviations are visible, post-announcement estimates indicate a sustained increase in prices in the treated areas. The lack of a systematic pre-trend strengthens the argu- ment that the observed price effects are driven by the policy intervention rather than pre-existing differences between treated and control municipalities.

6.2 Within-region

To further validate the spatial regression discontinuity (RDD) results, we estimate an event study specification comparing outcomes across the Palma municipal boundary. Figures 11 and 10 display the dynamic treatment effects for listing propensity and log price per room, respectively.

In both figures, vertical dashed lines indicate three key policy milestones: the announcement (May 2017), the approval (September 2017), and the implementation (September 2018). We now treat the approval date as the primary regulatory cutoff, consistent with anticipatory behavior documented in the housing market. The coefficients remain close to zero in the pre-treatment period, supporting the parallel trends assumption. There is also no evidence of pre-trends or anticipatory behavior prior to regulation, as the confidence interval contains zero in both panels.

Figure 11 shows that prior to the approval, trends in listing propensity were stable and not statistically different between Palma and neighboring municipalities. Immediately after the

September 2017 approval, however, we observe a marked and persistent decline in the relative listing propen- sity within Palma. This pattern suggests that hosts began adjusting their supply behavior upon confirmation of the forthcoming restriction, even before its formal enforcement.

Figure 10 displays a parallel response in log price per room. While some volatility is present prior to the policy, there is a slight increase in relative prices within Palma beginning shortly after the approval.

Overall, the event study evidence reinforces the RDD findings. The timing and persistence of effects—both on quantity and price—align closely with the policy's approval, confirming this as the economically salient treatment date. These dynamics underscore the credibility of our identification strategy and suggest that market actors responded swiftly and meaningfully to regulatory expectations.

Figure 10: Event Study Plot: Price (logarithm of Price per Room)

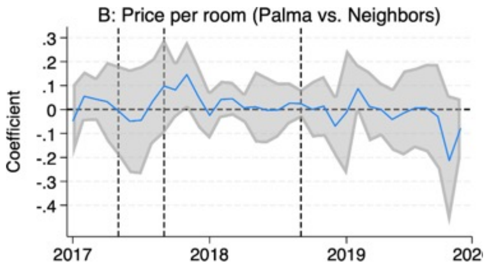
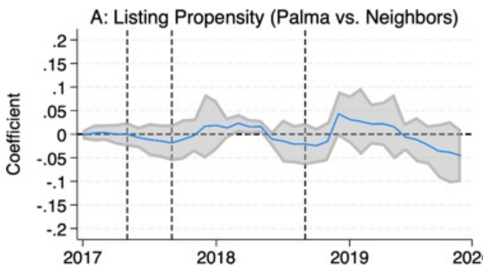


Figure 11: Event Study Plot: Listing Propensity (n prop 100a)



7. Discussion

At the regional level, the DiD estimates show that STR regulations in Mallorca led to a decline in listing activity alongside rising average prices. This pattern is consistent with a compositional selection mechanism: regulation disproportionately drives out lower-quality or informal listings, leaving behind a pool of higher-quality, more professional operators. This upward shift in the average quality of the supply induces a mechanical increase in observed prices, even in the absence of changes in aggregate demand. Similar dynamics have been documented in other contexts, where regulatory shocks induce exit among non-professional hosts and low-end listings (Li et al., 2019; Rossi-Hansberg et al., 2019).

In contrast, the spatial RDD around Palma's municipal boundary provides a sharper lens through which to isolate the competition effect. Because the comparison is restricted to highly similar listings on either side of a narrow two-kilometer bandwidth, the identifying variation is less likely to reflect differences in quality or host type. The observed 24.4% price increase for listings just inside the regulatory boundary, relative to those just outside, cannot plausibly be attributed to compositional upgrading alone. Rather, it reflects reduced market competition: with fewer ac- tive listings inside Palma due to the ban, the remaining units face less price pressure from nearby substitutes, allowing for markups under relatively inelastic demand.

Together, these two designs uncover distinct but complementary mechanisms through which STR regulation affects market outcomes. The DiD captures broader selection effects—including exits driven by compliance costs, informality, or marginal profitability—whereas the RDD isolates how reduced competitive pressure in tightly regulated zones directly inflates prices for the remaining units. Importantly, these are second-order effects of regulation that may not be fully anticipated by policymakers. The intention to reduce STR intensity for housing or tourism management rea- sons can inadvertently reshape market structure in ways that concentrate supply, shift demand externally, and raise prices.

These findings also underscore the presence of spatial spillovers. Supply constrained within Palma appears to reallocate to adjacent municipalities not subject to the same restrictions, effec- tively exporting STR activity to neighboring areas. This geographic substitution is in line with prior work on the spatial externalities of STR regulation (Farronato and Fradkin, 2022; Wang and Nicolau, 2017), and suggests that regulatory design must account for inter-jurisdictional responses. In sum, while the DiD estimates highlight compositional sorting as a general equilibrium re- sponse, the RDD results reveal localized competitive distortions. The strength and clarity of the RDD findings suggest that reduced competition is a key driver of post-regulation price dynamics. Both effects—the selection of higher-end listings and the diminished role of price competition—are plausible, unintended consequences of STR regulation. Recognizing these mechanisms is essential for evaluating the full welfare implications of housing policy interventions.

8. Limitations

While this study provides robust evidence of the causal impacts of STR regulation in Mallorca, several limitations should be acknowledged. First, the identification strategy in the difference-in- differences (DiD) framework assumes parallel trends between Girona and Mallorca in the absence of treatment. While both regions share important structural similarities, unobserved region-specific shocks may bias the estimates. Efforts to test for pre-trends mitigate this concern but cannot fully eliminate it. Also, due to data constraints, the analysis begins in 2017 and lacks a long pre-treatment window. This limits the ability to fully verify parallel trends or assess longer-term market dynamics prior to the policy shock.

Second, the regression discontinuity design (RDD), though credible in isolating local treatment effects at the Palma boundary, captures impacts in a narrow geographic corridor. Properties near the border are not representative of the city as a whole—many are located in suburban or peri-urban zones with lower demand intensity. Thus, the local average treatment effect (LATE) estimated via RDD may not generalize to Palma's central neighborhoods, where the regulatory shock may have been more severe or pricing dynamics different.

Despite these limitations, the use of both between-region and within-region strategies enhances the credibility of the results and offers new insight into how spatially targeted regulations affect housing markets.

9. Conclusions

The expansion of peer-to-peer (P2P) rental platforms has transformed the accommodation sector and triggered complex regulatory responses. This paper evaluates the effects of one of Europe's most ambitious interventions—the multi-layered short-term rental (STR) restrictions implemented in Mallorca between 2017 and 2019—on the structure and pricing of local rental markets. By combining a difference-in-differences design comparing Mallorca to Girona with a spatial regression discontinuity design (RDD) at Palma's municipal boundary, this study provides robust causal evidence on the consequences of STR regulation on market dynamics.

The analysis shows that the Mallorca-wide regulation led to a measurable contraction in STR activity, with the number of persistent listings falling by 2.8 to 4.5 percentage points. Simultane- ously, average prices per room rose between 1.5% and 7.6%, with stronger effects in high-demand, heavily regulated zones. These results point to two distinct yet interrelated mechanisms: a com- position effect, whereby lower-end or informal listings exit the market, and a competition effect, whereby reduced supply relaxes price pressure among remaining operators.

These mechanisms are further disentangled through the spatial RDD design. Listings just inside Palma's regulatory boundary were 17.5 percentage points less likely to remain active, but those that did exhibited a 24.4% increase in price per room relative to those just outside. Because listings on either side of the boundary are highly comparable in terms of quality and other observable features, the RDD design serves to control for the composition effect. This allows for a cleaner identification of the competition effect, with the observed price increase more plausibly reflecting reduced supply-side competition rather than improved listing quality.

Together, these findings highlight how STR regulation can generate unintended and often over- looked consequences, particularly through equilibrium effects that go beyond the direct reduction of listings. Policymakers may underestimate the extent to which regulatory interventions reshape market composition and pricing power. Moreover, displaced activity tends to relocate just outside the regulated area, creating spatial spillovers that shift—rather than resolve—underlying market pressures.

A. Appendix

This appendix presents additional tables and figures that support the main findings. It includes descriptive statistics, robustness checks, and supplementary analyses referenced in the main text.

A.1 Descriptive Statistics and Sample Composition

Table A1: Apartment Listings by Year and Location (All of Mallorca)

Year	Inside Palma	Outside Palma
2017	52,015	197,945
2018	36,135	215,446
2019	26,172	220,939

Table A2: Apartment Listings by Municipality and Year (Palma vs. Neighboring Areas)

Year	Municipality	Listings
2017	Palma	52,015
	Calvià	10,474
	Llucmajor	5,113
	Valldemossa	327
	Bunyola	218
	Marratxí	295
	Santa María del Camí	144
	Esporles	204
	Puigpunyent	74
	Santa Eugènia	69
	Algaida	129
2018	Palma	36,135
	Calvià	7,742
	Llucmajor	3,402
	Valldemossa	239
	Bunyola	171
	Marratxí	152
	Santa María del Camí	107
	Esporles	132
	Puigpunyent	65
	Santa Eugènia	111
	Algaida	95
2019	Palma	26,172
	Calvià	5,049
	Llucmajor	2,398
	Valldemossa	111
	Bunyola	110
	Marratxí	82
	Santa María del Camí	70
	Esporles	47
	Puigpunyent	27
	Santa Eugènia	87
	Algaida	153

Table A3: Summary of Apartment Listings: Palma vs. Neighboring Municipalities

Year	Inside Palma	Outside Neighbors	Total Sample
2017	52,015	17,017	69,032
2018	36,135	12,286	48,421
2019	26,172	8,134	34,306

Table A4: Treatment and Control Group Information

Treatment	Control (0)	Treated (1)	Min Time (0)	Max Time (0)	Min Time (1)	Max Time (1)
treatmenta	221	53	20820	21458	21063	21063
treatments	221	53	20820	21458	21063	21063
treatmentp	221	53	20820	21458	21428	21428

Notes: Time is represented by the date variable.

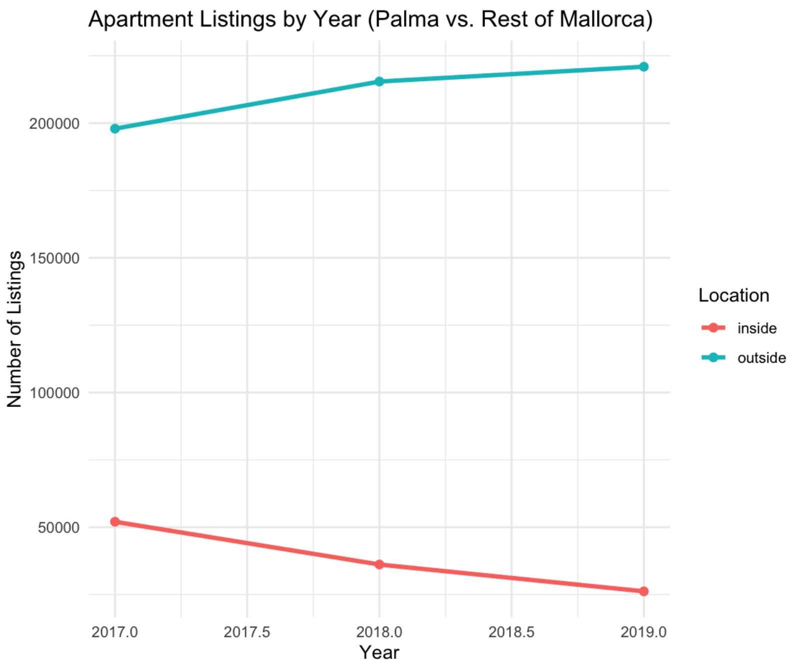
Table A5: Number of Apartment Listings by Year and Palma Location (All Mallorca)

Year	Inside Palma	Outside Palma
2017	52,015	197,945
2018	36,135	215,446
2019	26,172	220,939

Table A6: Apartment Listings by Year: Palma vs. Neighboring Municipalities

Year	Inside Palma	Outside Neighbors	Total N for analysis
2017	52,015	17,017	69,032
2018	36,135	12,286	48,421
2019	26,172	8,134	34,306

Figure A1: Number of Apartment Listings by Year and Palma Location (All Mallorca)

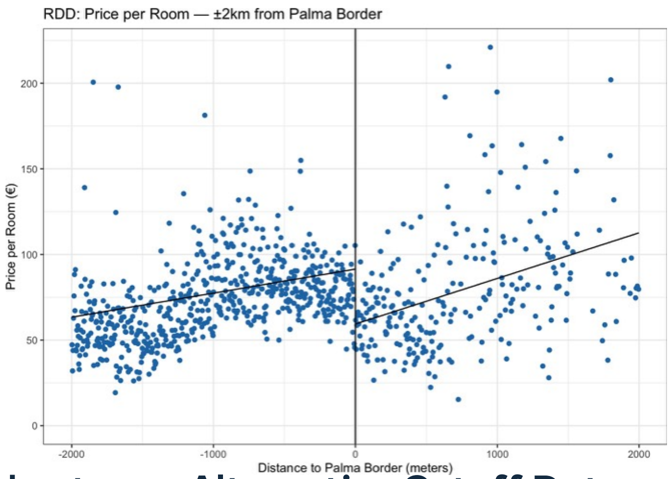


A.2 RDD Sample and Spatial Structure

Table A7: Summary of Mass Points by Municipality

Municipality	Listings with Identical Distances
Palma	40,261
Llucmajor	1,537
Calvià	650
Algaida	103
Marratxí	56
Esporles	35
Bunyola	29
Santa Eugènia	8

Figure A2: RDD: Price per Room (±2km from Palma Border)



A.3 Robustness: Alternative Cutoff Dates

To assess the timing of market responses to the STR regulation, we compare RDD estimates using two alternative policy thresholds: (i) the approval date (September 1, 2017), when the law was passed and publicly announced, and (ii) the implementation date (September 1, 2018), when enforcement began.

Table A8 reports results across three outcome domains—price per room, log price, and listing persistence—for both cutoff dates. Across all specifications, the estimated effects are nearly identi- cal in magnitude and significance. However, patterns of anticipatory adjustment are more clearly captured when using the approval date.

This finding is consistent with market actors internalizing regulatory information before enforcement. The evidence supports our decision to adopt the September 2017 approval as the effective treatment date throughout the main analysis.

Table A8: Comparison of RDD Estimates by Cutoff Date (Approval vs. Implementation)

Outcome	Specification	Cutoff Date	Estimate	Std. Error
6*Price per Room	Raw	2017-09-01	–19.803	1.924
		2018-09-01	–19.803	1.924
	Jittered	2017-09-01	–18.971	2.313
		2018-09-01	–18.971	2.313
	Covariate-adjusted	2017-09-01	–14.263	2.077
		2018-09-01	–14.263	2.077
6*Log(Price)	Raw	2017-09-01	–0.244	0.034
		2018-09-01	–0.244	0.034
	Jittered	2017-09-01	–0.244	0.034
		2018-09-01	–0.244	0.034
	Covariate-adjusted	2017-09-01	–0.194	0.030
		2018-09-01	–0.194	0.030
6*Listing Persistence	Raw	2017-09-01	0.174	0.019
		2018-09-01	0.174	0.019
	Jittered	2017-09-01	0.175	0.023
		2018-09-01	0.175	0.023
	Covariate-adjusted	2017-09-01	0.150	0.023
		2018-09-01	0.152	0.022

Notes: RDD estimates using ±2km bandwidth and triangular kernel. Covariate-adjusted models include controls for number of bedrooms, bathrooms, and guest capacity. Results are nearly identical across cutoff dates, though anticipatory effects emerge more clearly after the September 2017 approval.

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