Vacation rental market regulation and accommodation supply growth

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Abstract:

Short-term residential vacation rentals (RVRs) have increased their popularity in recent years. Local governments have introduced different regulatory changes to control their supply growth. This paper evaluates a policy intervention in a Northern Spanish destination that has reduced the bureaucratic procedures to officially open a RVR since 2016. We compare the evolution of accommodation growth of RVRs with that of tourist apartments exploiting a panel dataset of 78 municipalities between 2013-2019. Using difference-in-differences, we provide evidence that the easing of the administrative procedures increased the number of establishments and bed places in RVRs by 5 and 26 units, on average, per municipality.

Keywords: *vacation rental markets regulation; administrative procedures; entry regulation; policy intervention*

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1. INTRODUCTION

In recent years, peer-to-peer markets (also known as the sharing economy) have arisen as alternative suppliers of goods and services that allow consumers to access wider and more personalized commodities. Information technology developments have facilitated the creation of larger and more geographically diverse marketplaces with low entry costs for sellers (Einav et al., 2016). Among them, short-term peer-to-peer (P2P) accommodations are nowadays a popular alternative to traditional lodgings like hotels or tourist apartments, being considered as a disruptive innovation in the hospitality industry (Zach et al., 2020).

A growing body of literature documents that the emergence of P2P accommodations like Airbnb has important economic effects on local communities. On the positive side, some studies show that the increase in Airbnb supply (i) positively affects employment in all sectors of the hospitality, tourism and leisure industries (Fang et al., 2016; Dogru et al., 2020), (ii) increases neighbourhood investment in residential renovation and retail projects (Xu and Xu, 2021), and (iii) has expanded tourism demand through more meaningful travel experiences and lowered accommodation costs (Jiménez et al., 2021; Tussyadiah and Pesonen, 2016). On the negative side, the increase in the supply of short-term vacation rentals produces negative externalities in terms of increasing residential house prices and rents (Horn and Merante, 2017; García-López et al., 2020; Franco and Santos, 2021) and lowering the revenues of long-established incumbents (Zervas et al., 2017; Dogru et al., 2019). Some claim that P2P lodgings are far from the collaborative economy and are dominated by professional hosts, who gain non-negligible revenues (Gil and Sequera, 2020). This has created a public debate about the necessity to regulate by law the entrance, characteristics and functioning of P2P accommodations.

This paper evaluates the impact on the supply growth of (short-term) residential vacation rentals (henceforth RVRs) of the passing of a Law in 2016 in a popular destination in Northern Spain (Asturias) that reduced the existing bureaucratic procedures needed to officially register a RVR. Specifically, we analyse the effect of this policy intervention on both the number of establishments and bed places. RVRs are defined as full independent properties that are rented as accommodation during short periods to tourists in exchange of payment. Therefore, the analysis only focuses on entire properties not subject to horizontal property. We exploit a panel dataset of administratively registered RVRs during the period 2013-2019 for the existing 78

municipalities of Asturias. To properly estimate the causal effect of the regulatory change on supply growth, we initially use difference-in-differences (DiD) with two-way fixed effects (TWFE estimator). We assess the impact of the intervention on the evolution of RVRs using the number of tourist apartments in the same municipality as the control group. The reasons for using tourist apartments as the control units are discussed later in the paper. Next, we uncover potential heterogeneous effects across municipalities and periods to examine whether the policy regulation exerts non-linear effects over the accommodation distribution and over time.

Some prior studies have evaluated the impacts of vacation rental markets regulation on different outcomes like the usage of RVRs in adjacent non-regulated neighbourhoods (Valentin, 2021), property sales price (Kim et al., 2017) or the performance of incumbents (Yeon et al., 2020a). More recently, Benítez-Aurioles (2021), van Holm (2020), Yang and Mao (2019) and Yeon et al. (2020b) study the impact of RVR regulation on their demand, supply and economic performance, respectively. We contribute to this body of research but from a different perspective. We investigate the consequences of a policy change in the regulation of entry that facilitated the switch from residential properties to vacation lodgings. The paper thus closely relates to the literature on entry regulation showing that start-up regulations significantly hamper the opening of new businesses (Djankov et al., 2002; Chambers and Munemo, 2019) and the subsequent job creation in the corresponding industries (Bertrand and Kramarz, 2002). In our case, we examine how the easing of bureaucratic procedures to regularize RVRs affects their supply growth. A key aspect is that we analyse the induced change in officially registered RVRs. Therefore, the paper does only pay attention to the evolution of RVRs in the formal economy, without prejudice that the policy intervention induced a change from the informal to the formal economy together with the creation of new lodging establishments.

Since there is fair evidence that new firms' entry regulation has non-neutral effects on the industry growth (Hause and Du Rietz, 1984; Fisman and Sarria-Allende, 2010), our study has important implications for policy regulations, especially at the local level. If the easing of the bureaucratic procedures to register a RVR nudges hosts to regularize them, this might increase the number of operators in the sharing economy that surface to the formal economy. This does not only help public authorities to have information about the potential stressed areas in which RVRs could be impairing residential affordability, but it also allows local governments to collect taxes with which to compensate potential negative externalities. Moreover, if the

regulatory change induced an overwhelming growth in peer-to-peer accommodation supply, this could help policy makers in the development of subsequent regulations that set upper bounds to avoid gentrification problems.

The rest of the paper is organized as follows. Section 2 reviews the literature. Section 3 presents the case study, its legal framework before the intervention and the characteristics of the policy change. Section 4 outlines the dataset, presents some summary statistics and describes the econometric modelling. Section 5 reports and discusses the estimation results. Finally, Section 6 concludes with a summary of findings and some policy implications.

2. LITERATURE REVIEW

2.1.The success of P2P accommodation and the need for regulation

Airbnb is nowadays the leading marketplace for peer-to-peer accommodation. Originally, it started as an online channel that connected non-commercial providers of space suitable for overnight accommodation (hosts) to potential guests for short-term use through direct interaction.[1] Hosts typically offer spare room to cover expenses and earn extra pocket money, but without being registered as formal businesses (Dolnicar, 2019). This new form of accommodation has seen a gradual demand increase all over the world, which has been accompanied by supply growth. Some of the reasons for the success of P2P lodgings are that (i) they are usually better located concerning tourist attractions (Gutiérrez et al., 2017), (ii) they satisfy the needs of niche markets neglected by traditional accommodations like pet owners (Dolnicar, 2019), and (iii) they are generally cheaper, thereby allowing tourists to allocate their travel budget over different items (Tussyadiah and Pesonen, 2016).

However, the original conceptualization of 'sharing' has blurred over time and nowadays online P2P rental platforms like Airbnb are closer to commercial distribution channels than to their original peer-to-peer nature. Because at the very beginning RVRs were unregulated and started to be highly demanded by travellers, they attracted more and more private and commercial investors. As a result, a large share of hosts currently operates close to business intermediaries,

[1] Our analysis focuses on RVRs, no matter whether they are sold in Airbnb platform or not. Nonetheless, most RVRs are announced in this online marketplace. According to Asturias legal regulation, it is compulsory to be officially registered as an accommodation to be publicized in online marketplaces.

holding several properties, and earning non-negligible revenues. This has led to the so-called *professionalization* of Airbnb (e.g., Gil and Sequera, 2020); indeed, multi-property hosts own about 60% of the listings in the market (Adamiak, 2019).

The emergence and popularity of Airbnb have threatened the market position of incumbents, especially hotels (Zervas et al., 2017; Dogru et al., 2019). Because of this, the hotel sector started to argue that peer-hosted space represented unfair competition: they were not bound by standard accommodation regulations and did not pay tourism-specific taxes, which enabled them to be more competitive and set lower prices. In addition to this, Airbnb has been shown to increase housing rents (Horn and Merante, 2017; García-López et al., 2020; Franco and Santos, 2021) and to impose negative externalities on local communities. In this regard, the conversion of residential apartments into tourist accommodations displaces residents from the city centres (Celata and Romano, 2020) and generates significant nuisance impacts like noise, congestion or competition for parking (Wegmann and Jiao, 2017; Gurran and Phibbs, 2017; Martín-Martín et al., 2019).

Because of this tension, many local governments around the world have introduced formal regulations. The regulatory measures differ widely across countries and cities, ranging from taxation (e.g. London), the need to have a licence to operate (e.g. Barcelona), fines for non-registered properties (e.g. Amsterdam) and limitations on the number of days per year the property can be rented (e.g. Berlin, Paris), among others. In this regard, the regulatory regimes vary notably across geographic areas, even between cities within the same country (Gurran et al., 2020). A review of the most relevant regulatory responses implemented in several tourist destinations in the world is provided in von Briel and Dolnicar (2020) and Aguilera et al. (2021). In general terms, existing regulations are not being truly effective due to the great difficulties in enforcing them. However, if RVRs were officially registered, this would help public authorities to exert better control over them.

2.2.Empirical evidence on SVRs regulation

Several papers in tourism and urban planning research have discussed the need for regulating RVRs. Wegmann and Jiao (2017) analyse the phenomenon of urban vacation rental and proposes general principles to guide regulations. Among other suggestions, they urge regulators to take micro-geographic approaches that consider the differences in P2P accommodation

supply and characteristics across adjacent areas. Martín-Martín et al. (2020) discuss the problem of over-tourism in some Spanish regions caused by the unregulated proliferation of RVRs. They advocate for regulating them at the national level to avoid unfair competition across regions. DiNatale et al. (2018) focus on how RVRs are affecting small cities in Oregon, showing that although RVRs have positive and negative impacts on local communities, many cities struggle to effectively regulate it.

Whereas most scholars agree on the need to regulate RVRs, what is less clear is the appropriate way to do so. Regions and cities are highly heterogeneous so 'one size fits all' policies might not be appropriate. Furukawa and Onuki (2019) compare RVR regulation in 17 American cities. They indicate that regulatory frameworks are stricter in cities in which occupancy rates grow fast and for whom the lodging industry represents a larger share of the local economy. Nieuwland and Melik (2020) explore the regulatory policies implemented by 11 European and American cities. They show that European cities are more lenient towards RVRs than American cities, which in general ask for more permits, safety precautions and information provision. They also argue that since the negative externalities imposed on local communities differ across cities, policy responses should be city-specific.

Some works have conducted simulation studies to ascertain the potential effects of some specific policy regulations ex-ante. For the case of Amsterdam, Overwater and Yorke-Smith (2022) examine the qualitative macro-effects of maximum-night policy measures using agent-based modelling. Their simulations illustrate that a greater proportion of low-income citizens will live in the city when the regulation of the market is stronger. Although banning the touristic market restrains the overall increase in house prices, the authors indicate there might be problems with such regulation enforcement, concluding that tighter limits on the number of nights a property can be listed on Airbnb is preferable to an outright ban. Vinogradov et al. (2020) simulate different scenarios, ranging from a lack of regulation to limiting the number of days for renting and taxation. They show that imposing taxes on RVR revenues takes the most unstable properties off the market, thereby helping to distribute RVRs more evenly across the urban space.

However, research that provides formal analyses on the causal impacts of policy regulations in the RVR market is in its infancy. Existing empirical studies about the impact of RVRs

regulation can be broadly classified into three groups depending on the outcome of interest: (i) hotel performance (Yeon et al., 2020a; Falk and Yang, 2021), (ii) housing property values (Kim et al., 2017; Valentin, 2021) and (iii) RVRs supply, demand and performance (Benítez-Aurioles, 2021; Bibler et al., 2021; Yang and Mao, 2019; Yeon et al., 2020b). We now proceed to briefly review each of them.

Regulations and the performance of incumbents

Yeon et al. (2020a) evaluate the impact of the passing of a law by New York State that prohibited listing an advertisement for illegal short-term rentals on hotel performance. Their findings indicate that RVRs regulation did not affect hotel performance as a whole, but it exerted a positive effect on lower-scale hotels. Falk and Yang (2021) study how the introduction of stricter rules on RVRs in some European cities affects hotel overnight stays. Using an appropriate choice of treated and control units and controls for accommodation prices, terrorist attacks and real income of the destination country, they provide evidence that stricter regulations increase hotel overnight stays by around 9%.

Regulations and housing property prices

To analyse how RVRs affect the housing market, Kim et al. (2017) take advantage of a policy experiment in Anna Maria Island (Florida). One of the three cities that composed the island implemented a minimum stay for RVRs while the others did not. They evaluate the impacts on property values between 1995 and 2015 using a difference-in-differences approach. Their results show that more restrictive RVRs ordinances are associated with lower shares of hosts and lower property values, with the latter effect being mitigated by neighbourhood density. Similarly, Koster et al. (2021) evaluate a RVRs regulation (Home Sharing Ordinances that ban informal vacation rentals) on the housing market in Los Angeles County using a panel regression-discontinuity experimental design around the affected cities' borders. They find that ordinances decreased the number of listings by 50%, housing prices by 2% and rents also by 2%.

Possibly one of the most robust studies on the impacts of RVRs regulation is conducted by Valentin (2021). He exploits a sharp regulatory change in 2016 that prohibited RVRs in one neighbourhood in the urban centre of New Orleans while regulating them in other parts of the

city. Using a difference-in-discontinuity design, he disentangles the positive and negative effects on housing prices stemming from the prohibition of Airbnb. This author finds that the regulatory change increased the probability of Airbnb properties' closures throughout the city, with the effect being larger in neighbourhoods facing more stringent regulation.

Regulation and RVRs performance

Yang and Mao (2019) examine the role of distinct types of rental regulation on Airbnb supply using data for 1068 zip codes in 28 major US cities. Their analysis reveals that the number of units is negatively affected by tailored legal frameworks and hostile enforcements but unrelated to legal restrictions, licensing requirements or tax collection obligations. Interestingly, when the authors split the analysis by property type, they show that the legal framework hinders the supply of entire houses and private rooms whereas hostile enforcement only inhibits the supply of entire houses. Yeon et al. (2020b) evaluate the impact of a law that prohibited advertisements for illegal short-term rentals in New York City on their economic performance. Their estimates indicate the monthly revenues of Airbnb listings subject to the regulation significantly decreased. Similarly, van Holm (2020) examines the passing of a law in New Orleans aimed at preventing RVRs unfettered growth. This author shows that although the regulation initially reduced the overall number of RVRs in the city, their growth has resumed later. Furthermore, the regulation seems to have shifted growth into residential neighbourhoods. For the case of Andorra, Domènech and Zogal (2020) document that the passing of a regulation law in 2017 that required the fulfilment of some strict quantitative and qualitative measures for all short-term rentals (having an ID register or banning private rooms) was not very successful at stopping the growth of illegal accommodations. Their findings indicate the supply of Airbnb is much higher than the number of registered housings for tourist use.

Benítez-Aurioles (2021) analyses the adoption of an urban development plan in Barcelona in March 2017 aimed at limiting the growth of tourist accommodations in the city. Three different areas are defined. In two of them, no new accommodations or expansions of existing ones are allowed. In the remaining one, there are no restrictions on the opening of new establishments. Using reviews as a proxy of demand and a difference-in-differences analysis, she documents that the restriction in the supply growth resulted in more intensive use of available accommodations. Therefore, the policy was not effective at reducing the over-tourism problem and even exacerbated it. Bibler et al. (2021) study how voluntary collection agreements (VCA)

between Airbnb and US jurisdictions that enforce tax collection affected booking prices. Also using a difference-in-difference methodology, they find that the enforcement of a 10% tax reduces the price paid to hosts by 2.4%, increases the total price renters pay by 7.6% and reduces nights booked by 3.6%. The paper concludes that tax jurisdiction can increase compliance substantially by entering VCA, but taxing Airbnb is not an effective policy to reduce its market activity in a given area.

3. STUDY CONTEXT AND LEGAL FRAMEWORK

3.1.Case study: The Principality of Asturias

Asturias is a Northern Spanish region with about a million inhabitants. Figure 1 illustrates the geographic position of this region within Spain. The tourism industry is an important driver of economic growth for this region, representing around 11% of its GDP and 12.7% of total employment by the end of 2019 (Tourist Information System of Asturias, 2020). Tourism in Asturias is strongly linked to its natural amenities and cultural heritage, being an appealing destination both for cultural and nature-based tourists. This region has one National park (*Picos de Europa*), four natural parks (*Somiedo, Las Ubiñas, Fuentes del Narcea* and *Redes*) and three UNESCO World Heritage sites (*Camino de Santiago*, *Cueva de Tito Bustillo* and *Iglesias del Reino de Asturias*). Furthermore, although it is not a sun and beach destination, the practice of aquatic sports like surf or canoeing has increased its popularity in the last years, with the *Descenso International del Sella* becoming a relevant summer event.

FIGURE 1 HERE

3.2.Legal framework for vacation rental accommodations and policy change

Protecting consumer welfare is one of the main rationales for economic regulation. In Spain, there is substantial heterogeneity in the regulation of tourist accommodation establishments at the regional level. Since the Law of Urban Rents was modified in 2013, the regulation of tourism establishments has been fully under the jurisdiction of the autonomous communities (regional governments).[2] Each region has implemented its regulatory changes and the National Commission on Markets and Competition (CNMC in Spanish) has opposed this, claiming that

[2] See Ortuño and Jiménez (2019) for an overview of Airbnb penetration across Spanish regions and cities.

local rules hinder effective competition in the tourist market across regions (Martín-Martín et al., 2019).

In Asturias, tourist accommodation establishments were initially regulated by Law 7/2001 about tourism. This law regulated all types of tourism establishments (hotels, tourist apartments, campsites, etc.), their characteristics, requirements, classification, duties, responsibilities and potential sanctions in case of infringement. RVRs were explicitly considered as a type of tourism lodging. However, hosts needed administrative authorization to convert any unoccupied property into a RVR. This was a necessary condition to legally operate. In particular, they must present a formal request accompanied by personal data about the owner and the property, a municipality licence that allows to open a RVR, a technical memorandum with blueprints and full details about each lounge, bedrooms, size, amenities, and a copy of civil responsibility insurance payment, among others. Other requirements are: (i) stays were restricted to full weeks, weekends or bank holidays (two days before or after the weekend), (ii) bookings needed to be done exclusively by telephone, (iii) bookings are understood to be cancelled if guests do not show up before 20PM, (iv) payments needed to be done in cash at the establishment at the moment the guest is presented the bill, and (v) prices must be publicised in official tourist guides. The other types of accommodation demanded similar requirements.

In the summer of 2016, the government of the Principality of Asturias passed the Decree 48/2016, about residential vacation rentals. The regional government was urged to take action because the existing regulation had become quite obsolete, particularly for a type of tourist establishments based (in principle) on peer-to-peer sharing. The most important change was the substitution of the administrative authorization with a responsibility statement (ex-post control). This regulatory change falls within the *Bolkestein* Directive. This proposal developed by the European Commission aims to provide a legal framework that eliminates the obstacles to the freedom of establishment for service providers by simplifying administrative procedures (Hagemejer et al., 2014). Therefore, since 2016 hosts could open a RVR without having to wait until the lengthy authorization and licencing procedures are completed. They only require presenting an affidavit in which they assert they fulfil all the legal requirements. In addition to this, the reform introduced some other changes. First, restrictions to renting the property for single days or days within weeks are eliminated. Second, the communication channel between host and guest is not restricted to be the telephone, thereby opening the possibility to interact

through online marketplaces like Airbnb. Third, the host and guests can freely agree on the arrival hour without any restriction. Fourth, telematic payments were allowed. Fifth, the obligation to publicise prices in official tourist guides was eliminated.

The pre-reform regulation of the specific days to rent, booking channel or cash payment might have prevented hosts from opening new RVRs or registering their businesses (i.e., possibly operating under the informal economy). Bureaucratic delays suppose important opportunity costs for entrepreneurs (hosts) and forgone profits that represent important entry barriers (Djanjov et al., 2002). Therefore, this regulatory change that facilitates the administrative procedures to open a RVR is expected to have fuelled both the opening of new establishments and/or the legalization of RVR supply in Asturias.

4. DATA AND METHODS

4.1.Dataset

We use official records about the tourist accommodation supply in the 78 municipalities of Asturias. The data is drawn from the Tourist Information System of Asturias (SITA), which provides a panel dataset on the accommodation establishments and bed places per municipality and year. This information is retrieved from the Registry of Tourist Enterprises and the data is freely available at http://www.sita.org/. For the analysis, we consider the period 2013-2019. In this way, we have three pre-intervention (2013-2015) and four post-intervention (2016-2019) periods.

4.2.Descriptive analysis

In Asturias we can find (officially registered) the following types of tourist accommodations: (i) short-term vacation rentals (RVRs), (ii) tourist apartments, (iii) hotels, (iv) hostels (including boarding houses and shelters), (v) campsites and (vi) rural accommodations (including rural houses, small rural hotels, and self-catering cottages). Table 1 presents the average number of registered tourist accommodation establishments and bed places per municipality before and after the regulatory change. The last column reports a t-test for mean equality between the two periods.

TABLE 1 HERE

Table 1 reveals interesting insights. First, whereas the number of establishments and bed places of the traditional supply (tourist apartments, hotels, hostels, campsites and rural accommodations) is not statistically different (on average) between the two periods, the number of RVRs is significantly higher in the post-intervention period. That seems to suggest that the (regulated) supply of RVR increased after the passing of the 2016 Law. Nonetheless, for the moment take this as merely exploratory. Second, there is large variability in the different types of accommodation supply across space and over time (within pre- and post-intervention periods) according to the high values of the standard deviations. As such, it seems it is important to control for this geographic and temporal heterogeneity.

Figures 2 and 3 map the average number of RVR establishments and bed places per municipality in the pre- and post-intervention periods. As shown there, there are important differences across municipalities in terms of the penetration of short-term vacation rentals. There is a clear inland-coastal pattern by which municipalities on the coast exhibit high levels of RVRs penetration, both before and after the regulatory change and both considering the number of establishments and bed places.

FIGURE 2 HERE

FIGURE 3 HERE

To analyse the effects of the previously described regulatory change on the supply growth of RVR, we need an appropriate comparison group. We select tourist apartments in the same municipality as the control group. Several reasons support this choice. First, similar to RVRs, they are full properties not subject to horizontal property consisting of a bedroom(s), a bathroom(s), a living room and a kitchen that are temporarily rented as accommodation lodgings and have to satisfy several living conditions and other requirements (claims sheet, liability insurance).[3] Second, despite their similarities, at the same each type of property has

[3] For both, it is required they have drinking water (cold and hot) and electricity power 24 hours a day, sewage disposal system, garbage collection system, heating, first aid it, extinguisher, a telephone for the client's use and signposted access. In addition, the bedrooms must have direct ventilation to the outside and persian blinds.

different technical requirements, making apartments and RVRs conceptually two different accommodation properties.[4] Importantly, tourist apartments can be either separate dwellings belonging to the same building or blocks of dwellings in adjacent buildings that form a unit as a whole. All this rules out substitution effects since a tourist apartment cannot be easily converted into a RVR or vice versa, at least in the short-run. Third, in the pre-intervention period, both RVRs and tourist apartments demanded the same administrative authorization to legally operate. Fourth and most importantly, the opening of a tourist apartment was not affected by the policy change implemented in 2016. That is, the easing of bureaucratic procedures implemented from 2016 onwards does not apply to them since the regulation is specific to RVRs. If the evolution of both types of accommodation follows parallel trends in the pre-intervention period, we can use the supply of tourist apartments as the counterfactual of RVRs in the absence of the entry regulation policy for each municipality. This offers the advantage that, contrary to other applications that use the values at other non-treated geographical areas that could not be comparable, we construct the counterfactual from very similar accommodations located in the same municipality.[5] That is, we compare the evolution of two similar but distinct types of properties that share the same environment. As a result, our dataset contains a total of 1,092 observations (2 groups x 78 municipalities x 7 time periods).

4.3.Econometric modelling: difference-in-differences methodology

To evaluate the causal impact of the 2016 regulation on supply growth, we use the difference-in-differences (DiD) method. The DiD method has been widely used in the economics literature for intervention impact assessments and in recent years it has also been used in tourism research (e.g., Bernini and Pellegrini, 2013; Yeon et al., 2020a; 2020b; Kozic, 2019; DiMateo, 2020; Zhang and Zhang, 2021). It offers the advantage that, if the identifying assumptions are met

[4] Specifically, RVRs (tourist apartments) require bedrooms to have a minimum of 10 (12) and 6 (8) square meters for double and single rooms, respectively. The living room in a RVR must have a minimum size of 8 square meters but 14 square meters in the case of tourist apartments. Beds in RVRs must have a minimum width of 0.8 or 1.35 meters, whereas there is no such requirement in tourist apartments. Similarly, RVRs have a maximum capacity of 14 people or 7 bedrooms, whereas there is no limit in the case of tourist apartments. Moreover, tourist apartments require a check-in place, daily cleaning service and change of sheets and elevator in case of a building with several floors.

[5] For instance, some studies evaluate the effect of a policy intervention at the municipality level taking other non-treated municipalities as the control group (Kozic, 2019; Di Mateo, 2021). However, such approach has the drawback that (i) the policy is typically not randomly assigned across geographic units (Falk and Yang, 2021), (ii) the sample characteristics of treated and control units are usually non-balanced, generally requiring PSM-DiD methods (Zhang and Zhang, 2021), and (ii) time-varying unobserved confounders might be different between treated and control units.

(see below), it separates the true causal effect of an intervention from time-invariant unobserved heterogeneity. The model formulation is as follows:

$$y_{ijt} = \alpha + \beta_1 RVR_i + \beta_2\, Post_t\, x\, RVR_i + \delta X_{jt} + \gamma_j + T_t + \varepsilon_{ijt} \qquad (1)$$

where $i = 1{,}2$ stands for the type of property (RVR versus apartment), $j = 1, \dots, 78$ refers to municipalities and $t = 2013, \dots, 2019$ indicates periods, y_{ijt} is the outcome variable of interest in levels[6], α is a constant term, $Post_t$ is a binary variable that takes value 0 in the baseline periods (pre-intervention) and 1 in the follow-up periods (post-intervention), RVR_i is a dummy for the regulated residential vacation rentals group (as opposed to tourist apartments), X_{jt} is a set of time-varying control variables that might confound the effect of the intervention on the dependent variable, γ_j are municipality time-invariant effects capturing unobserved heterogeneity, T_t are year fixed effects, ε_{ijt} is the idiosyncratic error term and α, β_1, β_2 and δ are parameters to be estimated.[7]

Equation (1) is a linear two-way fixed effects regression (TWFE). This regression model can be easily estimated by Ordinary Least Squares. The parameter β_2 measures the DiD estimand (average treatment effect on the treated, ATT). The proper implementation of the DiD method for causal analysis relies on the following assumptions: (i) there is a treated (affected by the intervention) and a control (not affected by the intervention) group, (ii) treated and control groups follow parallel trends in the pre-intervention periods (i.e., without the intervention, the treated group would exhibit a similar trend to that observed for the control group), and (iii) there is a clear time cut-off that delimitates when the intervention starts (i.e. there is a before and after period). Under these assumptions, the causal effect of the intervention on the interest variable y_{it} (ATT) is given by the difference in the outcome variable for treated and control groups before and after the intervention in the following way:

[6] We adopt a linear DiD model that assumes in the absence of the treatment treated and control groups would increase by the same absolute amount (i.e., parallel trends in levels). Nonetheless, a log-linear model is later estimated as a robustness check.

[7] Note the municipality fixed effects γ_j are identified separately from the RVR dummy because of having two observations (number of RVR and apartments) per municipality and year. The $Post_t$ dummy variable is not specified alone because of being redundant: the pre- and post-intervention time effects are captured by the time fixed effects T_t.

$$ATT = \{E(y_{it=1}|Post_{t=1} = 1, RVR_i = 1, X_{it}) - E(y_{it=1}|Post_{t=1} = 0, RVR_i = 0, X_{it})\} - \{E(y_{it=0}|Post_{t=0} = 0, RVR_i = 1, X_{it}) - E(y_{it=0}|Post_{t=0} = 0, RVR_i = 0, X_{it})\} \quad (2)$$

The reader is referred to Abadie and Cattaneo (2018) for further technical details about the DiD method.

4.4.Control variables and identifying assumptions

We considered the following time-varying control variables: (i) the population size of the municipality, as an indicator of market size, (ii) the number of hotels in the municipality, to consider market competence and as a proxy of the tourism attractiveness of the municipality, (iii) the number of restaurants and bars/cafés, as a proxy of the recreational business environment in the municipality, and (iv) the general consumer price index (base 2016) and the subindex for transportation (base 2016) to capture potential price effects in general and complementary services.[8] Table 2 presents descriptive statistics of these variables, again disaggregated between pre- and post-intervention periods. The average municipality in Asturias has about 13,300 inhabitants, although with large heterogeneity. Municipalities have around 34 restaurants and 95 bars and cafés on average. Importantly, the mean values for these covariates are not statistically different between the pre- and post-intervention periods according to t-tests. In contrast, we detect significant differences in the general consumer price index, which increased during the study period.

TABLE 2 HERE

To inspect the fulfilment of the 'parallel trends' assumption in the pre-intervention periods, Figures 4 and 5 plot the time evolution of the total number of registered RVR (dashed line) and tourist apartments (continuous line) establishments and bed places, respectively. To consider scale differences, the left-hand (right-hand) side axis reflects the number of RVRs (tourist apartments). We see that before the policy change the evolution of RVRs and apartments was quite similar (leaving scale differences aside), both for the number of establishments and the

[8] The first three variables are obtained from the Statistics Institute of Asturias (SADEI). The price indexes are drawn from the Spanish National Statistics Institute (INE).

number of bed places. Interestingly, whereas before 2016 there was a large difference in bed places between tourist apartments and RVRs, in 2019 there are more bed places in RVRs than in apartments.

As introduced before, inference requires that in the absence of the treatment average changes in outcomes among untreated are equal to the average changes among controls. Apart from the visual inspection, we formally evaluate this in two ways. First, we regressed the two variables on a linear time trend, the binary indicator for being a RVR, and the interaction between the two, together with the control variables described above. This is done for the pre-intervention subsample (2013-2015) only. This way of testing parallel trends follows practical recommendations by Abadie and Cataneo (2018, p. 484). In none of the regressions (Supplementary Material, Tables A1 and A2) the interaction term is statistically significant, suggesting that RVRs and tourist apartments appear to follow the same trends in the pre-intervention period. Nonetheless, recent studies in the econometrics literature indicate this sort of pre-tests might have low power (Roth, 2022). Alternatively, we implemented the tests proposed by Mora and Reggio (2015). These authors develop q alternative parallel trends assumptions for cases with several pre-treatment periods. We do not reject the null hypothesis of common pre-dynamics both for the number of establishments (p-value=0.30) and bed places (p-value=0.177).[9] Based on these checks, the parallel trends assumption in levels appears to be satisfied.

FIGURE 4 HERE

FIGURE 5 HERE

Finally, the appropriate implementation of the DiD methodology for causal inference requires the fulfilment of the so-called Stable Unit Treatment Value Assumption (SUTVA). This means that the potential outcomes for the control group must be unaffected by the treatment assignment of the treated units. In other words, we need to rule out potential substitution effects from tourist apartments to RVRs. There are several reasons why the SUTVA condition holds in our case study. First, as mentioned before, apartments are conceptually different from RVRs and have different legal provisions concerning the technical characteristics of the buildings.

[9] These tests provide consistent results under different model specifications with different control variables.

This precludes potential shifts from the apartment to the RVR market, at least in the short run. Second, as shown in Table 1, there are no significant differences in the number of establishments and bed places between the pre- and post-intervention periods for tourist apartments. Third, for the tourist apartments subsample, we run a 'placebo' panel fixed-effects regression of the number of apartment establishments and bed-places on a time trend, the indicator of post-treated period and the interaction between the time trend and $Post$. The regression output is presented in Table A3 in Supplementary Material. The time trend is positive and significant while the interaction with the post-treatment period indicator is not. Therefore, there is no evidence that the supply of tourist apartments reacted to the passing of the 2016 Law, thereby being a suitable control group.

5. RESULTS

5.1.Main findings

Tables 3 and 4 present the estimation results of the two-way fixed effects linear regression for the number of establishments and bed places, respectively. In column 1, we only control for municipality and year fixed effects (omitted to save space, see Tables A4 and A5 in Supplementary Material). Column 2 adds to the specification the population size of the municipality (in logs). Column 3 adds the number of restaurants. Finally, columns 4 and column 5 replace the latter variable with the number of bars & cafés and the number of hotels, respectively.[10] Standard errors are clustered at the municipality level; this adjustment is important because default standard errors may understate the standard deviation of the estimated treatment effect due to correlated residuals (Bertrand et al., 2004).

We find the average treatment effect of the policy regulation equals 5 for the number of RVRs establishments and 26.4 for bed places. These estimates remain unchanged considering different controls, showing great robustness. This means that the regulation entry change in 2016 increased the number of establishments (bed places) by 5 (26) units per municipality, on average. Since the mean number of RVR in the pre-intervention period was 4.08 and 23.40, this

[10] Because there is high correlation between the number of hotels, restaurants and bars/cafés, each of these three variables is introduced in the model separately. Additionally, the price indexes do not vary across municipalities and only have temporal variation. We prefer to specify a full set of year fixed effects to capture any type of year-specific shock in the main analysis. However, we replace them by the price variables in the robustness checks subsection.

represents around a 125% and 111% increase in the number of establishments and bed places relative to the 2013-2015 period. Furthermore, consistent with Figures 4 and 5, the estimation results also indicate that (i) the mean level of RVR and tourist apartment establishments (bed places) have increased over time according to the year fixed effects, and (ii) the number of RVR bed places is on average lower than the bed places in tourist apartments (-45).

TABLE 3 HERE

TABLE 4 HERE

Quite surprisingly, the supply of RVR is unrelated to the population size, the number of hotels and bars & cafés in the municipality. We only document that RVR bed places are negatively associated with the number of restaurants. This is puzzling, since pairwise scatterplots would lead us to expect a positive association (Figure A1 in Supplementary Material). Nonetheless, Yang and Mao (2019) also show that the supply of Airbnb properties is not significantly associated with the number of hotels or sociodemographic indicators. In our case study, it appears such an unconditional positive relationship vanishes or even reverts if we condition out on the year and municipality fixed effects (Figure A2 in Supplementary Material). To inspect this in more detail, we repeated the regression in (1) without the municipality fixed effects. Since the temporal variability of these covariates is not very large (Table 2), one could suspect their non-significance was due to partially overlapping with the municipality fixed effects. The corresponding estimates are shown in Tables A6 and A7 in Supplementary Material. From this alternative specification, we detect that (i) the number of RVR establishments is now positively correlated with the number of hotels, and (ii) the supply of RVR seems to be positively associated with population size. However, the rest remain non-significant.[11] Auxiliary regressions using the supply of hotel establishments and rural houses per municipality as the dependent variable also indicate that accommodation supply seems to be unrelated to contemporaneous population size and the number of restaurants (Table A8 in Supplementary Material). Therefore, the non-significance for explaining the evolution of RVRs holds for other types of accommodations. This could reflect that accommodation supply does not react contemporaneously to changes in the market conditions but possibly with some lag.

[11] The exclusion of the municipality fixed effects might produce biased estimates because of omitted variable bias. Nonetheless, this check serves to rule out that the non-significance of the time-varying controls is not due to identification problems.

Interestingly, the number of hotels per municipality is negatively correlated with the number of bars & cafes, in line with the negative (although non-significant) sign documented for this variable in Tables 3 and 4.

5.2.Heterogeneous effects

In its canonical format, DiD is applied when there are two time periods and two groups. By contrast, our DiD setup has several pre and post-intervention periods. In principle, this does not represent any problem for inference here since we have a sharp design in which all units are treated at the same period. The parameter β_2 in (1) captures the time average treatment effect of the intervention. Nonetheless, the causal interpretation of the linear TWFE estimator strongly relies on the assumption that the ATT is homogeneous across municipalities and periods (de Chaisemartin, C. and D'Haultfoeuille, 2020). As shown in Figures 2 and 3, before the policy regulation there were important level differences in the degree of penetration of RVRs across municipalities. This suggests that the effect of the entry regulation could be heterogeneous across geographical units depending on their pre-intervention levels. Similarly, Figures 4 and 5 suggest that the impact of the entry regulation is increasing over time.

To explore heterogeneous effects, we first conduct quantile difference-in-differences (QDID) at 0.25, 0.5 and 0.75 quantiles. Since quantile regression is non-linear, the corresponding difference-in-differences estimand is understood here as a changes-in-changes in the spirit of Athey and Imbens (2006). This model formulation, although quite more complex, offers some advantages over the linear DiD method like allowing the distribution of unobservables to vary across municipalities in an unknown form. Intuitively, it assumes the outcome variable is nonlinear in an unobserved confounder, which is assumed to be time-invariant (although potentially different) for treated and control groups. A key aspect of the method developed by Athey and Imbens (2006) is that the counterfactual can be different from that of the standard linear DiD because of the non-linearities involved. Nonetheless, it offers a complementary view of the policy effect under alternative assumptions.

Tables 5 and 6 report the parameter estimates of the QDID estimand for each dependent variable. For simplicity, we only report the QDID estimand. In this case, standard errors have

been computed using 500 bootstrap replications.[12] We document an interesting finding: when considering the number of registered RVR establishments, the impact of the entry regulation is significantly greater in the tails of the distribution. That is, the easing of the bureaucratic procedures to register a RVR increased their supply to a greater extent in those municipalities with either high or low accommodation supply. By contrast, for the case of the number of bed places, the estimates indicate that the effect is U-shaped. That is, the regulation expanded RVR bed places relatively more in those municipalities around the mean of the distribution of RVR bed places. This likely reflects differences in the housing stock characteristics, with the number of bed places per RVR establishment varying notably across municipalities. Therefore, these findings highlight our distinction between establishments and bed places, since their evolution seem to be different.

TABLE 5 HERE

TABLE 6 HERE

Next, to inspect dynamics in the treatment effect, we first assume the policy change exerts a linear increasing effect on the number of RVR establishments and bed places registered over time, as done by Groen and Polivka (2008). We replace the binary $Post$ variable with a time trend variable starting at one in 2016 and the interaction between the treatment dummy and this trend ($Trend_t \; x \; RVR_i$). In this way, we examine the dynamics in RVRs supply growth following the regulatory change. Tables A9 and A10 in Supplementary Material report the estimation results. We document that the effect of the intervention is increasing over time: on average, RVRs establishments (bed places) increased by 2.13 (12) units per year since 2016. This finding indicates that the regulatory change did not just produce a *level* change in the accommodation supply but that it expanded registered RVR supply *increasingly over time* (at least during the four post-intervention periods considered).

5.3.Robustness checks

We have conducted some further robustness checks to our findings. First, we have replaced the year dummies with the general CPI and the CPI subindex for transportation. The coefficient estimates are shown in Tables A11 and A12 in Supplementary Material. We find that both the

[12] The models have been estimated in Stata 16 using alternative official and user-written modules: *regress*, *diff* (Villa, 2016), *cic* (Kranker, 2019) and *didq* (Mora and Reggio, 2015).

number of RVR establishments and bed places are positively correlated with the overall level of prices and the prices of transportation across different model specifications. The estimates for the rest of the variables remain consistent with the main analysis. Second, we re-estimated our DiD model after log-transforming the dependent variable, as done by Zhang and Zhang (2021) and Yeon et al. (2021a; 2021b). A classical discussion in the DiD literature is the sensitivity of the findings to the functional form of the model regression, since parallel trends in levels do not necessarily imply parallel trends in non-linear transformations like taking logs or probit models (Abadie and Cataneo, 2018; Kahn-Lang and Lang, 2020; Meyer, 1995). Indeed, the parallel trend assumption in log form only holds for the number of bed places but not for the number of establishments (Supplementary Material, Table A13). Therefore, we only estimate the DiD model in logs for the number of bed places. Table A14 in Supplementary Material reports the estimation results. According to Halvorsen and Palmquist (1980), the per cent increase in bed-places due to the policy change is given by $exp(\beta_2 - 1) \times 100 \approx 116$. This indicates that the passing of the 2016 Law increased RVRs bed places by about 116% as compared with that of tourist apartments.[13] The regression results using the inverse sine transformation (Burbidge et al., 1988) that is more robust to the influence of extreme values (instead of taking logs) offers similar results (Supplementary Material, Table A15).

Third, we have estimated the impact of the passing of the 2016 Law using a panel event study estimator.[14] We specifically specify a fully saturated model with two lags and three leads and control for municipality fixed effects and population size (in logs).[15] Figures 5 and 6 present the event study estimates for the case of the number of establishments and bed places, respectively. The regression output is shown in Table A16 in Supplementary Material. Consistent with the dynamic effects mentioned before, we see that both the number of establishments and bed places of RVR smoothly increased after the passing of the 2016 Law.

FIGURE 5 HERE

[13] Please note this figure is similar to what we would have obtained using a simple descriptive relative change from the data in Table 1 as follows: $\frac{(RVR_{t=1}-TA_{t=1})-(RVR_{t=0}-TA_{t=0})}{RVR_{t=0}} \times 100 = \frac{(54.45-73.28)-(23.40-68.64)}{23.40} \times 100 = 113.7$.

[14] This methodology is similar to DiD: it estimates the variation in outcomes around the adoption of a policy compared with a baseline reference period. Unlike DiD, it considers lags and leads of the policy change to estimate heterogeneous effects over time. Although similar to the interaction with a time trend discussed before, in this case the temporal effects are not assumed to be linear. We used *eventdd* module (Clarke and Tapia-Schythe, 2021) in Stata 16.

[15] The inclusion of other controls offers about the same results. Tourist apartments (who are never affected by the policy change) act as pure controls following the terminology adopted by Clarke and Tapia-Schythe (2021).

FIGURE 6 HERE

Finally, Figure A1 in Supplementary Material illustrates that there are some municipalities in the sample with notably high values of both the dependent and the independent variables. To inspect whether this asymmetry across municipalities could be affecting our findings, we re-estimated our DiD model excluding those observations whose values are three standard deviations above the sample means.[16] Leverage versus squared residual plots (Sall, 1990) also detect the same values as potential outliers. The results are shown in Tables A17 and A18 in Supplementary Material. The effect of the policy regulation is now smaller for both the number of RVRs establishments (3.2) and bed places (21.2). This is in line with the heterogeneity across the penetration of RVRs presented in Tables 5 and 6, implying that the impact of the regulatory regime is quantitatively of less magnitude among less developed municipalities.

6. CONCLUSIONS

This paper has studied how a change in the entry regulation to the tourist accommodation market affects its supply growth. Specifically, we have evaluated a policy change in 2016 in a Northern Spanish region by which the administrative procedures to register a short-term vacation rental were eased. Together with allowing for more flexibility concerning the specific terms and conditions of the renting between guests and the host, the need for an administrative licence was replaced by a responsibility statement. The intervention reduced administrative costs and therefore entry barriers.

Using tourist apartments as the control group, we have exploited a panel dataset of registered accommodation establishments and bed places for 78 municipalities during 2013-2019 in a difference-in-differences setup. The estimates from a two-way fixed effects estimator indicate the policy change is associated with a 5 unit (26 unit) increase in the number of vacation rental establishments (bed places) registered per municipality, on average. In the latter case, this represents about 116 per cent increase. These estimates are robust to the inclusion of control

[16] A total of 58 observations are excluded as a result for the number of RVRs establishments. This corresponds to the whole data for the municipalities of Oviedo, Gijón and Avilés and Cangas de Onís and 1 year for Ribadesella (2019). These are the most important municipalities in the region, concentrating around 50% of the population, 49% of tourism demand, 45% restaurants, 46% of bars & cafés, 49% of RVRs establishments and 44% of hotels in the region in 2019. Similarly, for the case of RVRs bed places, the municipalities of Oviedo, Gijón and Avilés are also excluded (42 observations).

variables like the population size, the number of restaurants, bars & cafes or hotels. Therefore, our results are not driven by confounding factors. Furthermore, we have examined potential heterogeneous effects using quantile difference-in-differences and dynamic treatment effects, both considering a linear trend and a panel event study estimator. The findings from these extensions indicate the policy change increased the number of vacation rentals to a greater extent in those municipalities with either a low or high penetration of this type of sharing accommodations. However, the change in bed places seems to be U-shaped. Importantly, the effect of the regulatory change is increasing over time. This could be explained by the intervention producing effects with some delay.

The results have relevant policy implications. The unregulated growth of residential vacation rentals is producing important distortions and negative externalities on local economies. Since this sort of tourist accommodations are based on peer-to-peer sharing and are usually sold in online marketplaces, their control imposes several challenges. A non-negligible share operates in the informal economy, so local authorities do not know exactly how many properties are rented or who are the owners. By reducing the administrative procedures needed to register a vacation rental, part of the detected increase in supply is likely to be due to some illegal hosts regularizing their properties and operating in the formal economy. This might happen because the economic costs of regularizing their vacation rentals become lower than the risks of being fined for operating illegally. Another share of the increase might well be the result of new hosts with unoccupied properties entering the RVR market due to lower entry barriers. As a result, the increase in the number of officially registered properties allows local authorities to (i) set bounds on the number of new establishments to open, (ii) identify stressed areas with a reduced supply of residential dwellings for long-term renting over whom take action, or (iii) collect taxes with which to compensate the negative effects of over-tourism and gentrification, among others. In this respect, RVRs pay 10% of VAT tax, which represents considerable revenues for public authorities.

The paper makes an important contribution to the literature on tourism accommodation markets and the sharing economy. Although some papers have discussed the necessity of regulating peer-to-peer accommodation properties following the Airbnb phenomenon, this is among the first empirical studies that evaluate how the supply of these accommodations is affected by a

change in the entry regulation to this market. Future studies should expand this work by analysing other destinations or different policy regulations.

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Table 1. Summary statistics of the number of accommodation establishments and bed places per municipality before and after the regulatory change

	Before regulation (2013-2015)				After regulation (2016-2019)				
Number of establishments	**Mean**	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**	**t-test**
Res. vacation rentals	4.08	14.52	0	135	9.21	26.95	0	271	-3.73***
Tourist apartments	3.60	6.79	0	51	3.73	7.76	0	64	-0.29
Hotels	7.27	12.41	0	67	7.06	12.32	0	67	0.28
Hostels	4.14	6.36	0	32	4.13	6.20	0	35	0.04
Campsites	0.67	1.41	0	8	0.68	1.40	0	8	-0.03
Rural accommodations	23.64	32.41	0	198	23.60	32.00	0	201	0.02
Total	43.43	65.41	1	487	53.60	91.37	1	786	-2.04**
Number of bed places									
Res. vacation rentals	23.40	84.46	0	778	54.45	162.18	0	1671	-3.77***
Tourist apartments	68.64	159.88	0	1310	73.28	180.35	0	1543	-0.44
Hotels	335.11	838.21	0	5512	328.48	828.73	0	5493	0.13
Hostels	84.54	137.31	0	901	89.15	143.17	0	941	-0.53
Campsites	332.75	910.85	0	7419	334.11	930.44	0	7423	-0.02
Rural accommodations	232.58	335.66	0	2268	237.30	342.00	0	2351	-0.22
Total	1077.05	2011.25	5	14720	1139.72	2179.43	5	16599	-0.48

Table 2. Summary statistics of the time-varying control variables

	Before regulation (2013-2015)				After regulation (2016-2019)				
Variables	**Mean**	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**	**t-test**
Population	13,594.1	40,550.6	159	275,735	13,232.7	39,992.3	132	273,422	0.147
Restaurants	35.10	82.57	0	521	33.10	75.01	0	478	0.418
Bars & Cafés	94.83	256.89	0	1,748	95.92	253.36	0	1,731	-0.07
CPI: General	100.23	0.37	99.8	100.7	101.77	1.190	100	103.0	-27.08***
CPI: Transportation	105.03	2.25	101.9	107.1	105.07	3.35	100	108.6	-0.23

Table 3. Estimation results from TWFE linear regression for the number of establishments.

	(1)	(2)	(3)	(4)	(5)
RVR	0.483	0.483	0.483	0.483	0.483
	(1.091)	(1.091)	(1.092)	(1.092)	(1.092)
Post x RVR	4.991***	4.991***	4.991***	4.991***	4.991***
	(1.325)	(1.325)	(1.326)	(1.326)	(1.326)
Ln population		35.360	31.799	35.233	37.346*
		(21.444)	(21.746)	(21.598)	(21.901)
Restaurants			-0.099*		
			(0.059)		
Bars & Cafes				-0.016	
				(0.051)	
Hotels					-1.860*
					(0.993)
Municipality fixed effects	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES
Constant	-1.798*	-267.943	-240.571	-266.868	-278.736*
	(0.949)	(162.198)	(164.575)	(163.508)	(164.544)
Number of municipalities	78	78	78	78	78
Number of years	7	7	7	7	7
Observations	1,092	1,092	1,092	1,092	1,092
R-squared	0.701	0.703	0.704	0.703	0.706

Clustered standard errors at the municipality level in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4. Estimation results from TWFE linear regression for the number of bed places.

	(1)	(2)	(3)	(4)	(5)
RVR	-45.244***	-45.244***	-45.244***	-45.244***	-45.244***
	(10.399)	(10.404)	(10.409)	(10.409)	(10.409)
Post x RVR	26.410***	26.410***	26.410***	26.410***	26.410***
	(7.122)	(7.125)	(7.129)	(7.129)	(7.129)
Ln population		268.382	239.512	266.069	249.328*
		(166.392)	(169.280)	(167.244)	(148.408)
Restaurants			-0.803**		
			(0.383)		
Bars & Cafes				-0.287	
				(0.394)	
Hotels					-0.326
					(0.237)
Municipality fixed effects	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES
Constant	12.066***	-2,007.965	-1,786.083	-1,988.339	-1,835.289*
	(3.163)	(1,252.124)	(1,274.809)	(1,259.535)	(1,100.916)
Number of municipalities	78	78	78	78	78
Number of years	7	7	7	7	7
Observations	1,092	1,092	1,092	1,092	1,092
R-squared	0.896	0.898	0.898	0.898	0.900

Clustered standard errors at the municipality level in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 5. Estimation results from quantile difference-in-differences for the number of establishments.

	Q=0.25	Q=0.50	Q=0.75
QDID	1.714**	0.857**	2.642***
	(0.602)	(0.372)	(0.511)
Number of municipalities	78	78	78
Number of years	7	7	7
Observations	1,092	1,092	1,092

Bootstrapped standard errors at the municipality level in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 6. Estimation results from quantile difference-in-differences for the number of bed places.

	Q=0.25	Q=0.50	Q=0.75
QDID	34.243***	41.243***	32.957***
	(5.803)	(5.403)	(6.537)
Number of municipalities	78	78	78
Number of years	7	7	7
Observations	1,092	1,092	1,092

Bootstrapped standard errors at the municipality level in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Figure 1. Asturias geographical position within Spain

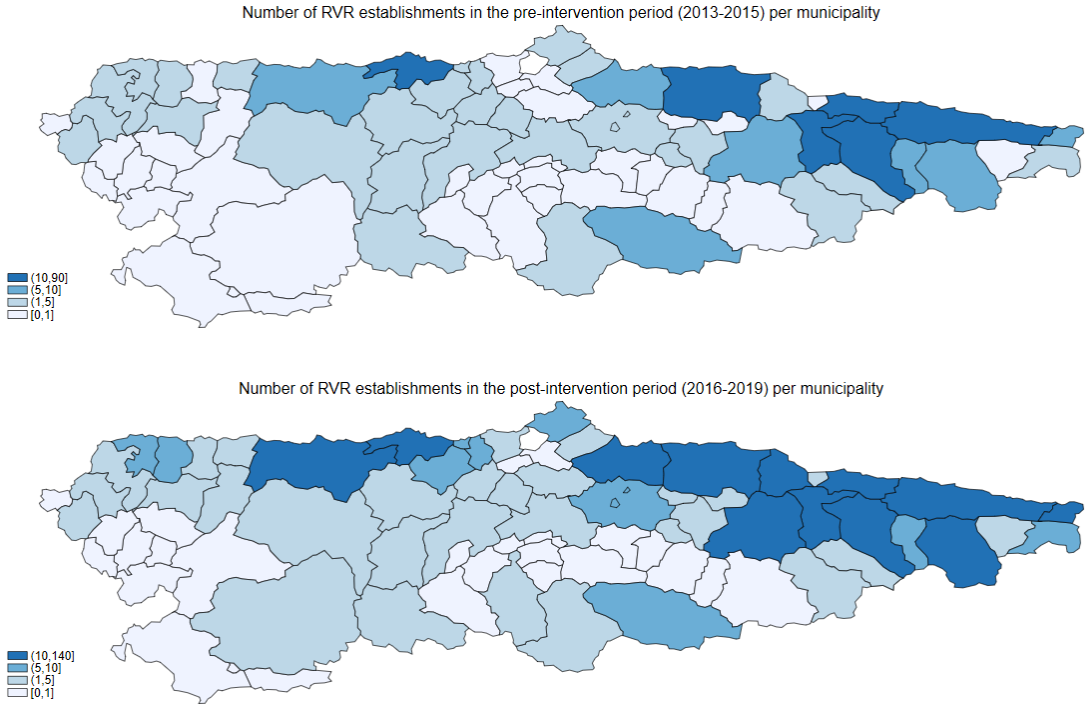

Figure 2. Average number of RVR establishments in the pre and post-intervention periods per municipality

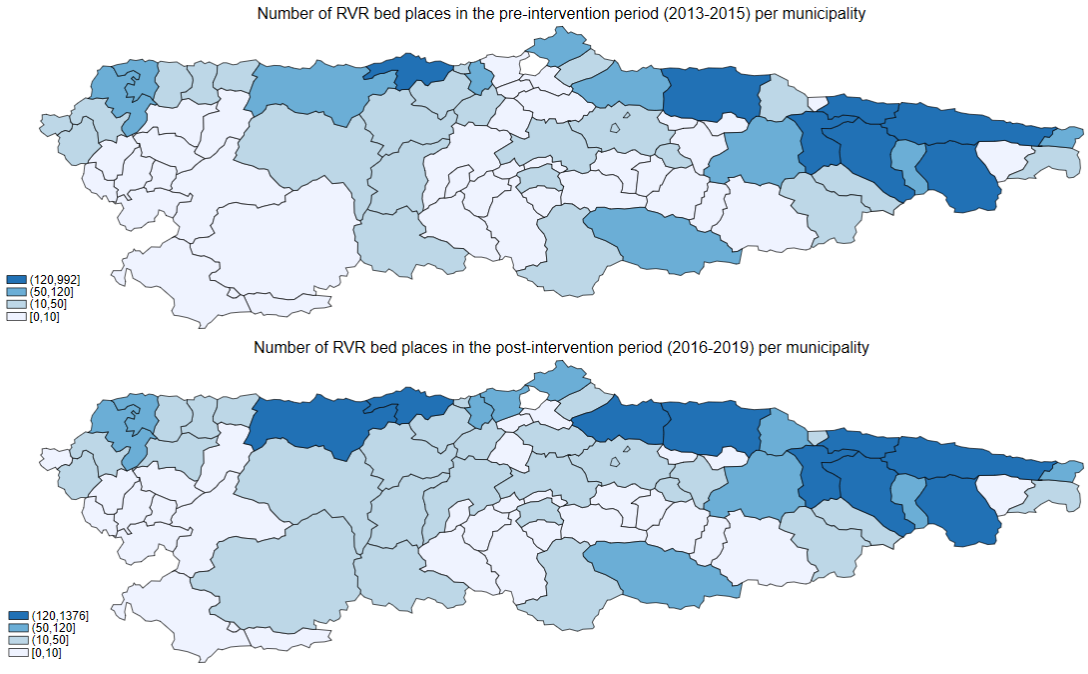

Figure 3. Average number of RVR bed places in the pre and post-intervention periods per municipality

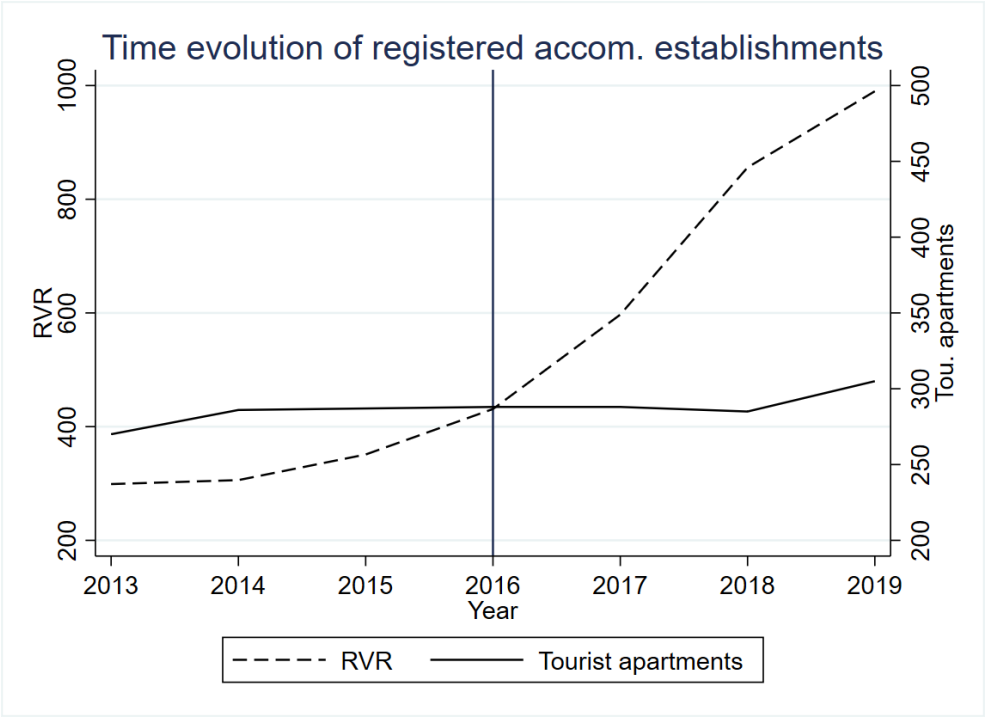

Figure 4. Time evolution of residential vacation rental and tourist apartments in Asturias (establishments) before and after the policy regulation in 2016

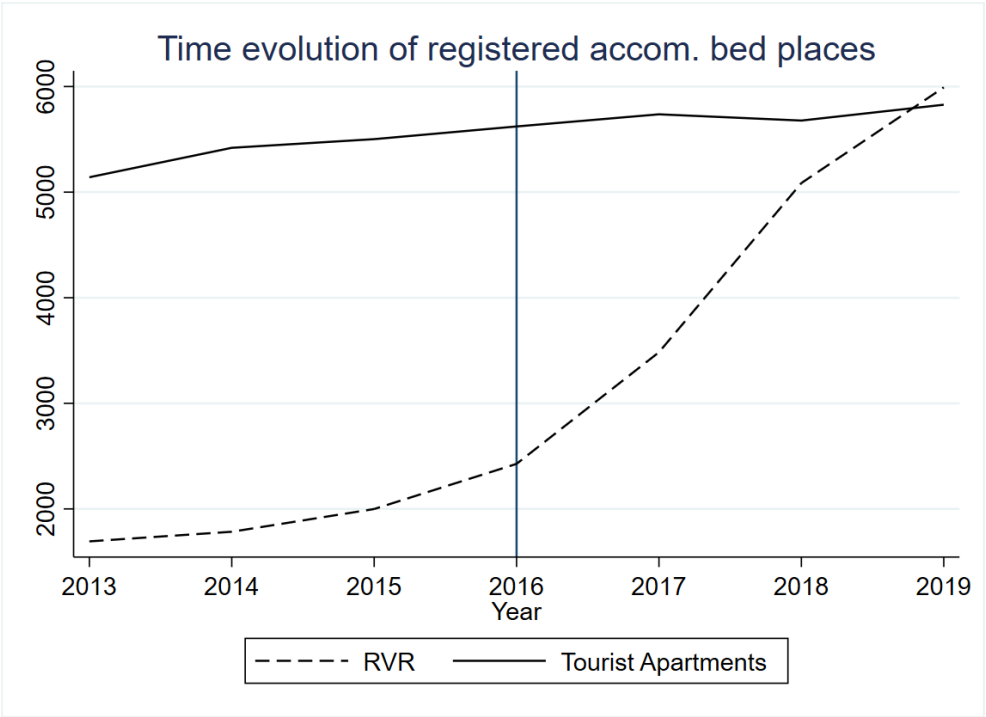

Figure 5. Time evolution of residential vacation rental and tourist apartments in Asturias (bed places) before and after the policy regulation in 2016

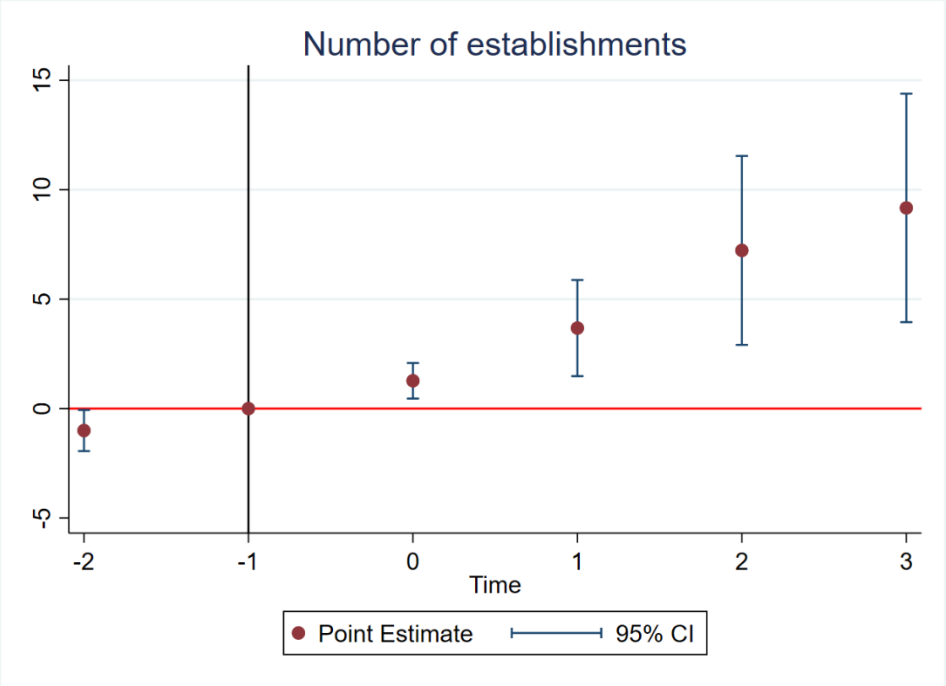

Figure 6. Event study estimates for the number of establishments

Note: The reference period for the comparison is -1 (one period before of the policy change), whose coefficient estimate is normalized to zero.

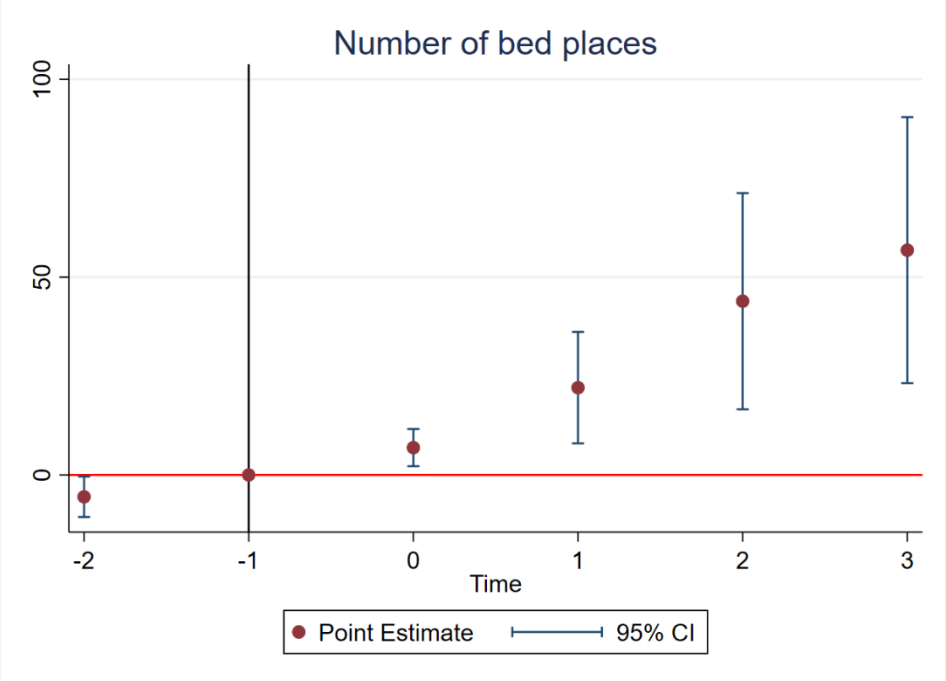

Figure 7. Event study estimates for the number of bed places

Note: The reference period for the comparison is -1 (one period before of the policy change), whose coefficient estimate is normalized to zero.