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SHORT-TERM RENTAL REVENUES AFTER THE LOCKDOWN: AN ADVANTAGE FOR NATURAL AREAS BUT ALWAYS IN DENSE RENTAL SPACES

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Short-term rental revenues after the lockdown : An advantage for natural areas but always in dense rental spaces

May 12, 2022

Lauriane Belloy[1]

Abstract

Has the Covid-19 crisis changed tourist destinations to greener places in France? Yes partly, at least by considering changes in revenue generated by short-term rentals on the AirBnB platform in the largest region of France (Nouvelle Aquitaine). To show this, I compare spatially the revenue generated by short-term rentals near different types of amenities between the summer months in 2019 (without a pandemic) and that same revenue after deconfinement in summer 2020.I find that the revenues of rentals near natural areas (public forests, rivers, lacke, etc) increase more strongly than those farther away after the lockdown (comparing the summer of 2020 with the summer of 2019). However among these locations, those with a high density of short-term rentals were the most favored. In addition, it was the locations near historical monuments that had a stronger lockdown months catch-up than those further away, unlike the locations near green spaces and the ocean. Another finding is that rentals located on the edge of rural areas did not generate significantly more income than those located next door in rural areas, unlike in previous years.

1 Introduction

During the first lockdown due to Covid-19, the question of how this crisis could change the world was open. According to the OECD, [2] with the Covid-19 crisis and the restrictions on international travel, municipalities close to cities that are usually very touristy but located in rural areas are promoting their cultural and historical sites.[3]In parallel during the pandemic, nature was taking back many highly touristic cities, such as the symbolic Venice, and the era of mass-tourism was questionned.[4] On May 23, 2020, the Airbnb Co-Founder and CEO Brian Cheskywe considered that "travel as we knew it is over" and spkoke about "a redistribution of where people travel" envisioning that people will prefer to "drive a couple hundred miles to a small community" instead of going to the classical tourist cities.[5] Moreover Airbnb has implemented marketing campaigns in order to promote rural towns, the company says in the New York Times that for the weekend of May 1, 2020 double its bookings compared to the same period in 2019 was located in areas away from tourist sites.[6]

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[2]https://www.oecd.org/coronavirus/policy-responses/les-actions-engagees-dans-le-domaine-du-tourisme-face-au-coronavirus-covid-19-86db4328/v

[3]Such as the Veneto region in Italy, which, as part of its recovery plan in the face of the Covid-19 crisis, has promoted its UNESCO heritage sites to attract tourists to places further away from Venice and thus reach a new category of tourists who want to find less crowded places.

[4]See for instance the Guardian https://www.theguardian.com/environment/2020/mar/20/nature-is-taking-back-venice-wildlife-returns-to-tourist-free-city

[5]https://www.dezeen.com/2020/06/23/travel-coronavirus-airbnb-co-founder-brian-chesky/

[6]https://www.nytimes.com/2020/09/24/travel/airbnb-pandemic.html

During the unlockdown between June and August 2020, TV news frequently reported on new isolated and green places where people went on vacation for the first time. However, at the same time, the same television news documented the dynamism of historical tourist areas. It is then hard to determine wheter the restrictions lifting has created a game-changing shift in the vacation choice of people or whether it was business as usual.

More precisely, the question asked here is : Has the lifting of many restrictions due to Covid-19-related health measures favored previously less income-generating short-term rentals, particularly rentals near natural and/or less dense amenities ?

According to Oxford's dictionary, an amenity « is a feature that makes a place pleasant, comfortable of easy to live in » which leaves room for many interpretations. For economists, there are two differents views of amenities. First, amenities are considered as a sub-class of externalities with non-market attributes (but with economic consequences) such as natural or environmental amenities linked to topographical features (coastline, mountains, rivers, landscapes) or historical amenities (monuments, parks, public infrastructures). The second type of amenities are endogeneous to the behavior of agents, for instance the diversity of restaurants is a positive amenity for tourists, but the number of tourists also influences this amenity. In this study I explicitly take into account the first kind of environmental and historic amenities, that are exogeneous to the agent choices. I am much more agnostic about the second type of amenities that are hard to measure, but I howeer take into account the density of Airbnb rentals since this density can capture a wide range of determinants of the attractiveness of certain places. Focusing specifically on amenities is crucial for governments to highlight assets that can attract tourists. In rural areas, highlighting these amenities can be a way to attract tourists and revitalize their communities. Conversely, in urban areas that are already highly touristic and affected by the phenomenon of short-term rentals that can generate nuisances, the scarcity of available housing for the local population and the increase in rental prices, this type of study can be useful to better understand the current dynamics of short-term rentals after the pandemic.

The aim of this study is to analyze the changes in revenue generated by short-term rentals between the summer of 2019 and the summer of 2020, the most touristic periods, but it is also the way to study both the impact of Covid-19 on short-term rental destinations and the « return to normal » i.e. the restrictions end due to the containment in June 2020 (lifting of restrictions and re-opening of bars and restaurants) in France.

The study area is the Nouvelle-Aquitaine region located in the southwest of France. The choice of this region has been done because it is the second region of France in number of overnight stays in 2019 according to INSEE (Institut National de la Statistique et des Études Économiques) and also because it has diversified natural amenities going from mountains (Pyrénées) toward a large coastline (extending over 723 km long which represents 20% of the total French coastline). This region is also home to many regional parks protecting nature as well as 535 000 hectares of public forests according to the ONF (Office National des Forêts), this region is also the first in France in terms of the number of listed monuments which represents an adequate study area to understand if the Covid-19 crisis has generated changes in tourists choice of destination. In addition, I have detailed short-term rental data from the AirDNA databases for the entire region. This data consists of monthly information on active short-term rentals such as revenue generated, location of the accommodation, number of reservations, number of days booked, characteristics of the accommodation.

Typically, the Airbnb-type participatory short-term accommodation sector is more specifically studied in metropolises and/or city centers where the activity may have negative externalities including on competition (the hotel industry) (Zervas et al., 2017), on housing prices (Horn and Merante, 2017; Koster et al., 2018; Barron et al., 2021; Garcia-Lopez et al., 2020) or on gentrification (Wachsmuth and Weisler, 2018; Jain et al., 2021). These studies are mainly concentrated in large cities or metropolises because

these rentals are concentrated in these locations and especially in city centers (Gutierrez et al., 2016) but few studies have been conducted on short-term rentals in non-urban areas, it can be however mention a study by Falk et al. (2019) that compares the price determinants of short-term rentals in Switzerland between rural and urban areas. Studying the entire Nouvelle-Aquitaine region allows us to provide an analysis of short-term rentals on a larger territory. Taking the whole of this region allows us to study a diversity of places such as a metropolis (Bordeaux), medium-sized cities (Limoges, Poitiers or Pau)[7], but also tourist cities on the coast (Biarritz, La Rochelle) as well as cities located in rural areas. Several natural types amenities are considered in our study including proximity of rentals to public forests and water bodies as well as proximity to the Atlantic Ocean. The results show that rentals close to forests and water bodies saw an increase in revenue after decontamination compared to rentals further away, however with a greater increase in locations with a high density of short-term rentals. In contrast, rentals near the ocean saw an overall decrease in revenue after the unlockdown compared to rentals further away except in the most rental-dense locations.

The historical amenities are also taken into account through the monuments registered and classified as historical monuments, which are often the amenities that attract tourists the most, but also make it possible to delimit the historical centers of the cities as well as the coastline type, i.e., rather urban, generally corresponding to the historical seaside cities of the nineteenth century (including the classified monuments of that epoch), as opposed to the « wilder » coastline, with more vegetation, which will make it possible to study whether there are any changes in terms of the type of tourism. Overall in the summer after deconfinement, rentals closest to these monuments saw a decrease in revenue compared to rentals farther away with, however, larger increases for rentals with the highest rental density. In addition, the rentals near the ocean and monuments have seen their revenues increase the most compared to those farther away, while rentals near the ocean and forests and water bodies have seen their revenues decrease compared to those farther away.

In order to identify the most « remarkable » amenities, I took into account the distance of the short-term rentals from the photographs published online in free access as a proxy for the most viewed sites but also to take into account the landscape that may be far from the rentals but represent a specific attraction for tourists. Analyzing the possible changes in income generated by short-term rentals according to their proximity to exogenous amenities can be an interesting element for public authorities to orient their regulation policies and monitoring of these rentals and tourism changes. Studying the impact of amenities on income changes in times of pandemic can be seen as a complement to studies on the influence of amenities on socio-economic elements indeed, the choice of location for these rentals is studied by analyzing endogenous amenities such as shops, especially bars and restaurants (Almagro and Dominguez-Lino, 2021) or, more globally, the socio-economic characteristics of the neighborhoods. The results indicate that the revenues of rentals closer to these " remarkable " locations have increased compared to those further away.

Quattrone et al. (2016) show that in the London city, short-term rentals are concentrated in neighborhoods where population diversity and youth are important as well as proximity to public transport, exogenous amenities such as natural elements (beaches, forests but also historical) are less taken into account for the location choice analysis and determinants of profits from short-term rentals. However, the role of these amenities has been studied in the case of household location choice, in particular Brueckner et al (1999), Carlino and Saiz (2008) reconcile the fact that the most popular tourist locations also attract more affluent residents. Lee and Lin (2017) also show that natural amenities anchor higher incomes over time in cities that harbor natural amenities most notably proximity to the ocean.

These different studies analyze the location choice of short-term rentals and/or the influence of ameni-

[7]In 2018 according to INSEE (Institut Nationale de la Statistique et des Etudes Economiques) Bordeaux had 257 068 inhabitants, Limoges 131 479 inhabitants, Poitiers 88 665 inhabitants and Pau 76 275 inhabitants

ties on the spatial sorting of individuals near these amenities. Studies on Covid-19 or pandemics more broadly have focused on the resilience of the tourism sector. Sharma et al. 2020 reviewed the various studies on resilience and listed different strategies adopted by businesses to cope with these pandemics. First the ability of adaptation of this sector due to its technology facilitating greater flexibility (Hall et al., 2020) such as online ordering applications to limit the number of people in stores or facilitate deliveries.Then the fast adoption of new norms such as the rules of social distancing (Assaf and Scuderi, 2020), then the role of public authorities in the survival of the tourism sector, especially when carrying capacity is reduced for health reasons (Tsionas, 2020) and finally th local linkages between different tourism enterprises i.e. mutual support before resumption of activities.(Sharma et al., 2020). Bae and Chang (2021) focus more specifically on tourist confidence and perceived risks of Covid-19 by building on a large literature since the 2000-2010s on tourists perceived risks in areas affected by epidemics such as avian influenza, SARS, or Ebola and their travel intentions (see also Lee et al. (2012) or Chew and Jahari, 2014) Zeng et al. (2005) also analyze the differentiating impact of the SARS in rural and urban China, and find a decrease in income for rural residents and difficulties in finding a job in the cities. The peer to peer sector has not been spared from this health crisis especially short term rentals and the impact of Covid-19 on this activity, Hu and Lee (2020) analyze the Airbnb rentals business loss through the bookings number during lockdown in 30 countries around the world and a focus on the London city. Private room cancellations were down 20% more than whole houses in London. Globally, with each doubling of Covid-19 cases, bookings decrease by 4.16%, a decrease that is smaller with distance to Wuhan City.

Indeed, with the pandemic, short-term accommodation consumers have been able to take into account the environmental and destination aspects in their travel choices in a more significant way than before the pandemic, such as limiting places with a high population density (Jang et al., 2021) or places that are usually very touristy, which increases the risk of contamination.

This paper contributes to complete this field of the literature by taking into account the effect of unlockdown on tourist revenues generated via short-term rentals and not on residents' revenues, while showing the importance of these different amenities.

This resident income anchoring could also apply to income generated by short-term rentals, however, with the pandemic and the activity loss in this rental type as well as changes in tourist behavior, the rentals that are usually the most frequented and revenue-generating, i.e., close to historical amenities and the most touristy natural amenities such as the ocean, may have generated less profit than rentals located in less frequented places, close to natural amenities such as forests, lakes or ponds. This income anchoring of residents living near historic monuments or natural amenities could therefore be studied to see if it can be applied to short-term rentals during the pandemic period. The model is estimated using the Poisson Pseudo-Maximum Likelihood (PPML) method to account for a large share of zeros representing rentals that are available for rent but have not generated income. I will first analyze the changes in income generated by short-term rentals between the summer of 2019 and the summer of 2020 by considering the distances of these rentals to various amenities as well as several density types, the density of rentals present during the summer of 2019, and the population density in each city. I will then focus on coastal cities and the income generated by short-term rentals according to the location type of the rentals, i.e., proximity to both the ocean and listed monuments and the ocean and forests and water bodies in order to distinguish two types of coastal destinations. I will then look at a complementary model that takes into account the April and May months, lockdown periods in France, in order to identify catch-up effects after unlockdown while keeping our distance-to-amenities variables. In section 2 I will present the data then the empirical strategy developed. In Section 3, I present our main results. Section 4 presents complementary analysis as a robustness check. Finally Section 5 concludes.

2 Data and Strategy of Identification

2.1 Data

The data on short-term rentals comes from the AirDNA listing, providers of data from Airbnb and Homeway. These data include monthly information for each short-term rental listing present in the Nouvelle-Aquitaine region of France for the June, July, and August months in 2019 and 2020, as well as the April and May months of those same years in the case of taking into account the two months of containment prior to the summer of 2020 and a counterfactual of those same months for 2019. The dependent variable is the monthly income generated for each accommodation available for rent at least one day in the month. Because some rentals have not generated any income during the month but were available for rent, the number of days available for rent is used as a control variable in our estimates. Each rental is geolocated, enabling to calculate the distances between the short-term rentals and the various amenities (Forest and water bodies, ocean, photographs and historical monuments). The distances between short-term rentals and the various amenities are calculated in different ways: for monuments it is the distance to the centroids, for water bodies and forests it is the distance to the edges, and for the ocean it is the land-sea distance.

The different natural exogenous features selected come from the BD Topo database of the IGN (Institut National de l'Information Géographique et Forestière) which contains vector objects in Shapefile format representing topographic elements of the French territory (in our case of the Nouvelle-Aquitaine region) such as hydrography, land use, regulated areas, transportation roads or buildings. The elements used to consider natural amenities that might attract tourists are public forests and water bodies on the one hand and the boundary between the land and the Atlantic Ocean on the other hand. Water bodies include, for example, marshes, ponds, lakes or lagoons. Public forests are forests open to all that are managed by public structures. These forests may be owned directly by the State and managed by the ONF (Office National des Forêts) or by local authorities such as municipalities, inter-municipalities, departments or regions. All public forests and water bodies represent 4 158 km^2 in the Nouvelle-Aquitaine region.

The historical monuments selected come from the « Atlas des patrimoines », a site of the Ministry of Culture providing vector elements in Shapefile format on the monuments listed or registered as French heritage. The historical monuments are monuments benefiting from a specific legal status aiming at protecting it because it constitutes « a historical, artistic, architectural, technical or scientific interest », these monuments can be churches, castles, manors, prehistoric or Gallo-Roman sites for example which represent attractive places for tourism. Two types of historical monuments protection have been taken into account, classified monuments, which represent the highest level of protection, and registered monuments which have a heritage and historical interest but which have a lower level of interest. Nouvelle-Aquitaine has 6 157 classified or registered monuments.

Finally, the photographs representing a proxy of the « remarkable » places come from the site FlickR, a photographs sharing site. The different photographs were web-scraped for each month and year used in our analyses in order to take into account cyclical elements such as festivals or seasonal natural elements for example. The recovered photographs are only those whose authors have authorized their public availability. In order to take into account the effects of density two indicators were chosen, one calculated with AirDNA data from the geolocation of the locations and one taking into account the municipal population density from the INSEE census data.

This last indicator is calculated by INSEE from a 1 km^2 grid which counts the inhabitants number within this grid. Different tiles groups are constituted and classified into three typologies, urban centers where more than 50 000 people live in this tiles group with more than 1 500 inhabitants per km^2, urban clusters that contain more than 5 000 inhabitants with more than 300 inhabitants per km^2 and finally in-

termediate rural meshes containing at least 300 inhabitants with more than 25 inhabitants per km². Then if the municipality is made up of more than 50% of inhabitants living in urban centers, this municipality will be classified as densely populated, if the municipality is made up of more than 50% of inhabitants living in an urban center or an urban cluster it will be classified as a municipality of intermediate density, the municipalities where more than half of the population lives outside of the constituted clusters will be classified as very sparsely populated, and the rest of the municipalities will be classified as sparsely populated. Dense and intermediate municipalities thus constitute urban municipalities and low-density and very low-density municipalities constitute rural municipalities. These categories of municipalities are calculated by INSEE through the 2017 population census.

Distribution of short-term rentals in summer 2019 and summer 2020 in Nouvelle-Aquitaine by population density

	Summer 2019	**Summer 2020**
Dense municipalities	20.88%	19.62%
Intermediate municipalities	29.39%	30.33%
Low density municipalities	41.96%	42.37%
Very low density municipalities	7.77%	7.67%

2.2 Empirical strategy

With respect to the amenity variables treatment, I hypothesize that the locations closest to the selected exogenous amenities will have larger impacts on income changes between the summer period prior to the health crisis and the same period during the pandemic. To account for the each amenity effect on the monthly income generated by each rental, the distances of the nearest amenities to each rental were calculated and then each amenity was transformed into a dummy taking the value 1 if the amenity is less than 2 km (Euclidean distance) from each rental and 0 if the amenity is more than 2 km away. The 2 km distance was chosen because the distributions between rentals more than 2 km and less than or within 2 km of each amenity constitute a rather balanced distribution for most of the amenities, in fact 42,88% of the rentals are within 2 km of forests or bodies of water, 67,85% of the rentals are within 2 km of classified or registered monuments, 41,01% of the rentals are within 2 km of the ocean and 24,16% of the rentals are within 2 km of a photograph. Moreover, for each amenity the differences in income per month between 2019 and 2020 are greater at short distances from them (see Appendix 1).

Each amenity is fixed in time except the distance to the nearest photographs which varies according to the month and the year. However, to avoid situations where distances could vary greatly and thus, for example, an observation could affect the transformation into a dummy, I chose to take the average of the distances, calculated by year and by month, of each location.

In order to account for « density » effects and identify whether the pandemic favored less dense locations a short-term rental density indicator have been construct, it represents the number of short-term rentals present in the summer of 2019 (i.e., in the June, July, and August months 2019) within 2 km of each rental in order to obtain an index, taking the rentals present in 2019 provides a view of the « density » of these accommodations in « normal » times without Covid-19.

An alternative of this indicator is the average number of rentals within 2 km of each rental present during summer 2019 by city. This indicator provides a broader and more extensive view than the number of rentals around each location. Keeping the number of rentals within 2km is also a way to take into account the neighborhood and therefore the potential competition, to include neighbors outside the geographical limits but also to capture the activity around each short-term rental as well as the degree of

tourist attractiveness of the area where the rental is located. This indicator is inspired by « experienced density » by De la Roca and Puga (2017) who use this kind of density calculation by taking the average of the number of individuals in a given radius in each city studied.

Concerning the municipal density, the municipalities considered as dense or intermediate by INSEE are equal to 1, the municipalities with low density or very low density are equal to 0.

Regarding the estimator choice, data contains a large number of zeros (14.38%) due to rentals that were available for rent but not rented during the month studied. Eliminating these zeros would be problematic since the aim of our study is to understand the changes in revenues generated by short-term rentals after the lifting of the Covid-19 restrictions in the summer of 2020 and these zeros are results that could indicate a decrease in activity.

However, this proportion of rentals that did not generate income can cause various estimation problems, particularly that of using the OLS model, which appears to be biased according to the work of Silva and Teneyro (2006). I therefore chose to estimate the model using the Poisson Pseudo-Maximum Likelihood (PPML) method. I consider only rentals that have been rented at least once during the periods studied in order to eliminate rentals that have never been rented and focus on increases or decreases in revenue.

The PPML model takes the following form :

$$\begin{aligned} Y_{i,t(m)} = exp[&\beta_0 + \beta_1(post_t \times amenity_i \times density_i^{2km}) + \beta_2(post_t \times amenity_i) \\ &+ \beta_3(post_t \times density_i^{2km}) + \beta_4 disp_{imt} + d_i + d_t + d_m] \times \varepsilon_{i,t,m} \end{aligned} \tag{1}$$

With $Y_{i,t(m)}$ the revenue generated by rental i in period t=2019,2020, $post_t$ representing the period variable equal to 1 for the summer 2020 period and 0 for the summer 2019 period, the variable $amenity_i$ corresponds to the different distances of each rental to forest and water bodies amenities, historical monuments, distance to the ocean, or photographs equal to 1 if these amenities are 2 km or less from each rental or 0 for rentals more than 2 km away. The variable $density_i$represents for each location the density of short-term rentals in 2019, i.e. the number of rentals present in the summer of 2019 within 2 km of each location, but it can also represent the average number of short-term rentals during the summer of 2019 around each available location in each municipality. This variable can also represent the population density per municipality taking the value 1 if the municipality is dense or intermediate and 0 if it is not dense or very dense. The variable $disp_{imt}$ represents the number of days available in the month, i.e. the number of days reserved plus the number of days available for rental but not rented. Finally the variables d are fixed effects, individual for d_i, period for dt i.e. summer 2019 or summer 2020 and taking into account the seasonal effects of months corresponding to d_m Finally $\varepsilon_{i,t,m}$ is the standard errors clustered at individual level to avoid serial correlation.

This model incorporates various interactions with the goal of studying monthly revenue changes in the summer of 2019, before the Covid-19 pandemic, and in the summer of 2020, after the pandemic, by comparing several geographic characteristics of short-term rentals :

- The triple interaction ($post_t \times amenity_i \times density_i^{2km}$) explains the difference in income in summer 2020 versus summer 2019 based on whether the rental is within 2km of exogenous amenities and the density of rentals within 2km of each amenity in 2019 (with one variant at the municipality and one alternative of population density in each municipality).
- The interaction ($post_t \times amenity_i$) explains the difference in income in summer 2019 during the pandemic between rentals closest to exogenous amenities and those farther away.

- The interaction ($post_t \times density_i^{2km}$) shows the difference in income in the summer of 2020 based on density (rental or population in 2019).

These interactions will allow to understand, for example, whether in the 2020 summer, rentals within or 2km of forests and water bodies had higher or lower revenues than rentals more than 2km from these amenities (interaction : ($post_t \times amenity_i$)), whether these changes between the closest and farthest rentals are greater or lesser for rentals with high density (interaction : ($post_t \times amenity_i \times density_i^{2km}$)), and whether these changes hold for all rentals with high density of rentals (interaction : ($post_t \times density_i^{2km}$)). The base model is the one presented just above with the number of short-term rentals present in summer 2019 within a 2km radius of each rental as the density variable.

3 Results

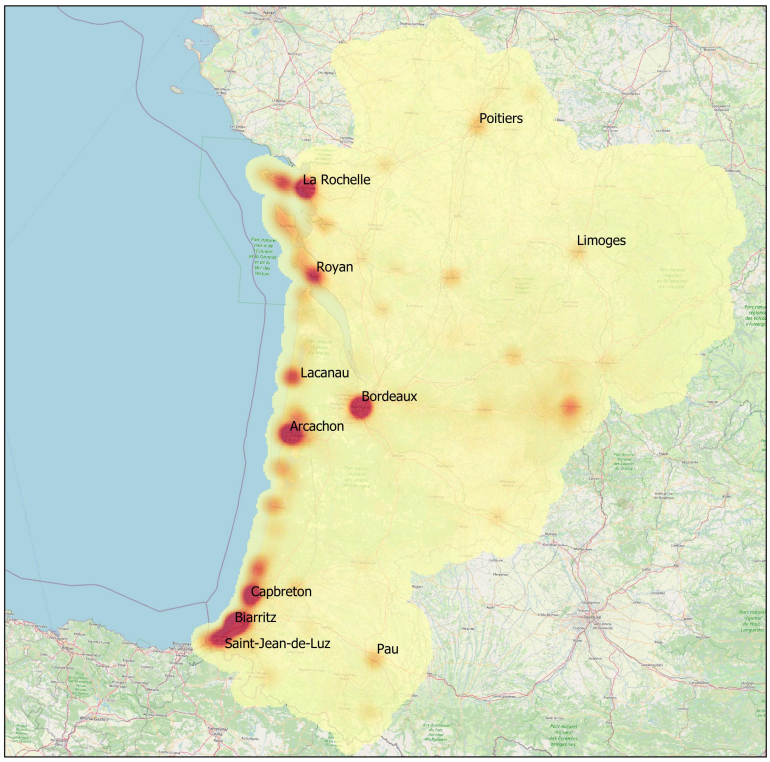
3.1 Descriptive

With the health crisis due to Covid-19, the lockdown measures and restrictions to limit the spread of this virus, many sectors of activity have been disrupted including the tourism sector with travel restrictions both nationally and internationally as well as the closure of bars and restaurants.

This health crisis has also affected short-term rentals both on the demand side between the summer 2019 period and the summer 2020 period (-13% of total days booked across the New Aquitaine region and -19% of total bookings) and on the supply side with a decrease in available rental units between these same periods (-9% across the Nouvelle-Aquitaine region). At the same time, the share of booking days for short-term rentals increased slightly between June, July and August 2019 and these same months in 2020 from 47,31% of bookings to 48,42%. However, these changes apply to all short-term rentals in the territory, without distinction or comparison according to the location of each rental. The decontamination could have influenced the tourists in their rental logics making them flee the densely populated spaces and thus find more open spaces on nature in order to limit the contacts.

Short-term rentals are mainly located on the coast and in major cities such as Bordeaux, Poitiers, Limoges and Pau. Between summer 2019 and summer 2020, revenues generated by short-term rentals decreased by 8,61% but with 8.66% fewer short-term rentals in summer 2020 than in summer 2019, the average revenues for the two types of rentals do not appear to be significantly different after the test of equality of means between the two summer periods going from an average of $2 108,89 per month in summer 2019 to an average of $2 111,63 per month in summer 2020. By comparing the average income per month generated by each short-term rental, I observe disparities between the three months taken into account. Indeed, in June, revenues were significantly lower in 2020 than in 2019, whereas in July and August, revenues were significantly higher in 2020 than in 2019, which implies that the last two months have been catching up. In the summer of 2019 rentals were rented on average 14,2 days per month compared to 13,4 days in the summer of 2020. For the full lockdown months i.e. April and May, there is a loss of revenue from an average of $976,96 per month in 2019 to an average of $476,7 per month in 2020. The number of short-term rentals in summer 2019 within 2km of each rental is relatively low with 25% of the rentals present in 2019 having less than 0,33 rentals within this radius, which may show some overall remoteness of rentals.

Short-term rentals density in Nouvelle-Aquitaine in 2020



0 50 100 150 km

Short-term rentals density within a radius of 10 km

5 5 000

Data : AirDNA - 2020
Creation : LB - 2021

	Descriptive statistics in 2019				
	Mean	**Min**	**Pctl(25)**	**Pctl(75)**	**Max**
Revenues ($)	2 108.89	0	400	2 590	132 604
Distance to the forest and water bodies	2 692.46	2 412	1 386.408	3 583.21	13 214.36
Distance to the ocean	36 487.34	0.014	590.71	70 674.72	264 614.4
Distance to the monuments	1 944.59	0	155.21	2 438.37	19 985.79
Distance to the photographs	7 294.36	0.081	927.09	10 572.97	72 544.22
Density	9.64	0.01	0.33	11.81	61.27
Number of reservations	3.42	0	1	5	29
Number of reservations days	14.2	0	4	23	31
Available days	25.49	1	22	31	31

	Descriptive statistics in 2020				
	Mean	**Min**	**Pctl(25)**	**Pctl(75)**	**Max**
Revenues ($)	2 111.63	0	326	2 647	87 451
Distance to the forest and water bodies	2 692.64	2 412	1 386.43	3 581.84	13 205.62
Distance to the ocean	36 793.27	0.014	578.09	71 594.46	264 670.7
Distance to the monuments	1 960.42	0	157.13	2 466.39	20 036.76
Distance to the photographs	8 130	0.79	1 038.07	11 543.09	61 358.69
Density	9.28	0	0.32	11.37	61.27
Number of reservations	3.04	0	1	4	31
Number of reservations days	13.45	0	3	23	31
Available days	24.55	1	19	31	31

3.2 Higher revenues for natural amenities in summer 2020 but with a larger increase for rentals in dense locations

Analyzing the results of the estimation of Equation (1), I find that the double interaction ($post_m \times amenity_i$) is statistically significant for each amenity . This indicates that compared to rentals more than 2km away from these different types of amenities, the closest rentals saw their revenues fluctuate significantly in summer 2020 compared to the same period in 2019. These effects, however, have differential impacts depending on the density of short-term rentals around each location in summer 2019, amplifying or diminishing the effects depending on the amenity studied. The assumption was that with the June 2020 unlockdown, "greener" tourist spots could have been prioritized as well as sparsely populated areas. The rentals within 2km of public forests and water bodies have seen a greater change in revenue than those further than 2km, with an average of 1,42% more revenue in the 2020 summer (Column 1). These facts may confirm the hypothesis of a preference for green spaces. However, if rentals close to these green spaces benefited more in terms of income in the summer after decontamination than those further away, this is particularly true for rentals where the density of short-term rentals was high in the summer before the pandemic. This can go in the direction of a search for proximity with nature but in places rather tourist. Regarding destinations 2km or less than 2km from the ocean, rentals close to the ocean saw their revenues be on average 2,57% lower than rentals more than 2km away in the 2020 summer (Column 2). However, these changes in income from locations near the ocean with a high density of rentals had additional income compared to locations with a lower density of rentals, while overall locations with a high density of rentals had lower changes in income than those with a low density

of rentals. Furthermore, the locations within 2km of the photographs do not appear to be statistically significant (Column 4). This can be explained by the already strong attraction capture for the set of photographs taken. But there is a difference between the locations where the density was high within a radius of 2km, it is especially the locations that were the least dense and therefore the least touristy that benefited from greater increases in income than the densest, on the other hand, taking the distances to the nearest photographs without averaging, rentals equal to or less than 2 km had higher revenues than rentals more than 2 km away. Regarding historic monuments, there was (Column 5) a 1,93% lower change in revenue for rentals within 2km of historic monuments compared to those more than 2km away in the summer of 2020 after unlockdown. I also note that there is no significant difference between dense and low-density rentals.

Finally, I performed the same analysis, but this time without taking into account the distance to the amenities, but taking into account the fact that the rental is located in a rural area, i.e. if the population density in the municipality of location is low or very low (equal to 0 if the rental is located in a dense or intermediate municipality in terms of population and 1 if the rental is located in a low or very low density town). In the summer after the relaxation of the barrier measures against Covid-19, rural municipalities did not experience a significant change in income compared to even the most dense urban municipalities in short-term rentals.

Concerning the population density by municipality, this time I find the same types of results for the distance to forests, the distance to the ocean and the distance to monuments, but the distance to photographs does not appear to be significantly different between the two summer periods. In summary, the summer after the relaxation of restrictions due to Covid-19 has rather favored rentals close to natural areas such as forests and bodies of water compared to rentals further away, conversely, rentals close to the Atlantic coast, have seen their income evolve less significantly than those further away. In contrast, rentals close to the monuments benefited less from unlockdown than those further away. Overall, rentals with a high density of short-term rentals generated less revenue than those located in less dense locations, which may indicate a certain avoidance of places that are too touristy, except in the case of rentals near natural areas. Tourists may have favored the rather "open" but fairly recognized and touristy places.

Models with density within a radius of 2km of each location

	(1)	(2)	(3)	(4)	(5)
	Forest	Ocean	Photographs	Monuments	Rural
Summer 2020 x amenity x density	0.00233***	0.00676***	-0.00109	0.000211	-0.000143
	(0.000353)	(0.000427)	(0.000728)	(0.000901)	(0.000870)
Summer 2020 x amenity	0.0142**	-0.0257***	0.0168**	-0.0193***	-0.00881
	(0.0043)	(0.000665)	(0.000699)	(0.000719)	(0.00675)
Summer 2020 x density	-0.00288***	-0.0064***	-0.000889	-0.0165*	-0.00177***
	(0.000252)	(0.000360)	(0.000692)	(0.000882)	(0.000214)
Distance to photographs x density			-000490		
			(0.00735)		
Distance to photographs			0.0359***		
			(0.00656)		
Constant	6.530***	6.537***	6.520***	6.538***	6.536***
	(0.00564)	(0.00561)	0.00725)	(0.00605)	(0.00584)
N	547717	547717	547717	547717	547717
Fixed Effects	Yes	Yes	Yes	Yes	Yes
Available days	Yes	Yes	Yes	Yes	Yes

Notes: PPML estimation, Standard errors are clustered at the individual level (*p<0.10, **p<0.05, ***p<0.01), data are monthly for the months of June, July, and August for the years 2019 and 2020, dependent variable is the monthly revenue generated for each active rental during the periods studied. Summer 2020 equals 1 if the rental is present in summer 2020, 0 otherwise; amenity equals 1 if the rental is equal to or less than 2km from the different amenities considered (Forest: The distance to forests and water bodies , Ocean: The distance to the Atlantic Ocean, Mean photographs: The average distance of each rental to the nearest photograph for each active period, Photographs : The actual distance to the nearest photograph, Monuments: The distance to classified or listed monuments, Rural: equal to 1 if the location is located in a rural commune, 0 otherwise, Density: The number of locations within a 2km radius in 2019). Distance to photographs is equal to 1 if the location is equal to 2km or less than 2km from the nearest photograph, distance changing according to the month and year the location is active unlike the other amenities.

On average, short term rentals close to the ocean have 16,75 short term rentals present in the 2019 summer compared to 4,39 for rentals more than 2km away, the coastal cities are historically very touristy places. In the previous model I identified a lower revenue evolution for rentals close to the ocean than for rentals further away in the 2020 summer compared to the 2019 summer and in parallel higher revenue evolutions for rentals close to forests and water bodies. Different coastal types towns exist, the more urban and historic ones, but other coastal towns are "wilder" and further away from the larger urban areas. To identify these differences I performed the same types of analyses, but instead of comparing income changes before and after the relaxation of health measures by distance to amenities and density, distance to amenities and distance to forests and water bodies or distance to historical monuments have been compared. This triple interaction enables to distinguish rentals close to the ocean in a rather urban and historical environment (notably with 19th century buildings or older monuments such as citadels) from rentals close to the ocean and rather natural spaces with forests and water bodies.

Models for rentals near the ocean

	(1) Ocean x Forest	(2) Ocean x Monuments
Summer 2020 x distance to ocean x distance to forest	-0.0308***	
	(0.0106)	
Summer 2020 x distance to ocean	0.0094	-0.0359***
	(0.00682)	(0.00926)
Summer 2020 x distance to forest	0.0463***	
	(0.00737)	
Summer 2020 x distance to ocean x distance to monument		0.0578***
		(0.0112)
Summer 2020 x distance to monuments		-0.0524***
		(0.00746)
Constant	6.518***	6.541***
	(0.00573)	(0.0604)
N	547717	547717
Fixed Effects	Yes	Yes
Available days	Yes	Yes

Notes: PPML estimation, Standard errors are clustered at the individual level (*p<0.10, **p<0.05, ***p<0.01), Data are monthly for the months of June, July, and August for the years 2019 and 2020, Dependent variable is the monthly revenue generated for each active rental during the periods studied. Summer 2020 is equal to 1 if the rental is present in summer 2020, 0 otherwise; Distance to ocean is equal to 1 if the rental is equal to 2km or less than 2km from the Atlantic Ocean, 0 otherwise; Distance to forest is equal to 1 if the rental is equal to 2km or less than 2km from forests and waterbodies, Distance to monuments is equal to 1 if the rental is equal to 2km or less than 2km from monuments listed or classified as historical monuments.

Results indicate that after the health restrictions were relaxed, rentals within 2km of the ocean and within 2km of forests or water bodies had significantly lower changes in income than those more than 2km from these areas. Conversely, rentals close to the coast and within 2 km of historic monuments have seen their revenues evolve more favorably than rentals more than 2 km from historic monuments. These results may indicate that rentals valued more for the urban setting and heritage dimension were favored more in the summer after unlockdown. On the other hand, in reality, the coastal rentals closest to natural amenities and constituting "wilder" places have had less favorable income trends than those further away, which may call into question the search for nature after the lockdown for coastal tourists.

3.3 A catch-up after unlockdown, less important for rentals closest to green spaces, the ocean and located in rural municipalities

A complementary model is also proposed to study catching up on the months of confinement after 2020. This time, it takes into account the April and May months corresponding to entire months of lockdown. In particular, this model is used to see the catch-ups after lockdown while taking into account the exogenous amenities studied in the previous model. In this model perspective have changed, instead of looking at the three summer months in 2019 and 2020 and comparing rentals within 2km or 2km of different exogenous amenities and those more than 2km away and then incorporating density, the pre-summer months of confinement in 2020 compared to 2019 were examined which allows us to see the trajectory of incomes during and after confinement between the two years, but also to see if these trajectories were greater or lesser depending on the distance to amenities.

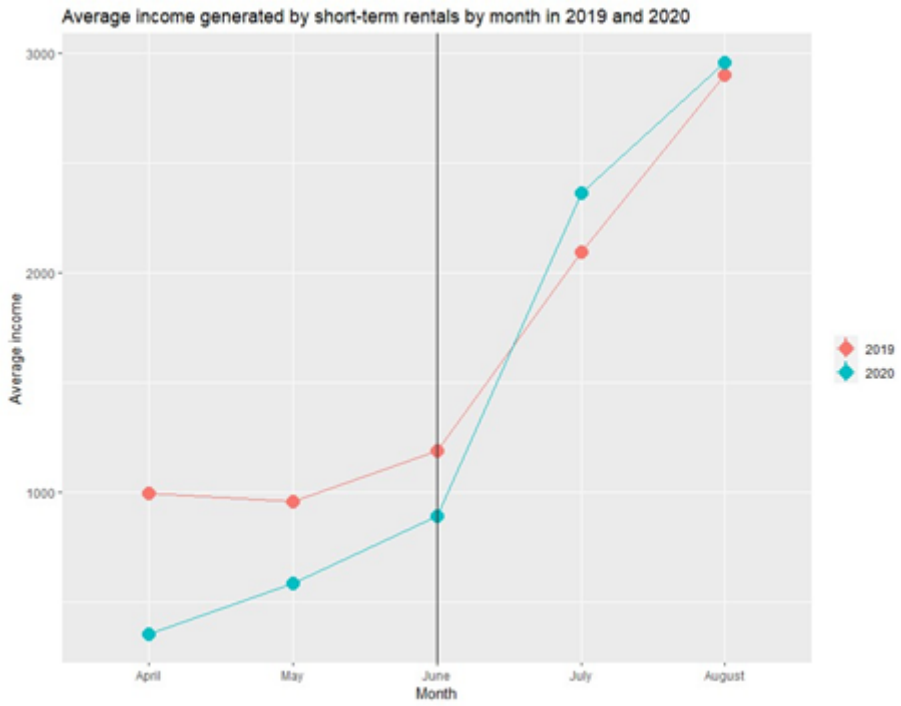
The advantage of this complementary model is that it takes the year (2019 or 2020) as the counterfactual unlike the previous model which takes distance to amenities as the comparison element, the time elements only serve as the pre and post period. Here is the form of the model :

$$Y_{i,t,m} = exp[\beta_0 + \beta_1(post_m \times years_t \times amenity_i) + \beta_2(post_m \times years_t) + \beta_3(post_m \times amenity_i) + \beta_4(years_t \times amenity_i) + \beta_5 disp_{im} + \beta_6 years_t + d_i + d_m] \times \varepsilon_{i,t,m} \quad (2)$$

In this second equation $post_m$ corresponds to the period after the lockdown i.e. equal to 1 for the June July and August months and 0 for the April and May months. $years_t$ equals to 1 if the year is 2020 and 0 if the year is 2019. The $amenity_i$ and $disp_{im}$ variables and the fixed effects remain the same as before.

This method is inspired by Haiqiang et al. (2020) who use a similar method to study consumption changes after lockdown in China. Since the pre-unlockdown deviations are " abnormal " because this is the lockdown period and thus limitations in travel, this model allows for the identification of catch-up effects of activity after June.

In case of non-significant results this would indicate that the trend after June in 2020 would be the same as in 2019 and thus the gap during containment did not narrow and thus there was no catch-up of activity. According to the chart below, after June, the 2020 average earnings catch up with and exceed the 2019 average earnings for July and August.



Observing the results of the different models according to the amenities taken into account in the previous models, it can be noted that after the month of June, the double interactions (post x years) are positive, ranging from a doubling of income in relation to the trend to an increase of more than 50% according to the inclusion of amenities in the triple interaction, which confirms the catching up and even the overtaking mentioned when describing the graph. Regarding amenities, those with less rapid

increases are rentals within 2km of forests and bodies of water, those within 2km of the ocean, and those located in rural communities compared to those located more than 2km away or in urban communities. Conversely, rentals close to photographs and historical monuments have seen a larger increase in revenue than the same rentals farther away compared to the 2019 trend.

Model with months

	(1) Forest	(2) Ocean	(3) Photographs	(4) Monuments	(5) Rural
Months after lockdown x years 2020 x amenity	-0.112***	-0.125***	0.171***	0.298***	-0.252***
	(0.0183)	(0.0180)	(0.0178)	(0.0191)	(0.0180)
Months after lockdown x years 2020	0.732***	0.743***	0.612***	0.482***	0.819***
	(0.0115)	(0.0119)	(0.0107)	(0.0158)	(0.0133)
Months after lockdown x amenity	0.0846***	0.171***	-0.241***	-0.205***	0.252**
	(0.00951)	(0.00920)	(0.00888)	(0.0107)	(0.00926)
Years 2020 x amenity	0.142***	0.116***	-0.189***	-0.326***	0.272***
	(0.0183)	(0.0181)	(0.0176)	(0.0192)	(0.0181)
Years 2020	-0.681***	-0.676***	-0.542***	-0.400***	-0.767***
	(0.0115)	(0.0120)	(0.0107)	(0.0158)	(0.0135)
Distance to phoographs			0.264***		
			(0.00863)		
Constant	6.450***	6.409***	6.455***	6.598***	6.369***
	(0.00679)	(0.00688)	(0.00625)	(0.00849)	(0.00725)
N	847130	847130	847130	847130	847130
Fixed Effects	Yes	Yes	Yes	Yes	Yes
Available days	Yes	Yes	Yes	Yes	Yes

Notes: PPML estimation, Standard errors are clustered at the individual level (*p<0.10, **p<0.05, ***p<0.01), Data are monthly for the months of April, May, June, July, and August for the years 2019 and 2020, Dependent variable is the monthly revenue generated for each active rental during the periods studied. Months after lockdown equals 1 if the rental is active in the months of June, July and August, 0 otherwise; Amenity equals 1 if the rental is equal to or less than 2km from the different amenities considered (Forest : The distance to forests and water bodies, Ocean: The distance to the Atlantic Ocean, Mean photographs : The average distance of each rental to the nearest photograph for each active period, Photographs: The effective distance to the nearest photograph, Monuments: The distance to classified or listed monuments, Rural: equals 1 if the location is in a rural municipalities, 0 otherwise, Years 2020: equals 1 if the location is active in 2020, 0 otherwise). Distance to photographs is equal to 1 if the location is equal to or less than 2km from the nearest photograph, distance changing according to the month and year the location is active unlike the other amenities.

3.4 No more differences in rental income between urban and rural areas

I will perform a third estimation to identify possible changes in the summer of 2020 regarding the revenues generated by short-term rentals on both sides of the cities considered as urban according to INSEE. The purpose of this is to see if in the summer of 2020, incomes differed depending on whether the rental was located in an urban municipality but relatively close to the "border" with municipalities classified as rural. To do this, a regression discontinuity design is used to consider only the rentals closest to the urban and rural community boundaries, if unlockdown has played a significant role the incomes within the urban communities should give significantly different results in the summer of 2020 compared to the same previous periods. The model takes the following form :

$$Y_{i,m} = exp[\beta_0 + \beta_1 disturb_i + \beta_2 urb_i + \beta_3(disturb_i \times urb_i) + \beta_5 disp_{im} + d_m] \times \varepsilon_{i,t,m} \quad (3)$$

With $Y_{i,m}$ the revenue generated by rental i in 2020 in month m, $disturb_i$ the distance of the rental from the urban/rural boundary, urbi equals 1 if the rental is located in an urban municipality and 0 if it is located in a rural municipality. As before $disp_{im}$ corresponds to the number of days available for rent in the month and finally dm corresponds to the fixed effects of the month. Data located in an urban municipality is positive while rentals located in rural municipalities are negative. The data used is based on a bandwidth of 1 100 m around the boundaries between urban and rural municipalities. This distance corresponds to the median distance to the boundary of rentals located in urban municipalities.

The fact that the rentals are located in a rural municipalities as defined by INSEE did not have a significantly different effect on the revenues generated between summer 2019 and summer 2020, however, the question of rentals on the outskirts of rural municipalities and rentals located in rural municipalities but close to municipalities classified as urban can be asked. 3.

The active rentals in summer located in rural and urban areas are distributed evenly across the studied territory with an increasing trend in the share of active rentals in rural areas as defined by INSEE going from 47,63% in 2018 to 50,04% in 2020, The purpose of this analysis is to verify whether the typology of municipalities favors income and whether this may have changed with the Covid-19 health crisis, so for the effects of renting one's dwelling in urban versus rural areas with a bandwidth of 1 100 m (median of the distance of rentals located in urban areas) between the territorial boundary.

In general this technique is used to identify whether an area that has undergone regulation changes agents' behaviors, in which case the results should be insignificant during the periods before the regulation was put in place and significant afterwards, in our case it is the opposite is the case. Indeed before the health crisis (in summer 2018 and summer 2019) rentals located at a distance of up to 1,100 m from the boundary between urban and rural areas had incomes on average 14,5% higher in summer 2019 and higher than 11,5% in summer 2018, against a non-significant result in summer 2020, which could be explained by the fact that renting at the boundary of urban areas and therefore potentially more dense in terms of population is no longer a discriminating element.

To consolidate the results, the same regressions at bandwidths 100 m further (1200 m) and 100 m closer (1000 m) were performed (see Appendix 2 Table 3), the results are similar, with significant results for the years 2019 and 2018 and not significant for the year 2020.

Spatial regression discontinuity design with a bandwidth of 1100 meters

	(1)	(2)	(3)
	2020	2019	2018
Urban municipality	0.0827	0.145***	0.115**
	(0.0550)	(0.0528)	(0.0568)
Distance to border	-0.000169**	-0.000216***	-0.0002017**
	(0.0000752)	(0.0000703)	(0.0000764)
Urban municipality x Distance to border	0.000104	0.000138*	0.000145*
	(0.0000791)	(0.0000746)	(0.0000806)
Constant	6.553***	6.268***	6.098***
	(0.0565)	(0.0537)	(0.0606)
N	75275	81267	77469
Fixed Effects	Yes	Yes	Yes
Available days	Yes	Yes	Yes

Notes: PPML estimation, Standard errors are clustered at the individual level (*p<0.10, **p<0.05, ***p<0.01), data are monthly for June, July, and August for the years 2020 for regression (1), 2019 for regression (2), and 2018 for regression (3). The dependent variable is the monthly revenue generated for each active rental during the periods studied. Urban Municipality is equal to 1 if the rental is located in an urban municipality and 0 otherwise, Distance to border is the distance to the border between urban and rural municipalities with data less than 0 if the rental is located in a rural area and positive if the rental is located in an urban area.

4 Robustness

In order to measure the robustness of the estimates I performed a series of tests. The tests take into account the main regression, i.e. the one with the number of short-term rentals within 2km of each rental. First, I ran the same regressions between summer 2018 and summer 2019 (see Appendix 3 table1), the two summers prior to the health crisis. The results are insignificant for the double interactions (summer 2019 x amenity) corresponding to the change in revenue for rentals near each amenity type relative to rentals further away in summer 2019 versus summer 2020. The results all appear non-significant regardless of the amenities considered in contrast to the baseline estimates between summer 2019 and summer 2020 which means that between summer 2018 and summer 2019 there was no different evolution between locations equal to or less than 2km and those more than 2km from the different amenities studied which may show a significant impact of unlockdown.

The triple interactions, on the other hand, are significant but with signs opposite to the signs observed in the estimates between summer 2019 and 2020, especially for distance to the ocean and distance to forests and bodies of water, which shows that, before the health crisis, the change in income was less important for rentals with a high density and closer to forests and bodies of water or to the ocean than for those with a lower density, which can be explained by the extent of short-term rentals in more rural areas, which are less dense with short-term rentals.

Concerning the regressions of the types of locations close to the ocean (see Appendix 3 table2 and table3), I can make the same findings, the results are not significant except for the distance to forests and bodies of water but significant at the 10% threshold with a negative sign contrary to the estimate between the summer of 2019 and the summer of 2020, which also goes in the direction of impacts specific to unlockdowns in June 2020.

On the side of the model considering April and May (see Appendix 3 table4), the results of the triple interactions are opposite with stronger revenue increases for rentals near forests and bodies of water or

the ocean starting in June and unlockdown in 2019 compared to 2018 and much lower coefficients than the results between 2018 and 2019.

I also made the same estimates by removing the 5% of the most dense locations (see Appendix 3 table5) and the 5% of the least dense locations (see Appendix 3 table6) in order to control for possible distortion effects. With the 5% of the locations removed, there is no change in the results except for the average of the photographs which appears significant at the 1% level, concerning the estimate for the 5% of the least dense locations the results are the same as the main estimate.

Regarding the differentiation of the locations close to the ocean according to their "natural" or "historical" characteristics, the results remain the same by removing the 5% of the locations with the highest densities (see Appendix 3 table7) with slightly lower results (see Appendix 3 table8) but with the same significance. In addition, by removing the 5% of the least dense locations, it can be seen that in the summer of 2020, the coefficient of the locations close to the ocean for the regression (1) is significant contrary to the estimation with all the locations but the results are consistent for the coefficients of the triple interactions which are the main results.

Finally, concerning the complementary model taking into account the months before unlockdown (see Appendix 3 table9), the results remain the same with very slight differences in the order of magnitude of the coefficients by removing the 5% of the most dense locations as well as the 5% of the least dense locations.

Conclusion

With the health crisis and various lockdowns, short-term rentals have seen a decrease in activity in summer 2020 compared to summer 2019 (on average a 9% decrease in revenue generated) but also a decrease in active rental supply between these 2 periods.

The purpose of my study was to analyze changes in revenue generated by short-term rentals in the Nouvelle-Aquitaine Region in the summer of 2020, the post unlockdown tourism period, compared to the summer of 2019, the pre-sanitary crisis period, by comparing host revenues based on their proximity to various natural, landscape, and population density amenities likely to attract tourists.

The results indicate that active rentals equal to or less than 2 km from natural amenities such as public forests and water bodies saw a greater increase in revenue than rentals more than 2 km away, as did rentals near outstanding landscape areas (i.e., near photographs). Conversely, rentals close to the Atlantic Ocean as well as rentals close to historical monuments have seen their revenues evolve less significantly than rentals more than 2 km from these amenities. On the other hand, the rentals with the highest density and located near forests and bodies of water or near the ocean saw their revenues increase more strongly than the rentals located near these same amenities but with a lower density of guests, while the revenues of the densest rentals independently of the distance to the amenities decreased. These results show a certain change of attractiveness for rentals close to nature but still towards the most touristic and dense places, the crisis of Covid-19 thus refocused the choices of the tourists towards the usually touristic places even if the rentals close to the more natural spaces were plebiscited. Similarly, when focusing on coastal rentals, rentals near the ocean and near historical monuments saw their revenues increase more strongly than those farther away, while those near the ocean and natural areas saw their revenues increase less strongly than those farther away. Also taking into account the months of lockdown prior to the summer unlockdown, the catch-up was less strong for rentals near natural areas, the ocean, and rentals located in rural municipalities. The strongest catch-up was for rentals near hisorical monuments, results opposite to the results between summer 2018 and summer 2019.

Finally, despite non-significant results for rentals located in rural municipalities between summer 2019

and summer 2020, I was able to identify that on the edge of urban areas at the rural boundary, incomes no longer appear significantly higher than rentals located at the urban boundary and located in urban areas unlike the previous two years where urban rentals had significantly higher incomes than those in rural areas near the territorial boundary.

This study was able to show shifts toward short-term rental tourism favoring rentals closer to natural areas and away from the most dense short-term rental locations after the health crisis while reaffirming areas where tourism activity was pre-Covid-19 active. Short-term rental tourism, despite changes in behavior, still favored places that were already dense before the crisis, which may be consistent with a certain anchoring of tourist locations despite the health crisis. Although rentals near natural areas have seen an increase in revenue compared to rentals farther away after unlockdown, the most popular locations remain the areas with the highest density of rentals and therefore the most touristy before the pandemic.

These results could be important elements for the public authorities, in particular the tourist offices to implement adapted tourist policies but also for the municipalities in order to prevent the development of rentals in places which are still not very dense but which have natural spaces for example.

It would be interesting for future research to look whether the preference for natural places will continue over time or whether it is a temporary trend after leaving confinement. Another opening would be to study in more detail the determinants of these preferences for green spaces but also for the persistence of the attractiveness of dense areas.

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Appendix 1

Figure 1 :

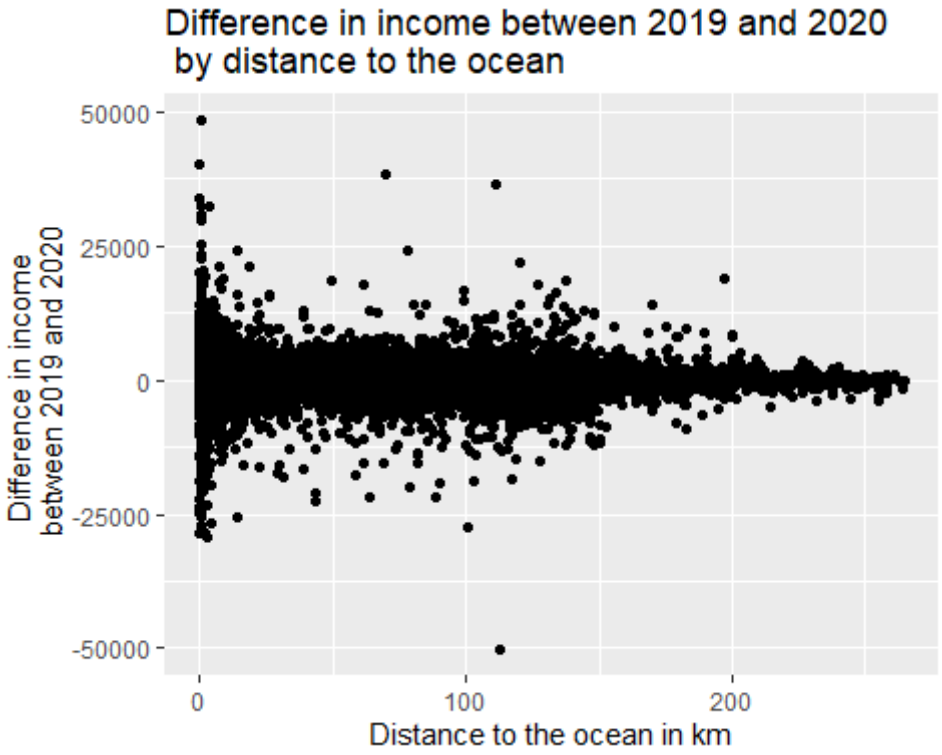


Figure 2 :

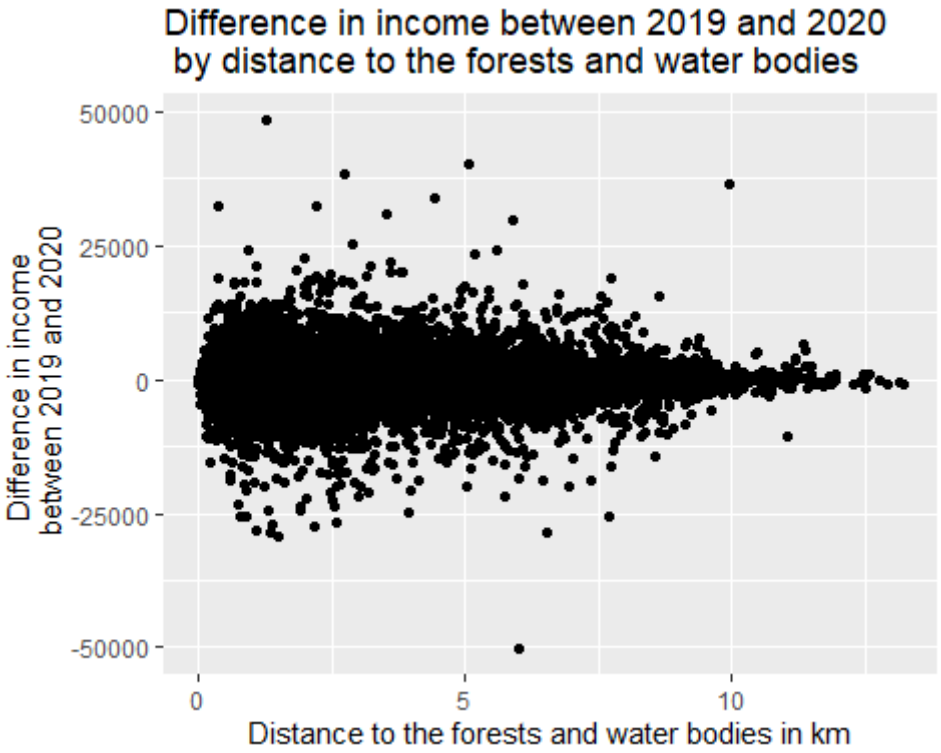

Difference in income between 2019 and 2020
by distance to the forests and water bodies
Difference in income
between 2019 and 2020
50000
25000
0
-25000
-50000
0
5
10
Distance to the forests and water bodies in km

Figure 3 :

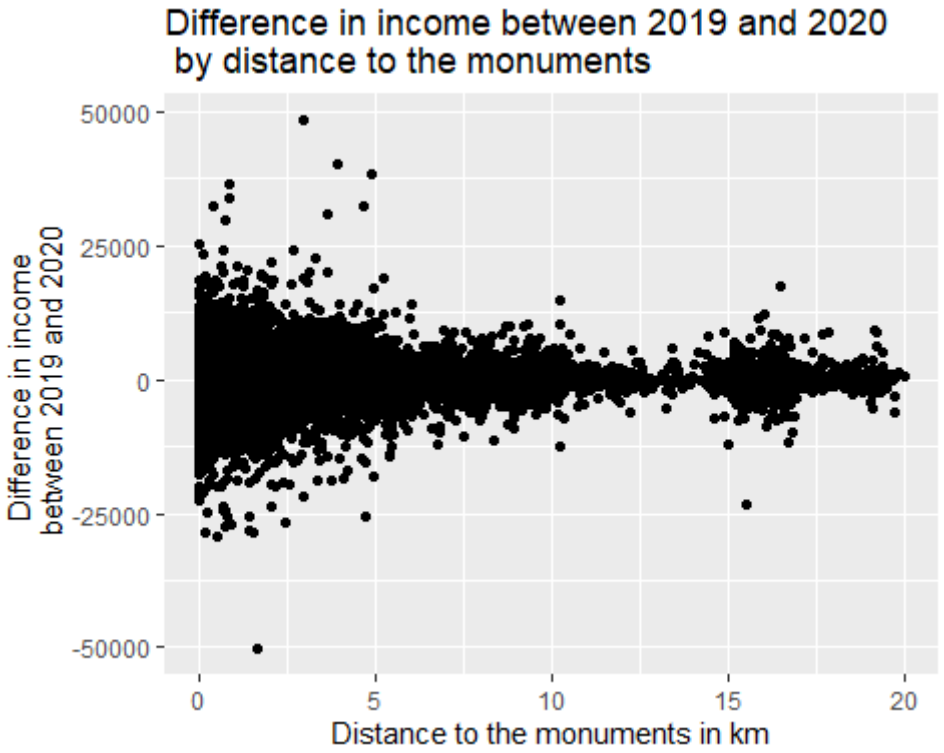
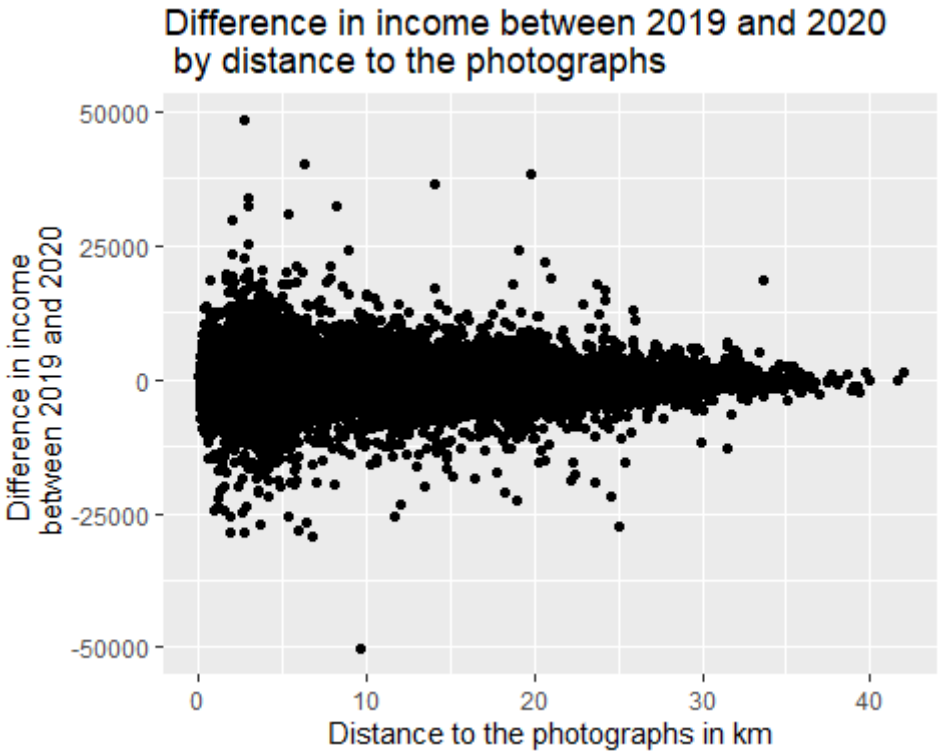


Figure 4 :


Difference in income between 2019 and 2020
by distance to the photographs
Difference in income
between 2019 and 2020
50000
25000
0
-25000
-50000
0
10
20
30
40
Distance to the photographs in km

Appendix 2

Table 1 :

Models with density per municipality within a radius of 2km of each location

	(1) Forest	(2) Ocean	(3) Photographs	(4) Monuments	(5) Rural
Summer 2020 x mean amenity x mean density by municipality	0.00251***	0.00558***	-0.00198***	-0.00119	0.000852
	(0.000383)	(0.000470)	(0.000616)	(0.000920)	(0.000977)
Summer 2020 x amenity	0.0136**	-0.0237***	0.0168**	-0.0151***	-0.00892
	(0.00658)	(0.000676)	(0.000706)	(0.000745)	(0.00698)
Summer 2020 x mean density by municipality	-0.00297***	-0.0055***	0.0000773	-0.0000972	-0.00160***
	(0.000280)	(0.000398)	(0.000561)	(0.000898)	(0.000235)
Distance to photographs x mean density by municipality			000429		
			(0.00658)		
Distance to photographs			0.0323***		
			(0.00655)		
Constant	6.530***	6.537***	6.513***	6.536***	6.535***
	(0.00566)	(0.00564)	0.00681)	(0.00614)	(0.00591)
N	547717	547717	547717	547717	547717
Fixed Effects	Yes	Yes	Yes	Yes	Yes
Available days	Yes	Yes	Yes	Yes	Yes

Notes: PPML estimation, Standard errors are clustered at the individual level (*p<0.10, **p<0.05, ***p<0.01), data are monthly for the months of June, July, and August for the years 2019 and 2020, dependent variable is the monthly revenue generated for each active rental during the periods studied. Summer 2020 is equal to 1 if the rental is present in summer 2020, 0 otherwise; amenity is equal to 1 if the rental is equal to or less than 2km from the different amenities considered (Forest: The distance to forests and water bodies, Ocean: The distance to the Atlantic Ocean, Mean photographs: The average distance of each rental to the nearest photograph for each active period, Photographs: The actual distance to the nearest photograph, Monuments: The distance to classified or listed monuments, Rural: equal to 1 if the location is located in a rural municipalities, 0 otherwise, Mean density by municipality: The average number of locations within a 2km radius in 2019). Distance to photographs is equal to 1 if the location is equal or less than 2km from the nearest photograph, distance changing according to the month and year the location is active unlike other amenities.

Table 2 :

Models with population density within a radius of 2km of each location

	(1)	(2)	(3)	(4)
	Forest	Ocean	Photographs	Monuments
Summer 2020 x amenity x population density	0.00279***	0.0749***	-0.0489***	-0.0322***
	(0.0105)	(0.0112)	(0.0120)	(0.0121)
Summer 2020 x amenity	0.0186**	-0.0282***	0.0163*	-0.0153***
	(0.00743)	(0.00802)	(0.00915)	(0.00737)
Summer 2020 x population density	-0.0298***	-0.0564***	0.00639	0.0134
	(0.00675)	(0.00765)	(0.00758)	(0.0103)
Distance to photographs x population density			0.0349***	
			(0.00962)	
Distance to photographs			0.0217***	
			(0.00707)	
Constant	6.526***	6.534***	6.509***	6.534***
	(0.00576)	(0.00569)	0.00600)	(0.00596)
N	547717	547717	547717	547717
Fixed Effects	Yes	Yes	Yes	Yes
Available days	Yes	Yes	Yes	Yes

Notes: PPML estimation, Standard errors are clustered at the individual level (*p<0.10, **p<0.05, ***p<0.01), data are monthly for the months of June, July, and August for the years 2019 and 2020, dependent variable is the monthly revenue generated for each active rental during the periods studied. Summer 2020 is equal to 1 if the rental is present in summer 2020, 0 otherwise; amenity is equal to 1 if the rental is equal to or less than 2km from the different amenities considered (Forest: The distance to forests and water bodies, Ocean: The distance to the Atlantic Ocean, Mean photographs: The average distance of each rental to the nearest photograph for each active period, Photographs: The actual distance to the nearest photograph, Monuments: The distance to classified or listed monuments, Rural: equal to 1 if the location is in a rural municipalities, 0 otherwise, Population density: equal to 1 if the location is in an urban municipalities, 0 otherwise). Distance to photographs is equal to 1 if the location is equal or less than 2km from the nearest photograph, distance changing according to the month and year the location is active unlike the other amenities

Table 3 :

Spatial regression discontinuity design with a bandwidth of 1000 and 1200 meters

	(1) 2020 1000m	(2) 2020 1200m	(3) 2019 1000m	(4) 2019 1200m	(5) 2018 1000m	(6) 2018 1200m
Urban municipality	0.0668	0.0553	0.127**	0.138***	0.103*	0.103*
	(0.0580)	(0.0505)	(0.0561)	(0.0494)	(0.0603)	(0.0530)
Distance to border	-0.000128	-0.0000845	-0.000182**	-0.000175***	-0.000181**	-0.000178***
	(0.0000875)	(0.0000613)	(0.0000839)	(0.0000592)	(0.0000908)	(0.0000641)
Urban municipality x Distance to border	0.0000636	-0.00000434	0.000121	0.0000682	0.000104	0.0000949
	(0.0000919)	(0.0000651)	(0.0000886)	(0.0000630)	(0.0000953)	(0.0000681)
Constant	6.568***	6.592***	6.282***	6.292***	6.121***	6.127***
	(0.0594)	(0.0518)	(0.0567)	(0.0502)	(0.0641)	(0.0566)
N	71011	79470	76599	85879	73000	81677
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Available days	Yes	Yes	Yes	Yes	Yes	Yes

Notes: PPML estimation, Standard errors are clustered at the individual level (*p<0.10, **p<0.05, ***p<0.01), data are monthly for June, July, and August for the years 2020 for regression (1), 2019 for regression (2), and 2018 for regression (3). The dependent variable is the monthly revenue generated for each active rental during the periods studied. Urban Municipality is equal to 1 if the rental is located in an urban municipality and 0 otherwise, Distance to border is the distance to the border between urban and rural municipalities with data less than 0 if the rental is located in a rural area and positive if the rental is located in an urban area.

Appendix 3 :

Table 1 :

Models with density within a radius of 2km of each location (summer 2018 and summer 2019)

	(1)	(2)	(3)	(4)	(5)
	Forest	Ocean	Photographs	Monuments	Rural
Summer 2019 x amenity x density	-0.00166***	-0.00257***	0.00176*	0.00645***	-0.00465***
	(0.000449)	(0.000448)	(0.000957)	(0.00138)	(0.00133)
Summer 2019 x amenity	0.00131	0.00773	-0.0122	-0.0120	0.00767
	(0.00782)	(0.00818)	(0.00899)	(0.00863)	(0.00804)
Summer 2019 x density	0.00104***	0.00179***	-0.00120	-0.00591***	0.000551**
	(0.000260)	(0.000270)	(0.000914)	(0.00136)	(0.000252)
Distance to photographs x density			0.00232***		
			(0.000635)		
Distance to photographs			0.00693		
			(0.00835)		
Constant	6.414***	6.414***	6.400***	6.421***	6.414***
	(0.00670)	(0.00673)	0.00732)	(0.00727)	(0.00699)
N	552916	552916	552916	552916	552916
Fixed Effects	Yes	Yes	Yes	Yes	Yes
Available days	Yes	Yes	Yes	Yes	Yes

Notes: PPML estimation, Standard errors are clustered at the individual level (*p<0.10, **p<0.05, ***p<0.01), data are monthly for the months of June, July, and August for the years 2018 and 2019, dependent variable is the monthly revenue generated for each active rental during the periods studied. Summer 2019 equals 1 if the rental is present in summer 2019, 0 otherwise; amenity equals 1 if the rental is equal to or less than 2km from the different amenities considered (Forest: The distance to forests and water bodies, Ocean: The distance to the Atlantic Ocean, Mean photographs: The average distance of each rental to the closest photograph for each active period, Photographs: The actual distance to the closest photograph, Monuments: The distance to classified or listed monuments, Rural: equal to 1 if the location is in a rural municipalities, 0 otherwise, Density: The number of locations within a 2km radius in 2018). Distance to photographs is equal to 1 if the location is equal to 2km or less than 2km from the nearest photograph, distance changing according to the month and year the location is active unlike the other amenities.

Table 2 :

Models for rentals near the ocean (summer 2018 and summer 2019)

	(1)	(2)
	Ocean x Forest	Ocean x Monuments
Summer 2019 x distance to ocean x distance to forest	0.0130	
	(0.0130)	
Summer 2019 x distance to ocean	-0.0131	-0.00917
	(0.00833)	(0.0123)
Summer 2019 x distance to forest	-0.0172*	
	(0.00910)	
Summer 2019 x distance to ocean x distance to monuments		-0.00115
		(0.0144)
Summer 2019 x distance to monuments		0.0126
		(0.00902)
Constant	6.421***	6.414***
	(0.00690)	(0.00732)
N	552916	552916
Fixed Effects	Yes	Yes
Available days	Yes	Yes

Notes: PPML estimation, Standard errors are clustered at the individual level (*p<0.10, **p<0.05, ***p<0.01), Data are monthly for the months of June, July, and August for the years 2018 and 2019, Dependent variable is the monthly revenue generated for each active rental during the periods studied. Summer 2019 is equal to 1 if the rental is present in summer 2019, 0 otherwise; Distance to ocean is equal to 1 if the rental is equal to 2km or less than 2km from the Atlantic Ocean, 0 otherwise; Distance to forest is equal to 1 if the rental is equal to 2km or less than 2km from forests and bodies of water, Distance to monuments is equal to 1 if the rental is equal to 2km or less than 2km from monuments listed or classified as historical monuments.

Table 3 :

Model with months (summer 2018 and summer 2019)

	(1) Forest	(2) Ocean	(3) Photographs	(4) Monuments	(5) Rural
Months after lockdown x years 2019 x amenity	0.0227*	0.0868***	0.00176	-0.0473***	0.00648
	(0.0133)	(0.0130)	(0.0130)	(0.0146)	(0.0127)
Months after lockdown x years 2019	0.0463***	0.0187**	0.844***	0.0882***	0.0509***
	(0.00786)	(0.00781)	(0.00825)	(0.0126)	(0.00851)
Months after lockdown x amenity	0.0599***	0.0967***	-0.242***	-0.166***	0.245***
	(0.0115)	(0.0112)	(0.0109)	(0.0125)	(0.0109)
Years 2019 x amenity	-0.0372***	-0.0974***	0.0283**	0.0648***	-0.0195
	(0.0134)	(0.0131)	(0.0125)	(0.0151)	(0.0129)
Years 2019	-0.00911	0.0182**	-0.0576***	-0.0694***	-0.0137
	(0.00807)	(0.00806)	(0.00840)	(0.0133)	(0.00864)
Distance to phoographs			0.195***		
			(0.0104)		
Constant	6.250***	6.230***	6.266***	6.359***	6.167***
	(0.00776)	(0.00787)	(0.00741)	(0.00963)	(0.00877)
N	853723	853723	853723	853723	853723
Fixed Effects	Yes	Yes	Yes	Yes	Yes
Available days	Yes	Yes	Yes	Yes	Yes

Notes: PPML estimation, Standard errors are clustered at the individual level (*p<0.10, **p<0.05, ***p<0.01), Data are monthly for the months of April, May, June, July, and August for the years 2018 and 2019, Dependent variable is the monthly revenue generated for each active rental during the periods studied. Months after lockdown equals 1 if the rental is active in the months of June, July and August, 0 otherwise; Amenity equals 1 if the rental is equal to or less than 2km from the different amenities considered (Forest: The distance to forests and water bodies, Ocean: The distance to the Atlantic Ocean, Mean photographs: The average distance of each rental to the nearest photograph for each active period, Photographs: The effective distance to the nearest photograph, Monuments: The distance to classified or listed monuments, Rural: equals 1 if the rental is located in a rural municipalities, 0 otherwise, Years 2019: equals 1 if the rental is active in 2019, 0 otherwise). Distance to photographs is equal to 1 if the location is equal to or less than 2km from the nearest photograph, distance changing according to the month and year the location is active unlike the other amenities.

Table 4 :

Models with density within a radius of 2km of each location (With the top 5% of locations removed)

	(1)	(2)	(3)	(4)	(5)
	Forest	Ocean	Photographs	Monuments	Rural
Summer 2020 x amenity x density	0.00115**	0.00666***	-0.00137*	0.000375	-0.000151
	(0.000335)	(0.000660)	(0.000769)	(0.000927)	(0.000908)
Summer 2020 x amenity	0.0201***	-0.0279***	0.0196***	-0.0197***	-0.00969
	(0.00679)	(0.00728)	(0.00751)	(0.000731)	(0.00720)
Summer 2020 x density	-0.00224***	-0.00624***	-0.000810	-0.0165*	-0.00177***
	(0.000378)	(0.000549)	(0.000691)	(0.000882)	(0.000336)
Distance to photographs x density			-0.00331		
			(0.000729)		
Distance to photographs			0.0333***		
			(0.00665)		
Constant	6.532***	6.540***	6.522***	6.541***	6.539***
	(0.00583)	(0.00578)	0.00647)	(0.00619)	(0.00609)
N	520328	520328	520328	520328	520328
Fixed Effects	Yes	Yes	Yes	Yes	Yes
Available days	Yes	Yes	Yes	Yes	Yes

Notes: PPML estimation, Standard errors are clustered at the individual level (*p<0.10, **p<0.05, ***p<0.01), data are monthly for the months of June, July, and August for the years 2019 and 2020, dependent variable is the monthly revenue generated for each active rental during the periods studied. Summer 2020 equals 1 if the rental is present in summer 2020, 0 otherwise; amenity equals 1 if the rental is equal to or less than 2km from the different amenities considered (Forest: The distance to forests and water bodies, Ocean: The distance to the Atlantic Ocean, Mean photographs: The average distance of each rental to the nearest photograph for each active period, Photographs: The actual distance to the nearest photograph, Monuments: The distance to classified or listed monuments, Rural: equal to 1 if the location is located in a rural municipalities, 0 otherwise, Density: The number of locations within a 2km radius in 2019). Distance to photographs is equal to 1 if the location is equal to 2km or less than 2km from the nearest photograph, distance changing according to the month and year the location is active unlike the other amenities

Table 5 :

Models with density within a radius of 2km of each location (With the least dense 5% of locations removed)

	(1)	(2)	(3)	(4)	(5)
	Forest	Ocean	Photographs	Monuments	Rural
Summer 2020 x amenity x density	0.00219***	0.00661***	-0.00154**	-0.000293	0.000463
	(0.000358)	(0.000430)	(0.000738)	(0.000919)	(0.000883)
Summer 2020 x amenity	0.0181***	-0.0214***	0.0219***	-0.0154**	-0.0148**
	(0.00670)	(0.00678)	(0.00713)	(0.000754)	(0.00693)
Summer 2020 x density	-0.00273***	-0.00650***	-0.000428	-0.00108	-0.00178***
	(0.000254)	(0.000362)	(0.000703)	(0.000900)	(0.000215)
Distance to photographs x density			-0.000306		
			(0.000740)		
Distance to photographs			0.0335***		
			(0.00662)		
Constant	6.539***	6.546***	6.527***	6.546***	6.546***
	(0.00580)	(0.00578)	0.00754)	(0.00626)	(0.00597)
N	517441	517441	517441	517441	517441
Fixed Effects	Yes	Yes	Yes	Yes	Yes
Available days	Yes	Yes	Yes	Yes	Yes

Notes: PPML estimation, Standard errors are clustered at the individual level (*p<0.10, **p<0.05, ***p<0.01), data are monthly for the months of June, July, and August for the years 2019 and 2020, dependent variable is the monthly revenue generated for each active rental during the periods studied. Summer 2020 equals 1 if the rental is present in summer 2020, 0 otherwise; amenity equals 1 if the rental is equal to or less than 2km from the different amenities considered (Forest: The distance to forests and water bodies, Ocean: The distance to the Atlantic Ocean, Mean photographs: The average distance of each rental to the nearest photograph for each active period, Photographs: The actual distance to the nearest photograph, Monuments: The distance to classified or listed monuments, Rural: equal to 1 if the location is located in a rural municipalities, 0 otherwise, Density: The number of locations within a 2km radius in 2019). Distance to photographs is equal to 1 if the location is equal to 2km or less than 2km from the nearest photograph, distance changing according to the month and year the location is active unlike the other amenities.

Table 6 :

Models for rentals near the ocean (With the top dense 5% of locations removed)

	(1)	(2)
	Ocean x Forest	Ocean x Monuments
Summer 2020 x distance to ocean x distance to forest	-0.0215**	
	(0.0109)	
Summer 2020 x distance to ocean	-0.0000741	-0.0313***
	(0.00699)	(0.00974)
Summer 2020 x distance to forest	0.0353***	
	(0.00742)	
Summer 2020 x distance to ocean x distance to monument		0.0392***
		(0.0117)
Summer 2020 x distance to monuments		-0.0399***
		(0.00754)
Constant	6.525***	6.543***
	(0.00590)	(0.00622)
N	520328	520328
Fixed Effects	Yes	Yes
Available days	Yes	Yes

Notes: PPML estimation, Standard errors are clustered at the individual level (*p<0.10, **p<0.05, ***p<0.01), Data are monthly for the months of June, July, and August for the years 2019 and 2020, Dependent variable is the monthly revenue generated for each active rental during the periods studied. Summer 2020 is equal to 1 if the rental is present in summer 2020, 0 otherwise; Distance to ocean is equal to 1 if the rental is equal to 2km or less than 2km from the Atlantic Ocean, 0 otherwise; Distance to forest is equal to 1 if the rental is equal to 2km or less than 2km from forests and bodies of water, Distance to monuments is equal to 1 if the rental is equal to 2km or less than 2km from monuments listed or classified as historical monuments.

Table 7 :

Models for rentals near the ocean (With the least dense 5% of locations removed)

	(1)	(2)
	Ocean x Forest	Ocean x Monuments
Summer 2020 x distance to ocean x distance to forest	-0.0387***	
	(0.0109)	
Summer 2020 x distance to ocean	0.0178**	-0.0257***
	(0.00693)	(0.00994)
Summer 2020 x distance to forest	0.0541***	
	(0.00779)	
Summer 2020 x distance to ocean x distance to monument		0.0491***
		(0.0118)
Summer 2020 x distance to monuments		-0.0504***
		(0.00789)
Constant	6.524***	6.549***
	(0.00590)	(0.00630)
N	517441	517441
Fixed Effects	Yes	Yes
Available days	Yes	Yes

Notes: PPML estimation, Standard errors are clustered at the individual level (*p<0.10, **p<0.05, ***p<0.01), Data are monthly for the months of June, July, and August for the years 2019 and 2020, Dependent variable is the monthly revenue generated for each active rental during the periods studied. Summer 2020 is equal to 1 if the rental is present in summer 2020, 0 otherwise; Distance to ocean is equal to 1 if the rental is equal to 2km or less than 2km from the Atlantic Ocean, 0 otherwise; Distance to forest is equal to 1 if the rental is equal to 2km or less than 2km from forests and bodies of water, Distance to monuments is equal to 1 if the rental is equal to 2km or less than 2km from monuments listed or classified as historical monuments.

Table 8 :

Model with months (With the top dense 5% of locations removed)

	(1) Forest	(2) Ocean	(3) Photographs	(4) Monuments	(5) Rural
Months after lockdown x years 2020 x amenity	-0.0980***	-0.104***	0.105***	0.272***	-0.218***
	(0.0188)	(0.0195)	(0.0186)	(0.0194)	(0.0186)
Months after lockdown x years 2020	0.704***	0.736***	0.613***	0.482***	0.786***
	(0.0118)	(0.0126)	(0.0107)	(0.0158)	(0.0144)
Months after lockdown x amenity	0.0524***	0.0946***	-0.205***	-0.180***	0.223**
	(0.00994)	(0.0102)	(0.00939)	(0.0109)	(0.00962)
Years 2020 x amenity	0.122***	0.100***	-0.113***	-0.294***	0.229***
	(0.0188)	(0.0194)	(0.0182)	(0.0194)	(0.0187)
Years 2020	-0.646***	-0.739***	-0.542***	-0.399***	-0.725***
	(0.0118)	(0.0125)	(0.0107)	(0.0158)	(0.0143)
Distance to phoographs			0.228***		
			(0.00896)		
Constant	6.460***	7.977***	6.459***	6.580***	6.376***
	(0.00702)	(0.00414)	(0.00638)	(0.00857)	(0.00765)
N	805015	805015	805015	805015	805015
Fixed Effects	Yes	Yes	Yes	Yes	Yes
Available days	Yes	Yes	Yes	Yes	Yes

Notes: PPML estimation, Standard errors are clustered at the individual level (*p<0.10, **p<0.05, ***p<0.01), Data are monthly for the months of April, May, June, July, and August for the years 2019 and 2020, Dependent variable is the monthly revenue generated for each active rental during the periods studied. Months after lockdown equals 1 if the rental is active in the months of June, July and August, 0 otherwise; Amenity equals 1 if the rental is equal to or less than 2km from the different amenities considered (Forest: The distance to forests and water bodies, Ocean: The distance to the Atlantic Ocean, Mean photographs: The average distance of each rental to the nearest photograph for each active period, Photographs: The effective distance to the nearest photograph, Monuments: The distance to classified or listed monuments, Rural: equals 1 if the location is in a rural municipalities, 0 otherwise, Years 2020: equals 1 if the location is active in 2020, 0 otherwise). Distance to photographs is equal to 1 if the location is equal to or less than 2km from the nearest photograph, distance changing according to the month and year the location is active unlike the other amenities.

Table 9 :

Model with months (With the least dense 5% of locations removed)

	(1) Forest	(2) Ocean	(3) Photographs	(4) Monuments	(5) Rural
Months after lockdown x years 2020 x amenity	-0.116***	-0.122***	0.183***	0.322***	-0.270***
	(0.0189)	(0.0194)	(0.0181)	(0.0199)	(0.0185)
Months after lockdown x years 2020	0.730***	0.766***	0.601***	0.459***	0.820***
	(0.0118)	(0.0130)	(0.0112)	(0.0165)	(0.0133)
Months after lockdown x amenity	0.0904***	0.133***	-0.249***	-0.219***	0.263**
	(0.00982)	(0.00987)	(0.00909)	(0.0112)	(0.00959)
Years 2020 x amenity	0.150***	0.128***	-0.196***	-0.349***	0.285***
	(0.0189)	(0.0193)	(0.0178)	(0.0200)	(0.0186)
Years 2020	-0.684***	-0.780***	-0.535***	-0.380***	-0.768***
	(0.0119)	(0.0130)	(0.0111)	(0.0165)	(0.0136)
Distance to phoographs			0.270***		
			(0.00881)		
Constant	6.458***	7.961***	6.465***	6.618***	6.380***
	(0.00696)	(0.00430)	(0.00642)	(0.00888)	(0.00737)
N	799344	799344	799344	799344	799344
Fixed Effects	Yes	Yes	Yes	Yes	Yes
Available days	Yes	Yes	Yes	Yes	Yes

Notes: PPML estimation, Standard errors are clustered at the individual level (*p<0.10, **p<0.05, ***p<0.01), Data are monthly for the months of April, May, June, July, and August for the years 2019 and 2020, Dependent variable is the monthly revenue generated for each active rental during the periods studied. Months after lockdown equals 1 if the rental is active in the months of June, July and August, 0 otherwise; Amenity equals 1 if the rental is equal to or less than 2km from the different amenities considered (Forest: The distance to forests and water bodies, Ocean: The distance to the Atlantic Ocean, Mean photographs: The average distance of each rental to the nearest photograph for each active period, Photographs: The effective distance to the nearest photograph, Monuments: The distance to classified or listed monuments, Rural: equals 1 if the location is in a rural municipalities, 0 otherwise, Years 2020: equals 1 if the location is active in 2020, 0 otherwise). Distance to photographs is equal to 1 if the location is equal to or less than 2km from the nearest photograph, distance changing according to the month and year the location is active unlike the other amenities.