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PAPER

Title: When local business faded away: the uneven impact of Airbnb on the geography of economic activities

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Abstract: *This paper investigates the unequal effect of Airbnb on the spatial organisation of economic activity in Madrid, Spain. Using establishment-level data from Madrid City Council and consumer-facing information from this short-term rental company, we find that Airbnb contributes to shaping the urban space in line with tourists' need, ultimately displacing local businesses. These findings prove that short-term rentals do displace not only the local population but also resident-oriented businesses. Eventually, we show that our results are not driven by way of measuring the digital accommodation activity, other touristic actors, and confounders related to gentrification and the rise of online purchasing.*

Keywords: *(maximum 6 words) Digital platform, short-term rentals, Airbnb, neighbourhood change, retail sector, tourism*

JEL codes: R10, R23, Z32

Introduction

The rise of "home-sharing" economic platforms is posing numerous challenges to urban planners and policy makers (Ferreri and Sanyal, 2018). So far, the public debate and the academic literature have focused mainly on analysing the deleterious consequences of short-term rentals on housing affordability (Garcia-L´opez et al., 2020). However, a less studied question is to what extent internet-based platforms, such as Airbnb, contribute to changing the economic landscape in urban areas (Celata et al., 2017). In particular, there is still a lack of evidence on how digital platforms affect the mix of economic activities in the inner-city. In that regard, the expansion of short-term rentals phenomenon differs from other touristification processes since not only it increases the accommodation capacity in specific areas, but it also expands across the urban geography, ultimately exacerbating problematic relations between residents and tourists as local business may be displaced. In turn, the loss of local businesses may increase the decline of the local population as they no longer have services to meet their daily living needs.

The main mechanism we exploit in this paper is the displacement of residents by tourists triggered by Airbnb and its consequence on business transformation. Tourists are potential consumers with different consumption patterns than residents. Therefore, the arrival of those new customers may affect various activities unevenly. That impact is eminently local, as residents and tourists tend to spend a high proportion of their time budget in the nearby areas of their accommodation. In principle, local amenities that target resident consumers are more likely to be negatively affected by the arrival of tourists when their service offerings do not match tourists' needs and tastes. Conversely, tourist-oriented businesses could benefit from Airbnb-induced tourist inflows as it expands the local consumer pool. Eventually, the spatial organisation of the urban economic activity gets also affected as short-term rentals do not concentrate only in city centre areas but expand across the urban geography, blurring the touristy city. Therefore, a central research question is about the transformational influence of Airbnb across urban areas.

To answer this research question, we evaluate the unequal effect of Airbnb on the spatial organisation of economic activity in Madrid, Spain. Using establishment-level data from Madrid City Council and consumer-facing information from this short-term rental company, we analyse how the local economy has been affected by Airbnb in 2014-2019. We assess how this digital platform company has impacted establishments' deaths and births in the first stage. Then, we complement our analysis by going beyond traditional establishment turnover metrics to focus on transitions, that is those establishments that were open either in 2014 or in 2019 but have changed their main activity. In that regard, we are interested in whether Airbnb fosters establishments oriented to satisfy tourists' needs and, more importantly, whether local businesses are being substituted by other establishments across sectors, i.e., drugstores and butcher shops replaced by restaurants or souvenir shops. To do so, we leverage the temporal dimension of our data and the uneven geographic distribution of short-term rentals, which allows us to isolate the impact of Airbnb from other time trends related to e-commerce or gentrification processes.

The main results evidence that Airbnb contributes to business formation mainly driven by tourist-oriented establishment creation. Primarily, consumption amenities like restaurants and bars and, to a lesser extent, tourist-oriented retail shops like souvenirs or store shops, are positively affected by the arrival of Airbnb. Conversely, tradable and non-tradable businesses alike explain the decline in resident-oriented establishments. In particular, we show that the increase in tourist-oriented establishments occurs at the expense of local businesses. Our results are robust to alternative measures of short-term rental activity, tourism gentrification forces other than Airbnb and confounders related to gentrification and the rise of online purchasing taking place at the same time that digital accommodation disruption. This paper contributes to the literature on the economic impact of platform economy by providing for the first time evidence of the unequal effect of the 'home-sharing' platform Airbnb on the spatial economic organisation within the city. Furthermore, we propose a new methodology

and classification to identify which businesses are at risk of falling because of Airbnb disruption in local areas.

The rest of the paper is organised as follows. Section 2 provides a brief review of previous literature. Section 3 describes the data and methodology. Section 4 and Section 5 present the results and robustness checks, respectively. Finally, we draw our conclusions in Section 6.

Tourism gentrification and neighbourhood change

Over the last decade, urban tourism flows have skyrocketed, spurred by the outbreak of the platform digital economy (Jimenez et al., 2022). Regardless of other tourist accommodations like hotels and hostels, digital platform-mediated short-term rentals have leveraged the existing stock of local housing to develop their activity. Flexibility and absent regulation at the early stages explain why we have recently witnessed enormous growth in short-term rentals. However, platform accommodation-induced tourism has not come without cost. Several studies have pointed out how the proliferation of short-term rentals in urban areas is related to the increase in housing and rental prices (Garcia-Lopez et al., 2020; Barron et al., 2021). In that regard, "home-sharing accommodations" have exacerbated already existing gentrification process (Wachsmuth and Weisler, 2018; Yrigoy, 2019; Ardura Urquiaga et al., 2020; Cocola-Gant and Gago, 2021). In particular, the widespread use of digital platforms nowadays spurs digital accommodation companies' expansion across countries, intensifying transnational gentrification dynamics where worldwide higher-income classes appropriate local urban space (Sigler and Wachsmuth, 2015).

Tourism gentrification, understood as a subset of the transnational gentrification process, diverges from other local population displacement process. Classical gentrification displaces the resident population with higher-income individuals. Conversely, tourism gentrification implies a substitution of residents for tourists who do not settle down permanently (Lees and Ley, 2008). Looking at the consequences, both processes modify the urban space. Unlike classical gentrification, which contributes to business transformations

in line with the needs of the new residents with high purchasing power, tourism gentrification triggers urban changes to better satisfy tourists' needs (Behrens et al., 2018; Jover and Dıaz-Parra, 2020). Despite those differences, the two processes may sometimes overlap as residents may also mimic broader tourist lifestyle attitudes (Novy, 2018). Short-term rental disruption adds another layer to the complexity of tourism-led gentrification. On the one hand, home-sharing accommodations allow landlords to generate extra income by renting unused homing space whereas keeping their status as tenants. However, commercial actors have monopolised the sector in the last years (Gil and Sequera, 2020). Therefore, to what extent Airbnb displaces the local population is context-specific and depends on the magnitude of the Airbnb professionalisation. Moreover, short-term rental geographical distribution differs from other traditional accommodations. Home-sharing accommodations are more dispersed than hotels which are concentrated in the city centre (Guti´errez et al., 2017; Wachsmuth and Weisler, 2018). The possibility of bringing tourists to residential areas could exacerbate the tension between local serving businesses and tourist-oriented activities but, at the same time, contribute to decongesting tourism from central city areas. Besides, traditional accommodations already provide consumption amenities within their facilities, therefore the potential impact on the local area is attenuated.

In the empirical literature about gentrification impacts on neighbourhood outcomes, only a handful of studies have gone beyond demographic and housing market changes, focusing on the transformation of businesses activities in those neighbourhoods (Lester and Hartley, 2014; Schuetz, 2014; Meltzer, 2016; Behrens et al., 2018; Glaeser et al., 2020). In this literature, leisure amenities and cultural and creative sectors have been marked as the primary services bring-in by gentrifiers. Regarding Airbnb-led gentrification and business transformation, the literature is scant, and most papers have focused on the spillover of Airbnb effects on consumption amenities (Alyakoob and Rahman 2019; Basuroy et al. 2020; Hidalgo et al. 2022). This paper contributes to fill this gap, taking into account a holistic approach to

how short-term rentals reshape urban space, considering the overall effect of short-term rentals across the spatial organisation of the economic activity.

Methodology

Data

Study area

Our study takes place in the city of Madrid. We choose the city of Madrid as a compelling case study since it is one of the most prominent destinations in Europe by the number of Airbnb listings (Statista, 2019) and it is the most visited city in Spain (INE, 2020a). Both features make Madrid a suitable setting to study how the accommodation platform economy has contributed to shaping the urban economic landscape.

Dependent variable

As a primary source of data we rely on the administrative records of the Madrid Statistical department. In particular, we collect information from the *Madrid City Council's census of business premises*. Starting from 2014, this data set covers the universe of all business premises in the Madrid municipality with a monthly frequency[1]. Our study evaluates establishment dynamics at two different times: October 2014 and October 2019. Our time frame coincides with the period of maximum growth of short-term rentals in Madrid (Ardura Urquiaga et al., 2020). To remove any urban sprawl effect due to new urban developments across the city, we restrict our sample to business premises that are in our data set during the study period. In this way, changes in establishment dynamics are restricted to be driven by local demand shocks rather than supply drivers. Apart from some establishment information, such as its georeferenced location and accessibility, we know the business activities of each premise.

[1] In our data set, a business premises refers to the physical property where an establishment develops its activity. For further information about the data set, please refer to Appendix A.

For our proposes, we are interested in those businesses that cater to tourists or residents and whose consumption is local. The local consumption condition is key in our analysis since we are exploiting the fact that Airbnb users spend a high proportion of their time budget in nearby areas of their accommodation, ultimately impacting the urban economic landscape. To classify the establishments as tourist-oriented or resident-oriented, we rely on already-existing classifications and adapt them to our setting (Meltzer and Schuetz, 2012; Meltzer and Capperis, 2017; Allen et al., 2020; Aparicio et al., 2021). Mostly tourist-oriented activities comprises local consumption amenities such as restaurants, bars and coffees. Previous research has already shown that Airbnb is behind the rise in the food and beverage establishments (Alyakoob and Rahman 2019; Basuroy et al. 2020; Hidalgo et al. 2022). On top of that, food and beverage services correspond to the main expenditures made in-situ by tourists (INE, 2020b; Aparicio et al., 2021). We complement this group with other stores that target tourist needs like souvenirs, gifts, or currency exchange stores. We decide not to include other tourist-related activities such as the clothing business due to the agglomeration economies taking place in the city centre of Madrid. The co-location of short-term rentals and clothing stores downtown prevents us from identifying the Airbnb-induced tourism effects from other effects induced by locals' expenditure. Our decision is conservative as we expect part of the clothing business growth in Madrid is also partially due to Airbnb-induced tourism flows (Allen et al., 2020).

Regarding resident-oriented establishments, we select those activities that fulfil daily life's basic needs. In particular, we cover a broad set of neighbourhood amenities that serve local consumer demand directly (Meltzer and Capperis, 2017). We include in this group tradable and non-tradable services. Among the tradable category, we choose food-related stores such as butcheries or fishmongers and device-related stores like drugstores, phone and newsagent stores. Concerning the non-tradable group, we include personal care and education services: hairdressers, depilation or nursery schools. As in the case of clothing shops for the tourist-oriented activities, we decided not to include higher-level education and health services in our

analysis as they might not have only a local consumption. We do not include other potential local businesses such as pharmacies or tobacco shops, as the location is regulated and responds to local planning ordinances. Table 1 shows our proposed classification.

Table 1: Tourist-oriented and resident-oriented activities classification

Establishment type	**Activity code**	**Activity description**
Tourist-oriented		
Souvenirs	661002, 477807, 477808	Exchange currency, Expositions, Gift shop
Restaurant	561001, 561004	Restaurant, Bar restaurant
Bar	561005, 563002, 563005	Bar with kitchen, Bar without kitchen, Bar with performance
Ice-cream parlour	472902,472903, 472904	Ice-cream parlour (in-place elaboration), Ice-cream take-away
Coffee	561006, 561007	Coffee, Teahouse
Limiting-Service Eating places	472406, 472407	Take-away (in-place elaboration), Take-away
Ready-made meals	471101	Ready-meal store
Pastry shops	472402, 472403	Pastry, Pastry with baked goods
Resident-oriented		
Clothing textile	464201,952004, 960101	Textile shop, Textile laundry, Tailor
Furnishing	475903, 433001	Furnishing
Retail food	471104, 472907, 472102, 472203, 472302	Convenience, Fruit, Butchery, Fishmonger, Candy
Retail non food	477801, 474201, 931008	Drugstore, Phone store,Gym
Beauty salon	960206, 960203,960201	Hairdresser, Beauty salon, Depilation
Car workshop	452002,472102, 855001	Car workshop, Driving School
Newsagent	476201, 821001	Newsagent, Print shop
Nursery	851001	Nursery school

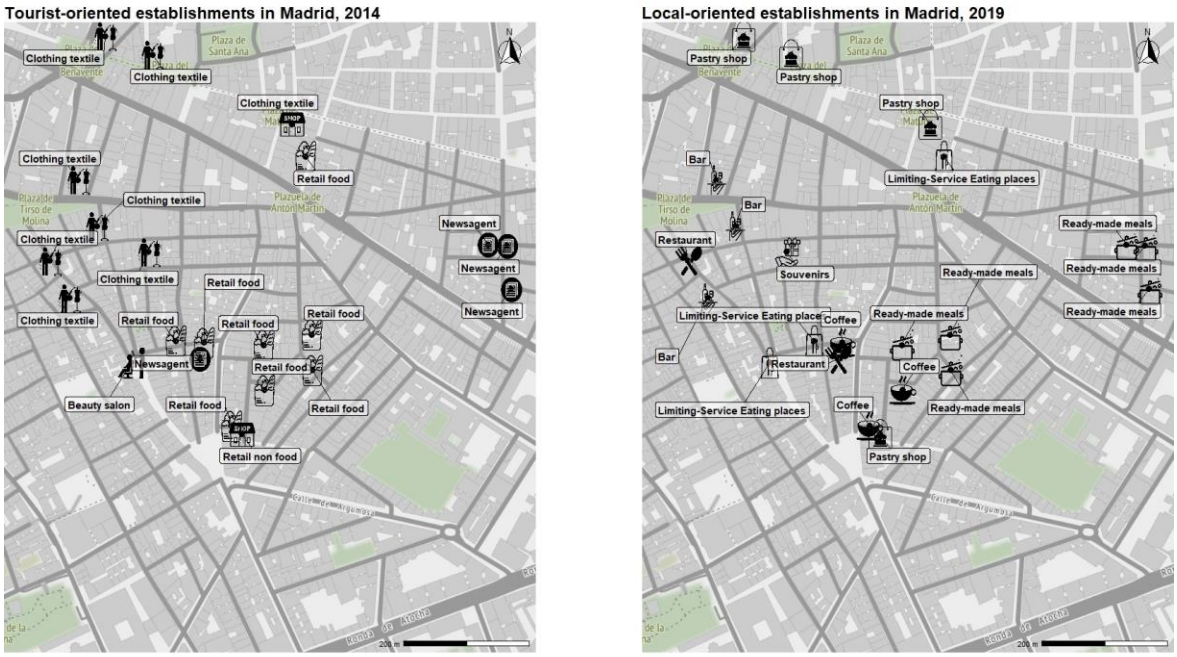
Notes: Activity codes refer to the most disaggregated information about business service offerings. They come from the classification of activities used by the Madrid City Council.

Once classified establishments according to their target population and based on their activity situation, we compute the first set of business dynamics variables: birth and death. *Birth* (*Death*) is a binary variable that takes the value of 1 for those establishments that were closed (open) in 2014 and open (closed) in 2019. As the core of our analysis is to understand the nature of Airbnb inducted change in business activities, we further distinguish birth and death by our proposed classification of tourist and resident-oriented business. As a result, our first group of business dynamics variables are: *birth*, *birth, tourist*, *birth, resident*, *death*, *death, tourist* and *death, resident*.

As a second step, we focus on transitions, i.e., those establishments whose activity in 2019 was different than the one they had in 2014. Therefore, we create a binary variable *transition* that takes value 1 for each business premises that were open in both years but changed its activities during the 2019-2014 period. This group is of special interest since it allows us to measure the effect of Airbnb on business displacements. Unlike other business dynamics metrics such as births or deaths, transitions better reflect the reorientation of local supply since it refers to those establishments that are open in our five-year period window but change their offering services. Conversely, births and deaths may be more related to long-term business trends. For the case of births, we do not observe any information about the business premises before 2014. For the case of death, we can not go beyond 2019 due to the COVID-19 outbreak, which represents an unprecedented disruption of business dynamics. In particular, the implementation of furlough schemes in the touristic sector prevents us from including recent years in our time frame due to the impossibility of disentangling the effect of the decline in touristic flows due to public aids.

As we are interested in accessing whether Airbnb-induced tourism contributes to establishment displacement toward touristic activities, we define two binary dependent variables, *transition, tourist* and *transition, resident*, which take the value of 1 for those business premises which change their offering in 2019 towards tourist-oriented or resident-oriented activities, respectively. Finally, it could be the case that Airbnb contributes to establishment displacement toward tourist-oriented activities at the expense of businesses more oriented to serve the needs of local residents. To test for this hypothesis, we complement our analysis of the effect of Airbnb on the nature of the retail change with the last two binary outcome variables: *transition, resident-tourist* and *transition, tourist-resident*. *Transition resident-tourist* (*Transition tourist-resident*) is 1 for those establishments which became tourist-oriented (resident-oriented) in 2019, conditioning on being a resident-oriented business (touristic business) on 2014. Figure I provide evidence of spatial displacement for resident-oriented businesses by tourist-oriented activities in the trendy touristic Embajadores neighbourhood.

Figure I: Resident-oriented establishments displaced by tourist-oriented



Notes: Business premises hosting resident-oriented establishments on 2014 (left) and the same business premises hosting tourist-oriented establishments on 2019 (right) in the neighbourhood "Embajadores" in Madrid.

Control variables

To measure short-term rental activity, we rely on consumer-facing information from the largest company in the sector, Airbnb. In particular, we collect information from Inside Airbnb, an independent, non-commercial website that scrapped information directly from the Airbnb site for different cities and countries worldwide. The entry of Airbnb in Madrid does not follow a homogeneous pattern. Airbnb is unevenly distributed, concentrating mainly in the city centre and spreading to the periphery like an oil slick (Gil and Sequera, 2020; Hidalgo et al., 2022). Therefore, Madrid's establishments are distinctly exposed to Airbnb-induced tourism depending on Airbnb listings location. To consider this distribution pattern of short-term rental activity

and its influence on the local business sector, we created a 150-meter buffer around each business premises in 2014 and 2019. Then, we count the number of short-term rentals within each buffer and compute the absolute difference in the number of short-term rentals in each buffer surrounding each business premises across the five-year window. Figure II depicts the creation of the buffer using the Embajadores neighbourhood as in Figure I. We prefer our Airbnb intensity measure to aggregate short-term rental data to census tracts or neighbourhoods, as both are based on arbitrary boundaries that do not reflect the Airbnb-induced tourism effect around every business premises. Furthermore, buffers are homogeneous measures in size and morphology, whereas other predefined spatial partitions have the problem of heterogeneity in shape and scale.

Figure II: Buffer creation

Notes: Short-term rentals (red house icons) surrounding a given business premises that offer clothing textile services in *Embajadores* neighbourhood in 2014 (left). Short-term rentals surrounding the same business premises but, this time, offering souvenir services in 2019 (right).

Lastly, we complement our data set with socio-demographic information which contributes to explain the urban establishment dynamics such as the population and the average household income at the census tract level. A final list with all the variables used can be find in Table AI and its main descriptive statistics in Table AII in the Appendix A section.

Specification

The aim of this paper is to study the impact of Airbnb entry in Madrid on business dynamics. To answer our research question, we use the following linear probability model specification:

$$\Pr(\textit{Establishments dynamics}_i^{2019-2014}) = \beta Airbnb_i + \rho X_c + \delta Z_i + \alpha_s + \gamma_n + \epsilon_i \quad (1)$$

where *Establishments dynamics*$^{2019}{}_i{}^{-2014}$ refers to the business dynamics outcome variables in Table AI depending on the specification. Our main coefficient of interest is β, which measures the effect of a change in the number of short-term rentals around a 150-meters buffer of business premises *i* on the probability that the establishment undergoes any change in business activity. We expand our specification to control for socio-demographic characteristics measured in 2014 at the census tract level X_c, such as population and the average household income. We measure them at the beginning of our sample period to avoid potential contamination effects from our treatment variable. To account for different geographical business dynamics trends depending on the location of the economic activity, we add as an explanatory variable the distance from the city centre of each centroid of the census tract where the business premises belongs to. The reason to measure them at the census tract level is to account for the possible influence of nearby characteristics on the dynamics of establishments within the census tract. We include a establishments-specific characteristics Z_i related to its accessibility (grouped or store-front) and we control for activity α_s and neighbourhood γ_n fixed effects[2]. In this way, we account for potential trends in the emergence or decline of certain economic activities in the city and unobserved time-invariant characteristics at the neighbourhood level. We cluster the standard errors at the neighbourhood level as business premises

[2] We include activity fixed effects at the activity current activity level for *birth*, *death* and *transition* specification. Conversely, we include activity fixed effects at the previous activity level for *transition tourist* and *transition local tourist* specification to prevent it from interfering with our dependent variable. Whenever we condition birth or death to be a tourist or resident-oriented activity, we do not include any activity fixed effects due to collinearity with the dependent variable.

share commonalities at a higher treatment level. Besides, we avoid the potential problem of overlapping buffers.

Results

This study aims to test how short-term rentals explain urban establishment dynamics, using the city of Madrid as a case of study. Our unit of observation is the business premises. We look in a cross-sectional setting whether businesses premises have experienced any business transformation during two moments in time, October 2014 and October 2019. In the first stage, we evaluate whether Airbnb affects the probability that an establishment opens or closes and whether that change in activity status is driven by being a tourist or resident-oriented business. In a second step, we go beyond births and deaths metrics to focus on transitions, that is, those establishments that were open either in 2014 or in 2019 but have changed their main activity. As we are interested in analysing whether Airbnb impacts the nature of retail change, we complement our transition variable, differentiating between tourist and resident-oriented businesses. Finally, we check whether those tourist-related transitions come at the expense of the local business.

Table 2 presents the first set of business dynamics results of our baseline linear probability model specification. The sample size varies across specifications due to the different comparison groups. In the case of the birth group, we include only inactive establishments between 2014 and 2019 and those born in 2019 and closed in 2019. For deaths, we select all those open establishments in both periods and those closed in 2019 but open in 2014. Whenever we condition to be a tourist or resident-oriented business birth (death), we include as a comparison group only its category groups, i.e., births (deaths) for the case of tourist-oriented and resident-oriented establishment.

Table 2: Linear probability model for establishments birth and death dynamics

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable:	Pr(Birth = 1)	Pr(Birth, tourist = 1)	Pr(Birth, resident = 1)	Pr(Death = 1)	Pr(Death, tourist = 1)	Pr(Death, resident = 1)
Airbnb buffer	0.0009***	0.0008***	-0.0006**	4.23×10^{-5}	-0.0006	0.001**
	(0.0002)	(0.0002)	(0.0002)	(7×10^{-5})	(0.0006)	(0.0005)
log(Population)	0.018	-0.002	-0.069***	-0.002	0.011	-0.034
	(0.018)	(0.021)	(0.026)	(0.004)	(0.035)	(0.048)
log(Avg Household income)	0.001	0.011	-0.023	-0.010	-0.032	-0.116*
	(0.032)	(0.032)	(0.038)	(0.007)	(0.066)	(0.067)
Store front	0.364***	-0.107***	0.041*	-0.043***	0.115***	-0.034
	(0.035)	(0.025)	(0.022)	(0.011)	(0.030)	(0.036)
Distance	6.93×10^{-6}	1.07×10^{-6}	-1.44×10^{-5}	-2.07×10^{-6}	2.93×10^{-5}	-3.57×10^{-5}
	(1.36×10^{-5})	(1.45×10^{-5})	(1.59×10^{-5})	(2.4×10^{-6})	(3.28×10^{-5})	(3.09×10^{-5})
Mean dependent variable	0.795	0.157	0.233	0.0232	0.190	0.265
R_2	0.274	0.054	0.0312	0.060	0.138	0.105
Observations	7,663	6,084	6,084	72,062	1,673	1,673

Notes: Statistical significance at the 1, 5 and 10% levels is indicated by ***,** and *, respectively. Cluster standard errors at the Airbnb buffer level. Airbnb buffer is computed as the absolute change in the number of short-term rentals around a 150-meter ring for each establishment between 2014 and 2019. Neighbourhood fixed effects included in each specification Activities codes fixed effects only included in the first and fourth column.

Results in Table 2 show that Airbnb contributes positively to the rise of new businesses (column 1), whereas it does not seem to affect the probability of closure (column 4). As Jim´enez et al. (2022) show for the case of several Spanish cities (including Madrid), Airbnb contributes positively to the arrival of new tourists; therefore, the positive effect of short-term rentals on the birth specification may respond to additional income flows coming from Airbnb-induced tourism. On the flip side, short-term rentals have an unequal impact on the business premises' service offerings. In this regard, Airbnb increases the probability that tourist-oriented business are born (column 2) and decrease it for resident-oriented establishments (column 3). We can observe a similar effect for the case of deaths; a decrease in the probability of closing for touristic businesses (column 5) and an increase for resident-

oriented businesses (column 6). The inclusion of the set of neighbourhood and activity fixed effects wiped out the significance of our control variables except for our dummy indicator for storefront business. The positive coefficient for storefront business in the birth specification and negative in the death specification reflect the fact that department markets are losing importance in cities (Horta¸csu and Syverson, 2015).

Although Table 2 provides insights about the impact of the short-term rental arrival in Madrid on business dynamics, we must be especially cautious with the interpretation of our coefficient of interest in those specifications. Airbnb listings may be self-selecting in those areas of the city where some urban revival phenomenon occurs. Under this scenario, the positive effect on births and the null effect on deaths may respond to unobserved city-specific events, which would have to happen, even in the counterfactual scenario that Airbnb had not entered those areas. Moreover, birth and death specifications are subject to left and right censoring due to data limitations. Therefore, we complement our first set of business dynamics variables with the transition group to try to partially overcome those issues. Table 3 summarises the main results.

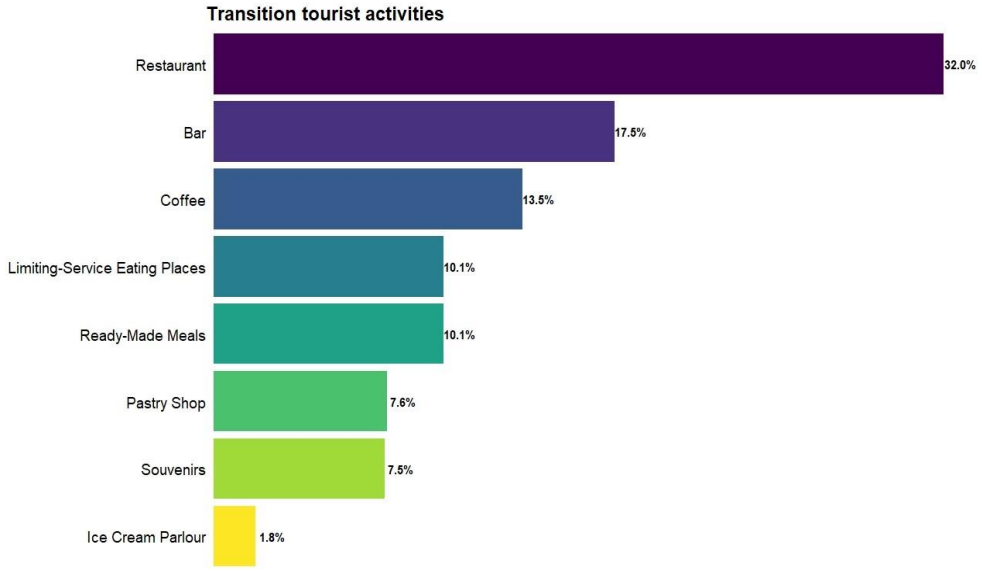
Table 3: Linear probability model for establishments transitions dynamics

	(7)	(8)	(9)	(10)	(11)
Dependent Variable:	Pr(Transition = 1)	Pr(Transition, tourist = 1)	Pr(Transition, resident = 1)	Pr(Transition, resident-tourist = 1)	Pr(Transition, tourist-resident = 1)
Airbnb buffer	0.0002***	0.0004**	-0.0004*	0.002***	7.94×10^{-5}
	(5.11×10^{-5})	(0.0002)	(0.0002)	(0.0004)	(0.0003)
log(Population)	0.002	-0.007	-0.013	0.097**	0.002
	(0.005)	(0.019)	(0.020)	(0.040)	(0.040)
log(Avg Household income)	0.009	0.049*	-0.069**	0.139**	-0.038
	(0.007)	(0.027)	(0.032)	(0.068)	(0.066)
Store front	0.021***	-0.055**	0.094***	-0.080	0.138***
	(0.008)	(0.023)	(0.021)	(0.054)	(0.051)
Distance	-3.01×10^{-6}	-1.85×10^{-5}	-7.37×10^{-6}	-3.41×10^{-5}	2.57×10^{-5}
	(3.36×10^{-6})	(1.52×10^{-5})	(1.44×10^{-5})	(3.07×10^{-5})	(3.21×10^{-5})
Mean dependent variable	0.110	0.217	0.262	0.151	0.175
R_2	0.228	0.184	0.107	0.169	0.218
Observations	85,791	9,334	9,334	1,518	1,600

Notes: Statistical significance at the 1, 5 and 10% levels is indicated by ***,** and *, respectively. Cluster standard errors at the Airbnb buffer level. Airbnb buffer is computed as the absolute change in the number of short-term rentals around a 150-meter ring for each establishment between 2014 and 2019. Activities codes and neighbourhood dummies included in each specification.

Our second set of business dynamic metrics confirms our previous results. We observe that Airbnb increases the probability that a business premises transition towards a tourist-oriented activity (column 8). An increase in twenty-five Airbnb listings (average Airbnb listing change within the buffer) around those business premises that underwent any type of transition raises the probability of transition toward a tourist-oriented establishment in 10%. At the same time, the same increase in short-term rentals decreases the probability of becoming a local business at the same magnitude (column 9). As can be seen in Figure III, the increase in the probability of transitioning towards a tourist-oriented business is driven mainly by restaurants, bars and coffee services. These establishments have opening hours that fit tourists' timelines better because they are open during the daytime and at night, whereas souvenir or gift shops are usually open only during the day.

Figure III: Tourist-oriented transitions



So far, we have found that Airbnb contributes to the rise of tourist-oriented business in Madrid, measured through births and transitions. At the same time, this short-term rental company negatively affects local businesses by increasing the probability of closure and decreasing the probability of birth and transition. We have hypothesised that the main mechanism that explains this fact is the substitution of residents for tourists whose consumption patterns differ from each other. In principle, the emergence of businesses that cater to tourists may respond to a general trend related to the rise of the

tourism sector in Spain and, in particular, in Madrid. Likewise, the decline in resident-oriented businesses can respond to phenomena other than Airbnb. If it was the case, we should expect that tourist-oriented transitions come at the expense of other sectors, including tourist-oriented ones. However, if Airbnb is behind the change in the spatial organisation of the economic activity in Madrid, we theorise to find that new-created establishments have displaced resident-oriented activities. However, we expect that Airbnb will have a stronger impact displacing non tourist-related activities than hotels and other traditional tourist related activities. Columns 10 and 11 of Table 3 test for this hypothesis. Indeed, whereas Airbnb increases the probability that an establishment becomes tourist-oriented, conditional on being a local business in the past, we do not observe the opposite. To get a better picture of which type of local activities are being displaced by touristic business, we reproduce

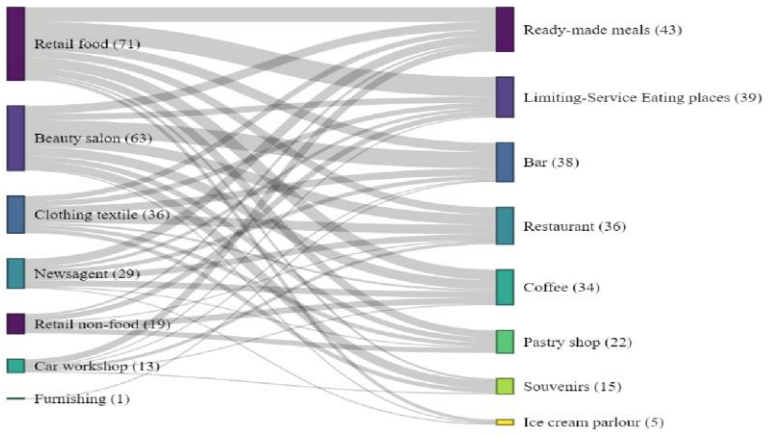


Figure IV: Resident-oriented establishments displaced by tourist-oriented

in Figure IV transition from resident to tourist-oriented activities. We can observe that consumption amenities account for most resident-tourist transitions in both directions, i.e., from food-oriented local businesses to food-oriented tourist establishments. Moreover, other non-tradable local businesses such as beauty salons or clothing textile activities are also crowded out, reflecting that local activities' displacement is not concentrated in specific sectors.

Consequently, our findings reveal the important role that Airbnb has played in the reconfiguration of economic activity in the city of Madrid, a case that can be extended to other European tourist cities. As a result, regulations are being introduced in all these cities to cope with the diffusion of short-term rental (Valentin et al., 2019).

Robustness checks

In this section, we test the robustness of our main results from Table 3 in several ways. First, we leverage the heterogeneous distribution of short-term rental activity across Madrid by removing from our sample all observations within a neighbourhood where a new hotel settles to avoid contamination tourist effects stemming from traditional accommodations. Third, we test whether the transitions towards tourism-oriented business and the decline in resident-oriented establishments masks other business-related phenomena beyond Airbnb-induced tourism, such as gentrification and e-commerce.

Traditional accommodations

In this exercise, we check whether our main tenets hold whenever we remove some neighbourhoods where new traditional and short-term rental accommodations enter[3]In this way, we are deleting mainly city centre neighbourhoods where the bulk of the short-term rental activity is concentrated. Our decision is conservative as we do not expect all economic activities in the neighbourhood to be affected by the arrival of a new hotel, but only those closest to it. However, the decision to prune our sample is also motivated due to hotel location decisions, which can be considered as a proxy for the tourist attractiveness of the whole area. Therefore, it is more likely that in those neighbourhoods, changes in the spatial organisation of the

[3] The neighbourhoods where new hotels locate are Sol, Cortes, Justicia, Universidad, Casco H. Vallecas, Castilla, Nueva Espan˜a, Prosperidad, Hispanoamerica, Arguelles, Delicias and Recoletos.

economic activity are driven by the overall touristic flows and not those coming from short-term rentals. Table 4 provides evidence that business displacement is driven mainly by the Airbnb arrival and not other trends in the tourism sector. In principle, this is due to Airbnb concentrating not only in tourist enclaves but also in other residential areas with good public transit and cultural cachet (Wachsmuth and Weisler, 2018). We can observe that once removed touristic neighbourhoods, the probability of a transition to a tourist-oriented business is doubled and the probability of a transition to a tourist-oriented business is increased fivefold for those businesses that transition to a tourist-oriented business conditional on being resident-oriented in the past. Therefore, outside the most touristic area of the city, the effect of Airbnb is even more intense and disruptive.

Table 4: Linear probability model for establishments transitions dynamics in non-touristic neighbourhoods

Dependent Variable:	Pr(Transition = 1)	Pr(Transition, tourist = 1)	Pr(Transition, resident = 1)	Pr(Transition, resident-tourist = 1)	Pr(Transition, tourist-resident = 1)
Airbnb buffer	0.0002***	0.0008***	-0.0001	0.0010*	8.05×10^{-5}
	(5.11×10^{-5})	(0.0002)	(0.0004)	(0.0006)	(0.0006)
log(Population)	0.0024	-0.0063	-0.0243	0.0654	0.0220
	(0.0048)	(0.0211)	(0.0229)	(0.0414)	(0.0492)
log(Avg Household income)	0.0085	0.0427	-0.0746**	0.1497**	-0.0393
	(0.0069)	(0.0290)	(0.0354)	(0.0752)	(0.0826)
Store front	0.0208***	-0.0474**	0.1031***	-0.0731	0.1259**
	(0.0076)	(0.0223)	(0.0229)	(0.0515)	(0.0573)
Distance	-3.01×10^{-6}	-1.22×10^{-5}	-8.76×10^{-6}	-2.05×10^{-5}	1.65×10^{-5}
	(3.36×10^{-6})	(1.58×10^{-5})	(1.57×10^{-5})	(3.18×10^{-5})	(3.63×10^{-5})
R_2	0.22844	0.18312	0.10705	0.17534	0.21989
Observations	85,791	7,548	7,548	1,293	1,211

Gentrification and e-commerce

Our tourist-oriented business classification is mainly composed of consumption amenities. Although food expenditure corresponds to tourists' largest expense made in-situ, local residents consume them too. In that case, touristification can be confounded with local lifestyle changes in which residents also engage in touristic practices (Novy, 2018). Furthermore, the

proliferation of food and beverage establishments has been linked with the gentrification process in several studies (Behrens et al., 2018; Glaeser et al., 2020; Couture and Handbury, 2020). If Airbnb enters those areas where locals are more prone to reproduce tourism consumption attitudes, our main results would not be capturing the pure Airbnb-induced tourism effect. To rule out the existence of a confounder like lifestyle-led gentrification, we perform a falsification exercise where we replace tourist-oriented activities for those activities which have been related to gentrification. To do so, we rely upon the proposed classification made by Behrens et al. (2018) and adapt it to our setting[4]. Table 5 shows that gentrification seems not to explain our previous results. Our finds coincide with Wachsmuth and Weisler (2018) insights that Airbnb does not necessarily concentrate in gentrifying areas and extent beyond central business districts with high rates of traditional accommodations.

Table 5: Linear probability model for establishments transitions dynamics in gentrification sectors

Dependent Variable:	Pr(Transition = 1)	Pr(Transition, tourist = 1)	Pr(Transition, resident = 1)	Pr(Transition, resident-tourist = 1)	Pr(Transition, tourist-resident = 1)
Airbnb buffer	0.0002***	4.31×10^{-6}	-0.0003	0.0005	0.0009**
	(5.11×10^{-5})	(7.3×10^{-5})	(0.0002)	(0.0004)	(0.0004)
log(Population)	0.0024	-0.0017	-0.0130	0.0066	0.0528
	(0.0048)	(0.0108)	(0.0206)	(0.0208)	(0.0691)
log(Avg Household income)	0.0085	0.0382**	-0.0717**	0.0677	-0.1351
	(0.0069)	(0.0148)	(0.0320)	(0.0462)	(0.1071)
Store front	0.0208***	-0.0237	0.0955***	-0.0052	0.1430*
	(0.0076)	(0.0152)	(0.0221)	(0.0263)	(0.0856)
Distance	-3.01×10^{-6}	-2.03×10^{-7}	-8.21×10^{-6}	-2.69×10^{-5}*	7.39×10^{-5}
	(3.36×10^{-6})	(7.82×10^{-6})	(1.43×10^{-5})	(1.46×10^{-5})	(5.56×10^{-5})
R_2	0.22844	0.11849	0.10511	0.13751	0.27988
Observations	85,791	9,414	9,414	1,526	578

Notes: Statistical significance at the 1, 5 and 10% levels is indicated by ***,** and *, respectively. Cluster standard errors at the Airbnb buffer level. Airbnb buffer is computed as the absolute change in the number of short-term rentals around a 150-meter ring for each establishment between 2014 and 2019. Activities codes and neighbourhood dummies included in each specification.

The prevalence of tradable establishments in our local-business category makes our empirical analysis exceptionally sensitive to shocks related to this sector. In particular, the rise of e-commerce might explain the decline in local

businesses. Again, if that phenomenon occurs in the same areas where Airbnb settles, we would be capturing the combined effect of online purchasing and touristification driven by Airbnb. To show that our main results are driven by a local demand shock triggered by Airbnb and no other phenomenon, we restrict our resident-oriented category to only non-tradable business[5]. Again, as can be seen in Table 6, we do not find evidence that our results are driven by other phenomena related to electronic commerce.

Table 6: Linear probability model for establishments transitions dynamics in tradable activities

Dependent Variable:	Pr(Transition = 1)	Pr(Transition, tourist = 1)	Pr(Transition, resident = 1)	Pr(Transition, resident-tourist = 1)	Pr(Transition, tourist-resident = 1)
Airbnb buffer	0.0002***	0.0005**	-0.0002	0.0030***	0.0002
	(5.11×10^{-5})	(0.0002)	(0.0001)	(0.0010)	(0.0002)
log(Population)	0.0024	-0.0091	0.0054	0.0785	-0.0059
	(0.0048)	(0.0190)	(0.0142)	(0.0647)	(0.0300)
log(Avg Household income)	0.0085	0.0453*	-0.0468**	0.1091	-0.0532
	(0.0069)	(0.0269)	(0.0227)	(0.1115)	(0.0472)
Store front	0.0208***	-0.0491**	0.0756***	-0.0322	0.0797*
	(0.0076)	(0.0229)	(0.0168)	(0.1105)	(0.0408)
Distance	-3.01×10^{-6}	-1.85×10^{-5}	8.94×10^{-6}	-7.74×10^{-5}*	2.45×10^{-5}
	(3.36×10^{-6})	(1.48×10^{-5})	(1.1×10^{-5})	(4.28×10^{-5})	(2.54×10^{-5})
R_2	0.22844	0.18312	0.10705	0.17534	0.21989
Observations	85,791	7,548	7,548	1,293	1,211

Notes: Statistical significance at the 1, 5 and 10% levels is indicated by ***,** and *, respectively. Cluster standard errors at the Airbnb buffer level. Airbnb buffer is computed as the absolute change in the number of short-term rentals around a 150-meter ring for each establishment between 2014 and 2019. Activities codes and neighbourhood dummies included in each specification.

Conclusion

The emergence of the accommodation platform economy, in which Airbnb stand out, has dramatically affected the spatial organisation of the urban economy. Nevertheless, the impact has been heterogeneous across business activities. Using Madrid as a case of study, we find that short-term rentals shape the urban space in line with tourists' needs. However, the positive impact on the economic activity driven mainly by the rise of tourist-oriented businesses masks adverse effects on non-touristic sectors. In particular,

[5] The non-tradable resident-oriented establishment are: Textile laundry, Tailor, Furnishing services, Hairdresser, Beauty and Depilation salon, Driving and Nursery school.

businesses oriented toward the needs of the resident population are particularly affected by the arrival of short-term rentals, which proves that Airbnb does displace resident-oriented businesses. Eventually, we show that our results are not driven by way of measuring the Airbnb activity, other touristic actors and confounders related to gentrification and the rise of online purchasing.

The present study makes meaningful contributions to tourism gentrification and neighbourhood change literature. We have shown that the effect of Airbnb exposition expands beyond the city centre. In this way, short-term rentals may fuel uneven geographies by contributing to expelling the local population from non-central neighbourhoods. At the same time, Airbnb-induced tourism can help to decongest the city centre of tourists and redistribute them better across the city. The uneven effect on the spatial organisation of the economic activity demands local authorities' intervention to regulate this activity in two ways: the short-term rental levels that are considered globally desirable in the city and the manner in which they are distributed throughout the territory. As such, policymakers should consider how Airbnb affects businesses differently depending on its consumer orientation. Otherwise, it exists the risk of eroding the collective city space in the affected neighbourhoods and intensifying the touristification phenomenon already taking place in urban areas. We believe that our results may help design policy interventions that consider not only its immediate effect on the housing rental market, but also the structural change in the geography of the economic activities.

Future work is needed to corroborate our findings across different cities and time. This is crucial to assess how persistent is the transition from resident to tourist-oriented activities, and whether it might depend on the urban geography and other sociodemographic determinants.

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A Appendix

Table AI: Variable definition and source

Variable	Definition	Source
Dependent variables:		
Birth	1 if an establishment open in 2019, 0 otherwise	Madrid Statistical department
Birth, tourist	1 if a tourist-oriented establishment open in 2019, 0 otherwise	Madrid Statistical department
Birth, resident	1 if a resident-oriented establishment open in 2019, 0 otherwise	Madrid Statistical department
Death	1 if an establishment close in 2019, 0 otherwise	Madrid Statistical department
Death, tourist	1 if a tourist-oriented establishment close in 2019, 0 otherwise	Madrid Statistical department
Death, resident	1 if a resident-oriented establishment close in 2019, 0 otherwise	Madrid Statistical department
Transition	1 if an establishment open in 2014 and 2019 but change activity, 0 otherwise	Madrid Statistical department
Transition, tourist	1 if an establishment open in 2014 and 2019 which change activity towards tourist services, 0 otherwise	Madrid Statistical department
Transition, resident	1 if an establishment open in 2014 and 2019 which change activity towards local services, 0 otherwise	Madrid Statistical department
Transition, resident-tourist	1 if an establishment is a tourist business in 2019 conditional on being a local business in 2014, 0 otherwise	Madrid Statistical department
Transition, tourist-resident	1 if an establishment is a resident-oriented business in 2019 conditional on being a tourist business in 2014, 0 otherwise	Madrid Statistical department
Explanatory variables:		
Airbnb	Absolute change in the number of Airbnb listings within a 150-meter buffer around each establishment between 2014 and 2019	Inside Airbnb
Population	Number of inhabitants in a given census tract	Municipal Register
Average household income	Average household income in a given census tract	Ministry of Development
Distance	Euclidean distance in meters to the city centre from census tract centroid	Spanish National Geographic Institute

Table AII: Descriptive statistics of the dependent and explanatory variables

	ΔOctober 2019 - October 2014		
Dependent variables	Sum	Mean	Sd
Birth	6632	0.05	0.22
Birth, tourist	973	0.007	0.08
Birth, resident	1448	0.010	0.1
Death	2192	0.015	0.12
Death, tourist	2192	0.003	0.06
Death, resident	2192	0.021	0.05
Transition	9765	0.074	0.262
Transition, tourist	2234	0.0161	0.13
Transition, resident	2597	0.018	0.14
Transition, resident-tourist	261	0.001	0.04
Transition, tourist-resident	300	0.002	0.05

	October 2014			**October 2019**		
Explanatory variables	Sum	Mean	Sd	Sum	Mean	Sd
Airbnb buffer	5595	7.604	18.744	21172	26.912	57.46
Population	3115101	1321.638	453.280	3276969	1364.267	480.8405
Avg. Household Income	87651106	37046.11	15304.25	87583302	37048.77	15307.81