Airbnb and hotel revenues in Greek popular destinations

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ABSTRACT

This paper explores the role of Airbnb listings on hotel revenues in certain popular Greek tourist destinations. The analysis makes use of the panel GMM method, while the findings document that the Airbnb listings exert a negative impact on hotel revenues. Moreover, the results indicate that it is primarily non-business and low-price hotels that are being influenced, while the hotel industry responds to the competition through lower room prices and not through occupancy rates. The paper documents that although the Airbnb is a new factor in the Greek tourism industry, it has turned into a significant competitor against hotels. The findings of this paper are expected to provide further insights into the workings of the sector and the potential regulated policies needed to be adopted by tourism authorities.

Keywords: Airbnb listings; hotel revenues; tourist destinations; panel GMM method; Greece

1. Introduction

The tourism industry has a strong association with the entire real economy; it substantially contributes to more job vacancies, as well as to higher foreign exchange revenues. Therefore, it has significant impact on economic growth. In Greece, the sector represents 18-20% of the national GDP, contributing to a serious reduction in unemployment, even on a seasonal pattern (Buhalis, 2001; Tsartas, 2010). At the same time, Airbnb is a relatively controversial issue, because it potentially competes both

with hotels and with the private rental market, without all of the same tax and regulatory constraints applied in either of the traditional accommodation markets. One of the research questions associated with the Airbnb market is how has Airbnb affected the profitability of the traditional hotel industry. Therefore, the question of whether Airbnb can be considered as a substitute for the traditional hotel industry has particularly salient implications for the regulatory debate.

Therefore, this study's goal is to explore how the new way of planning accommodation through the Airbnb platform affects the revenues of the hotel industry in certain Greek popular tourism destinations. In other words, the analysis plans to investigate whether a stronger role of the Airbnb business can impact hotel revenues in those popular Greek tourism destinations (defined later in the data section). The primary novelty of the paper is that explores, for the first time to the best of our knowledge, a critical issue within the hotel industry in the case of Greece. The results could be highly significant in terms of the discussion on whether the Airbnb industry should be regulated (given that it is largely unregulated across the Greek tourist sector). In addition, the findings are expected to clearly document whether there is any rising rivalry between Airbnb and traditional hotel revenues in Greece. This could potentially denote not only the critical impact on the future path of the economy in terms of economic growth (tourism has been contributing more than 20 percent of GDP in Greece over the last 16 years), but also whether this rivalry can affect the capacity of the tourism sector to successfully draw the country away from recession and contribute to the rising economic welfare of the Greek people. Additional novelties include the employment of certain robustness checks, as well as the fact that the analysis is based on a unique dataset of Airbnb listings across the major popular Greek tourist destinations. The findings are expected to be of high significance for both tourist and

financial authorities, since the hotel industry is strongly complaining that hosts on Airbnb do not pay the occupancy taxes imposed on hotels and can avoid other regulations, such as safety rules (Boutsioukis et al., 2019; Alexandridis et al., 2020). Moreover, tax authorities are also concerned that Airbnb is not reporting all earned income, as the Airbnb owners might not be registered as self-employed workers. Overall, the European Union has not issued any formal regulatory guidance against Airbnb services. Only certain European cities (and Greece after the mid of 2019) have tightened regulations applied to Airbnb rentals (Nieuwland and van Melik, 2020). For instance, Berlin has banned unregistered short-term rentals, and Brussels owners need permission from their building owners to participate in the Airbnb platform. In addition, Amsterdam limited the number of people who can jointly rent one property, and Barcelona requires the host to be in residence during the rental period, or otherwise this residence is treated as a traditional hotel accommodation. Cities like Barcelona and Paris limit the amount of time during the year a property can be rented through the Airbnb platform. After June 2019, Greece has imposed certain regulations targeting Airbnb owners who do not declare their earned income for tax purposes. More specifically, the new government introduced specific restrictions on the utilization of properties advertised on short-term rental platforms, such as Airbnb, for holiday accommodation. The restrictions have been imposed on individual owners, as well as investors and professional agents who benefit from the new market. They are associated with: i) no more than two properties can be utilized as short-term rentals by the same tax registration number, ii) no property can be leased out for more than 90 days per calendar year; for islands with a population of fewer than 10,000 inhabitants, the limit has been set at 60 days, and iii) for the limit of 90 days (or 60 days for small islands) to

be exceeded, hosts will have to prove that their total rental revenues do not exceed 12,000 euros per annum.

Accommodation is one of the most important elements in people's planning when they are travelling either for holidays or business or any other reason. This accommodation can be related to a number of types, i.e. hotels, motels, and guest houses. With the development of the Information Technology, a new type of accommodation comes through the Airbnb business, which has been highly benefited by certain informational technology developments. Overall, the literature on the role of Airbnb in the tourist sector is still very limited, but it is rapidly expanding. According to Zervas et al. (2015), the rise of Airbnb is explained as 'collaborative consumption', where individuals who possess underused assets (i.e., real estate), lend their assets and receive additional revenues. The Airbnb has targeted the market of the traditional hospitality industry. The concept of sharing is that it is a market that provides similar services to travelers from around the globe (Sundararajan, 2016). This new market has created innovative channels for the supply of such shared goods and services, raising new mechanisms of collaborative consumption (Schor and Fitzmaurice, 2015). At the same time, the participants in the Airbnb market (i.e., the real estate owners) do not suffer from the presence of certain fixed costs, i.e. labor costs, and they are in a position to price their real estate services very competitively (Guttentag, 2013).

Low prices offered by Airbnb are a primary determinant in accommodation selection decisions (Lockyer, 2005; Guttentag, 2013). Other studies in relevance to the European Airbnb market include a study in the case of Netherlands that provides evidence of a negative, albeit small effect of Airbnb entry on hotel prices (Hooijer, 2016), while Neeser (2015) considers the case of three Scandinavian countries, with his results documenting an insignificant impact on average hotel room prices. Finally,

Quattrone et al. (2016) explore the geography of Airbnb in London, and their findings illustrate that such Airbnb listings are strongly associated with certain socio-economic characteristics, with emphasis in desirable areas with young populations, lower unemployment rates, and residents born outside the UK.

The paper is close to the literature that investigates the influence of sharing platforms on incumbent firms. For instance, Cervero et al. (2007) and Martin et al. (2010) determine the effect of carsharing on vehicle ownership. Their results clearly highlight that carsharing membership increases the likelihood that individuals get rid of their car. Aguiar (2015) investigates the impact of the Spotify project on record sales, with his findings documenting that Spotify streaming reduces downloads of tracks, while Cramer and Krueger (2016) examine the efficiency of ride sharing versus direct taxi services in a number of US cities. Their results show that Uber charges less than taxies and preserves the same revenues per hour, with the primary driver of the efficiency of Uber being the inefficiency of taxi regulations. In relevance to this literature, Roma et al. (2019) argue that the effect of the penetration of the sharing economy on incumbents' prices is not straightforward, and actually depends on the type of incumbents, as well as certain product/service offer characteristics. Therefore, relying on a large sample of hotel price offerings from the Italian market, they provide evidence that the effect of the growing relevance of the sharing economy (exemplified by Airbnb) on incumbents' prices depends on the type of incumbents (low/medium-end versus high-end hotels), as well as on the accommodation period (weekend versus weekdays), and thus on the type of consumers looking for accommodation.

The paper is also close to the literature that investigates the impact of Airbnb on the hotel industry. In particular, Zervas et al. (2017) investigate the extend of Airbnb to hotel revenues in the state of Texas. They use data on more than 3,000 hotels in

Texas, spanning the period 2003 to 2014, while measuring Airbnb services either as a cumulative or as an instantaneous measure. They use a fixed effects panel model with hotel being the fixed factor to provide evidence of a negative link between Airbnb supply and hotel revenues; the hotels, however, are characterized as low-price services, while they primarily offer non-business services. As a result, hotels react mainly through the mechanism of lower hotel prices. Farronato and Fradkin (2016) argue that hotel profits, prices and occupancy rates are lower when there is a stronger presence of Airbnb services. Their empirical analysis also documents that in the case of the 50 largest US cities, it is the constraints to hotel capacity that can clearly predict Airbnb penetration, while these cities are characterized by the presence of stronger constraints and, thus, tend to experience a larger Airbnb penetration rate.

As in 2018, the tourism industry employs more than 800,000 people (Chasapopoulos et al., 2019), while the industry has extremely contributed to the growth path of the real economy, especially during the recent debt sovereign crisis and the application of three austerity programs. On the top of the industry's impact on national employment rates and income generation, tourism motivates firms to better cope with the international competition (Krueger, 1980), by increasing economies of scales (Helpman, and Krugman, 1985). However, in Greece, the presence of Airbnb has started generating certain problems for the hotels market (Grant Thornton, 2019). The study reveals that the strong growth of Airbnb rentals has generated a type of 'tourist ghettos', especially in the city centers, raising safety issues, driving away local inhabitants, and having negative spillovers onto the hotel market. More than six out of ten Greek properties listed on Airbnb are located in the regions of Athens (and suburbs), Crete, the South Aegean, followed by the regions of Central Macedonia, the Ionian Islands, and the Peloponnese. While in Athens the large hotel chains dominate the hotel

market, in the other tourist destinations, the market is highly competitive, with the hotel services being offered by different size hotel firms. The Greek hotel industry has been experiencing a constant increase over the recent 12 years (Figure 1), without any interruption, even after the 2008 financial crisis and the period 2010-2012, where the economy experienced a severe sovereign debt crisis and three austerity reform programs. In 2018, there were 2,970 hotels across all national tourist destinations.

[Insert Figure 1 about here]

2. Data and methodology

Data on Airbnb include accommodations of all shapes and sizes. The empirical analysis ensures that all Airbnb listings that are not active for rent services have been ignored from the relevant platform; the same is also true for all shared and private rooms (it is highly unlikely a hotel guest to view them as an alternative to a hotel room). Moreover, large Airbnb services appropriate for more than seven people have been also dropped since it is also unlikely that such groups do not seek traditional hotel services.

To the end of the empirical analysis, the study focuses on the major (and popular) tourist destinations in Greece: Athens, Delphi, Mykonos, Santorini, Corfu, Crete, Rhodes, Halkidiki, Thessaloniki, Nafplio, Skiathos, and Zakynthos, spanning the period 2012-2018. In the period before 2012, the Airbnb industry was practically nil and this dictates the time span considered. Data on Airbnb come from the Airbnb's web page and are based on the total reported listing within a year in association with the number of customers served, while hotel revenues data, as well as the number of available hotel rooms are obtained from the National Statistical Service of Greece. Hotel revenues data are on an annual basis, are calculated from the accounting reports

offered at the end of the accounting period (December), and are in relevance to 497 individual hotels in 2012, 549 individual hotels in 2013, 594 individual hotels in 2014, 619 individual hotels in 2015, 679 individual hotels in 2016, 725 individual hotels in 2017, and 819 individual hotels in 2018; Airbnb data come from 1,270 individual listings in 2012, 1,689 individual listings in 2013, 2,458 individual listings in 2014, 2,988 individual listings in 2015, 3,648 individual listings in 2016, 4,573 individual listings in 2017, and 5,458 individual listings in 2018. The model (in a log form) yields:

$$\begin{aligned} Log(HR_{ikt}) = a_{1i} + a_{2k} + a_{3t} + c\ log(Airbnb_{kt}) + d'\ X'_{ikt} + f\ log(Airbnb_{kt}^2) + \\ g_1\ log(Airbnb_{kt}\ x\ HotelPr_i) + g_2\ (logAirbnb_{kt}\ x\ HotelBu_i) + \\ g_3\ log(HR_{ik(t-1)}) + \varepsilon_{ikt} \end{aligned} \quad (1)$$

where i is the hotel, k is the tourist destination, and t displays the year. HR is the log of hotel revenues per available room, while the independent variable is the Airbnb listing. The coefficient c signifies the elasticity of hotel revenues with respect to Airbnb services. a_{1i} denotes hotel fixed effects, a_{2k} considers tourist destinations fixed effects, and a_{3t} indicates time fixed effects. X'_{ikt} is a vector of certain control variables in relevance to hotel revenues; to the end of the analysis, the vector includes the number of passengers at the nearest airports (proxying changes in tourism demand), as well as changes in certain demographic characteristics, such as unemployment (it could impact the demand for both hotels and Airbnb supply), and the size of population, used as a proxy for the role of economic activities occurred in the tourist destinations under consideration. Both unemployment and population are on a national basis, given that it is the overall macroeconomic environment of the country that determines the selection of those tourist destinations by the Greek tourists. Equation (1) also includes the squared term of the supply of Airbnb, capturing whether changes in Airbnb supply have

any asymmetric effects on hotel revenues. If the coefficient of this term, that is f, turns out to be negative, this implies that the marginal effect of Airbnb supply increases along with a stronger Airbnb supply.

The first interaction term between Airbnb and the type of the hotel indicates whether low-price hotels can be closer substitutes to Airbnb services. This interaction term signifies that in the case of young people it is generally this type of users who have lower budgets; as a result, they tend to be more frequent users of the Airbnb services. In empirical terms, the type of the hotel is defined as a binary indicator (hotel i is a low-cost hotel). A 'high cost' hotel is defined as the one which has an average price larger than the 50% price of the overall hotel price list.

In addition, hotels specialized in attracting more business travelers are expected to be less affected by the competition offered from Airbnb services. The rationale of this interaction term is that business travelers usually need more than simple room facilities, e.g. conference facilities. In addition, the users of such business facilities are not those who pay for their hotel rooms, with their accommodation costs being covered by their businesses, which usually are in a better position of making deals with hotels for their employees. A 'business hotel' is defined as the one which has a share of business travelers larger than 50%. Finally, e_{ikt} represents the error term. The number of passengers at nearest airports and unemployment rate data are obtained from the National Statistical Service of Greece, while those on population from the World Bank database. From the destinations included in the sample, Athens, Mykonos, Santorini, Corfu, Crete, Rhodes, Thessaloniki, Skiathos, and Zakynthos have their own airport sites, while in the cases of Delphi and Nafplio, passengers from the Athens airport were considered, while in the case of Halkidiki, passengers from Thessaloniki airport were

accounted. Table A1 in the Appendix provides certain descriptive statistics, while Table A2 reports the correlations across the variables under investigation.

To avoid the presence of potential endogeneity issues, we estimate the dynamic panel data model using the general method of moments (GMM) estimation recommended by Arellano and Bover (1995) and Blundell and Bond (1998). The presence of endogeneity potentially comes through potential reverse causality between hotel revenues and Airbnb listings. It is also worth pointing out that although the number of observations is different between hotel revenues and Airbnb listing, the panel GMM method still provides unbiased and efficient estimates (Judson and Owen, 1999).

3. Empirical analysis

The first part of the empirical analysis performs the Pesaran (2007) panel unit root test, which determines the stationarity properties of the variables under study. The null hypothesis is the presence of a unit root. The results are reported in Table 1 and clearly document the presence of a unit root across all relevant variables.

[Insert Table 1 about here]

Next, the GMM estimations are reported in Table 2. The results report two specifications (indicated in columns (1) and (2), respectively). The first one is in relevance to the model without any control variables, while the second reports the full results. The number of lags was determined through the Akaike criterion. The reported results clearly indicate the presence of a negative coefficient which is statistically significant at 1 percent. The estimates remain consistently similar across both modelling specifications, albeit the estimates turn lower in the second one due to the effect of controlling for other variables that impact hotel revenues. Given the modelling

approach, the estimated contemporaneous elasticity for hotel revenues is -0.084 and -0.063, respectively. Hence, a 1% increase in Airbnb listings decreases hotel revenues by 8.4% and 6.3%, respectively. Moreover, the findings document that the coefficient of the log of population is positive and statistically significant at one percent. Hence, increases in the population signifies an increase of economic activity; as a result, more tourists are involved in the hotel business. The coefficient of unemployment is negative, illustrating that stronger unemployment figures decrease hotel revenues, since the pool of potential tourists is smaller. The coefficient of total airplane passengers is positive, indicating that tourism demand gets stronger as increases in the number of incoming tourists are linked with higher accommodation demand for hotel services, leading to stronger hotel revenues.

In terms of the quadratic term included, the estimate is negative, implying an increasing rate of the negative spillovers Airbnb has on hotels' revenues. Moreover, the findings document that non-business hotels and low-price hotels are those more affected by the Airbnb market, thus, rendering these two types of hotels as a closer substitute to the Airbnb market. Finally, in terms of the lagged coefficients of hotels' revenues, its high (and statistically significant) value, that is 0.628, signifies a strong persistent effect of hotel revenues coming from previous periods, leading to a strong long-run effect of Airbnb on hotel revenues as well.

[Insert Table 2 about here]

4. Robustness check; different measures of the dependent variable-hotel prices and occupancy rates

This section repeats the results in Table 2 by considering the hotels' responses to Airbnb listings. The dependent variable now is measured either as hotel prices or as occupancy rates, where data are based on the hotel services price index, with both types of data being provided by the National Statistical Service of Greece. The new results are presented in Table 3. The results in Columns (1) and (2) show that increases in Airbnb supply lead to lower hotel prices, indicating that hotels lower their prices when the Airbnb competition turns stronger. Columns (3) and (4) report the results when hotel prices are replaced by the occupancy rates (data are also retrieved from the National Statistical Service of Greece). The new findings indicate that Airbnb also affects negatively the occupancy rates. In other words, the hotel industry responds by adjusting both their prices and their occupancy rates, albeit the response is stronger with respect to prices, highlighting that hotels prefer to respond to the competition through the price mechanism rather than that of the occupancy capacity (i.e., leaving their rooms empty).

[Insert Table 3 about here]

5. Robustness check: a different measure of asymmetry

To capture potential asymmetric effects, the analysis added previously two interaction terms, the first one between Airbnb and the type of the hotel in terms of the charged (low-price vs high-price hotels) and the second one between Airbnb and whether the hotel is business-type oriented or not. Based on a referee's recommendation, this part of the robustness analysis runs two additional estimations by splitting the overall sample into low- and high-cost hotels, and into business and not-business hotels. The results are shown in Table 4. The new findings clearly indicate that the effect of Airbnb is very negatively strong on the hotel revenues in the cases of low-

price and business-type hotels, while in the case of high-price and non-business-type hotels the impact remains negative, but it turns out to be statistically insignificant. Wald F-tests provide solid evidence that rejects in both cases the null hypothesis of equality in the two Airbnb coefficients.

[Insert Table 4 about here]

6. Robustness check: the role of destination

Finally, based again on a referee's suggestion, this part of the robustness analysis runs a different form of asymmetry based on the tourist destination. The analysis tests whether the Airbnb's listing effect might be different/asymmetric for "family type" vs "cosmopolitan type" destinations. From the available tourist destinations, i.e. Athens, Delphi, Mykonos, Santorini, Corfu, Crete, Rhodes, Halkidiki, Thessaloniki, Nafplio, Skiathos, and Zakynthos, only three of them can be characterized as purely "cosmopolitan type" destinations, Mykonos, Santorini and Skiathos, while the remaining can be characterized as "mixed type" destinations. Therefore, we run estimations between these two groups of destinations and the new results are reported in Table 5. They clearly highlight that Airbnb listings have no effect on hotels revenues in the case of the "cosmopolitan type" of destinations, implying that these destinations usually attract people coming from high-income groups that usually consume traditional hotel services (Tzanelli, 2015; Kamenidou et al., 2009). Once again, the Wald F-test provides evidence that rejects the null hypothesis of equality in the two Airbnb coefficients.

[Insert Table 5 about here]

5. Conclusion

This study explored, for the first time, the effect of Airbnb services on hotel revenues across a number of popular tourist destinations in Greece, spanning the period 2012-2018. Using the panel GMM methodology, the empirical findings clearly documented that Airbnb had a negative effect on hotel revenues, thus, implying the significance of this platform service for the traditional hotel industry. The analysis also highlighted that it is the non-business type of hotels that was mostly affected by the presence of Airbnb listings, while the hotel industry responded primarily by lowering prices, rather than adjusting the occupancy rates.

The research findings seem to carry significant implications for the future of the (traditional) hotel industry in Greece. The findings supported that Airbnb strongly competed with hotels and, thus, raise the need for a stronger regulatory environment in the hotel market primarily focusing on Airbnb services. At the same time, the findings clearly stress out the importance of facilitating sharing services, given the substantial benefits the Airbnb market provides both to the real estate owners and the consumer of tourism services. Based on the results provided in this paper and without ignoring the fact that Airbnb seems to be a shift of potential housing supply from the long-run residential housing market to the market for short-term accommodations, leading to lower prices for tourists, generates a bad trade-off, by negatively affecting the hotel industry that has traditionally supported the growth pattern of the country. In that sense, Airbnb has become a major economic stress for the Greek traditional hotel industry and, hence, should face close scrutiny. Potentially, the proper way to improve this picture is not to impose equal regulatory laws for both type of tourist accommodations and let the consumers of the industry to decide. In the European front, the European authorities must have the rules specified and applied. But since 2015 when the Services

and E-Commerce Directives were issued, there has not been any progress on the regulatory framework. At the right of generating this report, there are still two diverging views on the issue: the first one demands changes to existing rules, or even the adoption of new ones to protect the traditional hotel industry. This, however, is not an easy option given the delay characterized all legislation processes by the European Committee.

Finally, potential venues for future research could focus on the impact the Airbnb market may have on the housing market. Airbnb has received significant criticisms on leading to higher prices in the traditional rental market. Landlords prefer renting out their real estate assets to Airbnb users than to local renters, which substantially increases the likelihood of higher purchasing and rental housing prices.

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Appendix.

Table A1

Descriptive statistics.

Variables	Mean	SD	Min	Max
Hotel revenues (mil. Euro)	4,853.6	973.9	2,988.4	6,094.1
Airbnb listings	3,154.9	1,515.1	1,270.0	5,458.0
Unemployment rate(%)	24.6	10.9	19.4	27.2
Population	10,855,128	117,132.8	10,731,726	10,045,011
Passengers	23,819,010	328,966.5	18,764,195	26,775,237
No. of obs (hotels) = 4,482				
No of obs (Airbnb) = 22,084				

SD = standard deviation

Table A2

Correlation matrix.

Variables	Hotel revenues	Airbnb listings	Unemployment rate	Population	Passengers
Hotel revenues	1	0.546	0.509	0.396	0.485
Airbnb listings		1	0.537	0.428	0.503
Unemployment rate			1	0.562	0.106
Population				1	0.245
Passengers					1

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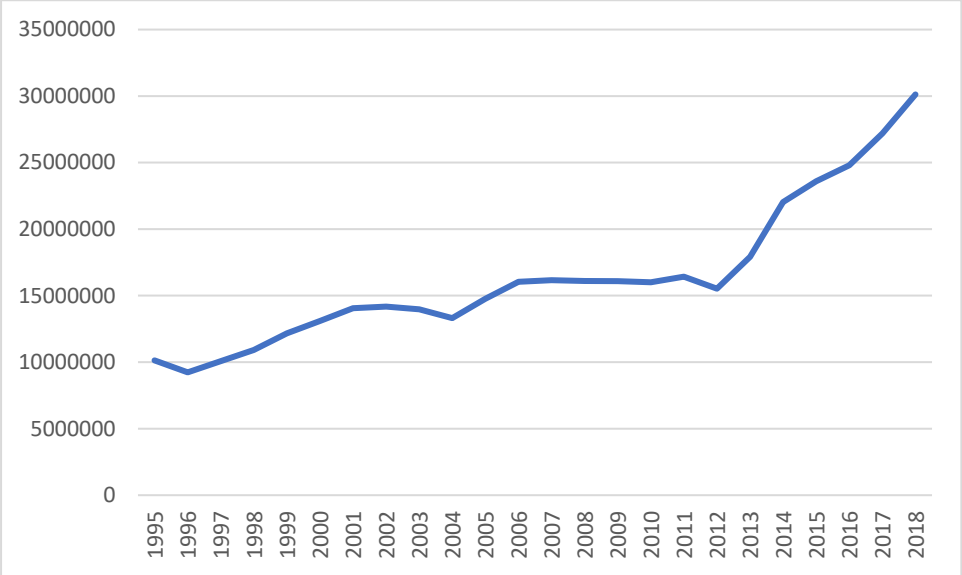

Figure 1. Tourist arrivals in Greece (1995-2018).

Table 1

Pesaran panel unit root.

Variable	Pesaran CIPS	Pesaran CIPS*
hr	-1.25	-1.37
Δhr	-5.68***	-5.86***
Airnbnb	-1.34	-1.39
ΔAirbnb	-5.91***	-6.17***
UN	-1.29	-1.38
ΔUN	-5.75***	-5.89***
pop	-1.32	-1.39
Δpop	-5.64***	-5.79***
pass	-1.29	-1.38
Δpass	-5.88***	-6.19***
No of hotels	4,482	
No of Airbnb	22,084	

Δ denotes first differences, while small letters denote variables in logs. HR is hotel revenues, un is the unemployment rate, pop denotes population, and pass is the passengers arrivals in near airports. CIPS* is the truncated CIPS test. The results are reported at lag = 4. ***: p≤0.01.

Table 2

GMM estimates: the dependent variable is hotel revenues.

Variables	(1)	(2)
Constant	0.014	0.008
	[0.21]	[0.29]
Δhotel revenues(-1)	0.628***	0.536***
	[0.00]	[0.00]
ΔAirbnb listings	-0.084***	-0.063***
	[0.00]	[0.00]
ΔAirbnb listings(-1)	-0.049**	-0.033**
	[0.03]	[0.05]
ΔAirbnb listings^2	-0.068***	-0.054***
	[0.00]	[0.01]
Unemployment rate		-0.073***
		[0.00]
ΔUnemployment rate(-1)		-0.044**
		[0.03]
Δpopulation		0.083***
		[0.00]
Δpopulation(-1)		0.049**
		[0.03]
Δpassengers		0.068***
		[0.00]
Δpassengers(-1)		0.037**

		[0.04]
ΔAirbnb x HotelPrice		-0.038**
		[0.03]
ΔAirbnb x HotelBusiness		-0.047**
		[0.02]
R^2	0.41	0.68
Fixed effects	YES	YES
AR(2)	[0.57]	[0.53]
Hansen test	[0.91]	[0.87]
Difference-in-Hansen	[0.99]	[0.99]

No. of obs (hotels) = 4,482

No of obs (Airbnb) = 22,084

Figures in parentheses denote p-values. The number of lags was determined through the Akaike criterion. AR(2) is the test for auto-correlation of order 2 in first-differenced errors. Difference in Hansen is the test of validity of GMM instruments in the level equation. The Hansen test is based on the Hansen J statistic. The null hypothesis is that the instruments are valid (i.e., uncorrelated with the error term), and that the exclusions restrictions are also valid. *: $p \leq 0.01$; **: $p \leq 0.05$; ***: $p \leq 0.01$.

Table 3

GMM estimates: the dependent variable is hotel prices or occupancy rates.

Variables	(1)	(2)	(3)	(4)
Constant	0.016	0.008	0.018	0.012
	[0.19]	[0.28]	[0.17]	[0.25]
Δhotel prices(-1)	0.634***	0.581***		
	[0.00]	[0.00]		
Δoccupancy rates(-1)			0.526***	0.494***
			[0.00]	[0.00]
ΔAirbnb listings	-0.083***	-0.067***	-0.078***	-0.061***
	[0.00]	[0.00]	[0.00]	[0.00]
ΔAirbnb listing(-1)	-0.051**	-0.044**	-0.054**	-0.046**
	[0.02]	[0.03]	[0.02]	[0.04]
ΔAirbnb listings^2	-0.049***	-0.042**	-0.036**	-0.025**
	[0.01]	[0.02]	[0.03]	[0.05]
Unemployment rate		-0.094***		-0.089***
		[0.00]		[0.00]
Δpopulation		0.096***		0.095***
		[0.00]		[0.00]
Δpassengers		0.108***		0.104***
		[0.00]		[0.00]
Δpassengers(-1)		0.069***		0.066***
		[0.01]		[0.01]
ΔAirbnb x HotelPr		-0.081***		-0.077***

		[0.01]		[0.01]
ΔAirbnb x HotelBu		-0.075***		-0.064**
		[0.01]		[0.02]
R^2	0.44	0.76	0.39	0.74
Fixed effects	YES	YES	YES	YES
AR(2)	[0.53]	[0.49]	[0.51]	[0.46]
Hansen test	[0.91]	[0.87]	[0.94]	[0.89]
Difference-in-Hansen	[0.99]	[0.99]	[0.99]	[0.98]

No. of obs (hotels) = 4,482

No of obs (Airbnb) = 22,084

Figures in parentheses denote p-values. The number of lags was determined through the Akaike criterion. AR(2) is the test for auto-correlation of order 2 in first-differenced errors. Difference in Hansen is the test of validity of GMM instruments in the level equation. The Hansen test is based on the Hansen J statistic. The null hypothesis is that the instruments are valid (i.e., uncorrelated with the error term), and that the exclusions restrictions are also valid. *: p≤0.01; **: p≤0.05; ***: p≤0.01.

Table 4

GMM estimates: the dependent variable is hotel revenues-low-price vs high-price hotels and business-type vs not business-type hotels

Variables	Low-price	High-price	Business	Not-business
Constant	0.004	0.022	0.007	0.026
	[0.35]	[0.16]	[0.32]	[0.15]
Δhotel revenues(-1)	0.568***	0.587***	0.613***	0.608***
	[0.00]	[0.00]	[0.00]	[0.00]
ΔAirbnb listings	-0.091***	-0.025	-0.098***	-0.022
	[0.00]	[0.14]	[0.00]	[0.16]
ΔAirbnb listings(-1)	-0.058**	-0.012	-0.056**	-0.008
	[0.02]	[0.29]	[0.02]	[0.35]
ΔAirbnb listings^2	-0.062***	-0.031*	-0.069***	-0.026
	[0.00]	[0.07]	[0.00]	[0.12]
Unemployment rate	-0.094***	-0.046**	-0.043**	-0.105***
	[0.00]	[0.03]	[0.04]	[0.00]
ΔUnemployment rate(-1)	-0.068***	-0.021	-0.020	-0.058***
	[0.00]	[0.17]	[0.37]	[0.00]
Δpopulation	0.097***	0.062***	0.066***	0.087***
	[0.00]	[0.00]	[0.00]	[0.00]
Δpopulation(-1)	0.057***	0.035*	0.034*	0.061***
	[0.00]	[0.07]	[0.07]	[0.00]
Δpassengers	0.104***	0.057***	0.062***	0.108***
	[0.00]	[0.00]	[0.00]	[0.00]
Δpassengers(-1)	0.068***	0.032*	0.035*	0.061***

	[0.00]	[0.06]	[0.06]	[0.00]
R^2	0.75	0.47	0.77	0.54
Fixed effects	YES	YES	YES	YES
Wald F-test	[0.01]		[0.00]	
AR(2)	[0.63]	[0.46]	[0.65]	[0.71]
Hansen test	[0.96]	[0.84]	[0.97]	[0.92]
Difference-in-Hansen	[0.99]	[0.99]	[0.99]	[0.98]
Hotel obs.	2,688	1,794	1,078	3,404

Figures in parentheses denote p-values. The number of lags was determined through the Akaike criterion. AR(2) is the test for auto-correlation of order 2 in first-differenced errors. Difference in Hansen is the test of validity of GMM instruments in the level equation. The Hansen test is based on the Hansen J statistic. The null hypothesis is that the instruments are valid (i.e., uncorrelated with the error term), and that the exclusions restrictions are also valid. Finally, the Wald F-test investigates the null hypothesis whether the two Airbnb coefficients in the two different groups (low- vs high-price hotels, and business vs not-business hotels) are equal. *: $p \leq 0.01$; **: $p \leq 0.05$; ***: $p \leq 0.01$.

Table 5

GMM estimates: “family type” vs “cosmopolitan type” destinations

Variables	Family type	Cosmopolitan type
Constant	0.006	0.019
	[0.33]	[0.21]
Δhotel revenues(-1)	0.597***	0.613***
	[0.00]	[0.00]
ΔAirbnb listings	-0.109***	-0.027
	[0.00]	[0.15]
ΔAirbnb listings(-1)	-0.065***	-0.011
	[0.00]	[0.31]
ΔAirbnb listings^2	-0.075***	-0.030
	[0.00]	[0.13]
Unemployment rate	-0.112***	-0.048**
	[0.00]	[0.03]
ΔUnemployment rate(-1)	-0.056***	-0.018
	[0.01]	[0.25]
Δpopulation	0.087***	0.073***
	[0.00]	[0.00]
Δpopulation(-1)	0.051**	0.037*
	[0.02]	[0.07]
Δpassengers	0.079***	0.061***
	[0.00]	[0.00]
Δpassengers(-1)	0.042**	0.031*
	[0.04]	[0.10]

R^2	0.75	0.63
Fixed effects	YES	YES
Wald F-test	[0.00]	
AR(2)	[0.62]	[0.58]
Hansen test	[0.93]	[0.90]
Difference-in-Hansen	[0.99]	[0.99]
Hotel obs.	3,974	508

Figures in parentheses denote p-values. The number of lags was determined through the Akaike criterion. AR(2) is the test for auto-correlation of order 2 in first-differenced errors. Difference in Hansen is the test of validity of GMM instruments in the level equation. The Hansen test is based on the Hansen J statistic. The null hypothesis is that the instruments are valid (i.e., uncorrelated with the error term), and that the exclusions restrictions are also valid. Finally, the Wald F-test investigates the null hypothesis whether the two Airbnb coefficients in the two different groups ("family type" hotels vs "cosmopolitan type" hotels) are equal. *: $p \leq 0.01$; **: $p \leq 0.05$; ***: $p \leq 0.01$.