

Understanding AirBnB in Fourteen European Cities¹

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Abstract:

This paper gives an overview of the activities of Airbnb in 14 European cities. Since Airbnb provides an online accommodation platform linking property owners and visitors, it could potentially affect both the hotel market and the domestic rental market in the localities in which it operates. We discuss the structure and the segmentation of the accommodation market, and then present some descriptive statistics on Airbnb activities in the 14 cities. Finally, we present some estimates of the impact of Airbnb on hotels and on rents, among the first estimates for European markets. We find Airbnb's presence in a market has a negative effect on hotel occupancy rates, but a positive effect on total hotel revenue and the average daily rate they charge. In the two countries we consider, the platform's impact on the rental market is ambiguous, suggesting local market conditions are important.

Keywords: AirBnB, Hotel Industry, Online Accommodation Platforms, Rental Market

JEL codes: D22, L83, L88, R31

1. Introduction

Since the launch of Airbnb across Europe from 2010, the platform has grown rapidly, and clearly offers travellers and property owners a service they value. However, Airbnb is controversial because it potentially competes both with hotels and with the private rental market, yet without all of the same tax and regulatory constraints of either of these existing short-term or long-term accommodation markets. Hoteliers perceive the entry of

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Airbnb as an 'unfair' competitive threat. There are also concerns that property owners are switching from long-term residential tenancies to short term Airbnb lets in major cities where housing is expensive and hard to find. Thus several cities around Europe have introduced regulatory restrictions on Airbnb or are discussing doing so.

This paper aims to provide some empirical evidence on the effects of Airbnb entry on the hotel and private rental markets, in a number of European cities. To date, there is relatively little empirical research on the platform in Europe, and yet there is considerable pressure on local authorities to regulate it more restrictively, despite the value it offers to users on both sides of the platform.

The assessment of potential harm requires answers to empirical questions. How much has Airbnb grown in different locations, and have Airbnb lettings affected the quantity of other short-stay accommodation (hotels) and the prices they charge? Has Airbnb affected on the other hand the price and availability of longer-term accommodation (the private rental market)? These effects could be large or small depending on whether Airbnb expands the supply of available properties, expands the demand by offering a wider menu of choice to travellers, or both; and also on the extent to which it is eroding the traditional segmentation between short-term and long-term urban accommodation. Other empirical questions are: how much do the effects of Airbnb vary between different cities depending on the market context? Where are Airbnb properties located, compared to hotels and to neighbourhoods of privately rented longer-term accommodation?

For local authorities, the questions concern the effectiveness of their regulatory frameworks. Hoteliers complain that hosts on Airbnb do not pay the occupancy taxes imposed on hotels and can avoid other regulations such as safety rules. Tax authorities could be concerned that Airbnb hosts are not reporting all their income, as they might not be registered as self-employed or freelance workers. Local residents might have concerns about a larger number of short-term visitors in largely residential areas. Local authorities in cities where there is high demand for rental housing worry that the supply will be diminished by owners turning to Airbnb rentals.

The contribution of this paper is to provide some empirical evidence on these questions in European cities. While demand for short stay and longer term rented accommodation is highly segmented and likely to remain so, the entry of Airbnb could break down supply side segmentation between these markets, as well as potentially increasing the supply of short term accommodation as owners of properties take advantage of the platform to rent out (part of) their property for the first time.

We have a large volume of web scraped data on Airbnb in a number of European cities, provided by the information company Airdna. Daily information from September 2014 to April 2016 for 14 European cities is extracted from Airbnb's website, from which the

average monthly and annual performance are computed.⁴ This includes the occupancy rate and revenue (in US dollars in the original data set) from April 2015 to March 2016. Together with all visible online features of the hosts and the properties, we are able to look at the connections between performance in terms of occupancy and revenues and property characteristics. Among the characteristics, the start date of the listing, the listing type (private room, shared room or entire apartment/home), and the location of the listing are particularly interesting, and we briefly describe these. Secondly, we were provided with data on hotels – average daily rate (ADR) per room, total revenues, and average occupancy rate – by the hotel information company STR. We also gathered data on private rental market, available from official sources for Germany and the UK, and other data on city or region level explanatory variables.

This paper provides some initial descriptive information on the novel data on Airbnb lets. We describe also the hotel characteristics for the same cities. We discuss the potential effects of Airbnb entry into a segmented accommodation market. We then present econometric results the cities for which we were able to collect the necessary data, taking particular care with the time series properties of the data as previous research has not addressed the non-stationarity that is present.

We find that a rise in the number of Airbnb listings in a city was associated over this period with a fall in the average hotel occupancy rate, but an increase in the average daily rate received by hotels. The combined effect on total hotel revenues was ambiguous to slightly positive. On the other hand, the arrival of Airbnb is positively correlated with the rental price index in the UK, but not in Germany.

2. Previous research

The economics of so-called ‘sharing economy’ peer-to-peer asset rental platforms in general are surveyed in a number of recent books and papers, including Coyle (2016), Edelman and Gerardin (2015), and Sundararajan (2016). Such markets have grown rapidly, thanks to a combination of the spread of smartphones enabling constant real-time online access and to innovations in algorithmic and marketplace design. A model of the consumer choice in a P2P market is discussed in Horton and Zeckhauser (2016). In their model, in which there is a single pool of owners and renters, there is a short-term equilibrium after the emergence of a P2P rental market, in which both owners and renters use the asset as if they were paying the market-clearing rental rate – the owners as there is now an opportunity cost to their own use of the asset. In the long run, the presence of the market for services from assets can change the buy-or-rent decision: the (normalized) purchase price equals the market clearing rental rate. If the short run rental rate is below

4 The 14 cities are Nantes, Paris, Strasbourg, Toulouse, Berlin, Cologne, Frankfurt, Munich, Edinburgh, Glasgow, London, Manchester, Amsterdam, and Barcelona.

(normalized) purchase price, demand for asset ownership will decline. These results are tempered by the presence of 'bring to market' costs, which include costs such as labour to prepare the asset for renting out (cleaning, key exchange) and also the temporal indivisibility of some assets (is it easy or hard to lend them out in small chunks of time). The existence of such costs means that consumers placing enough value on the use of the asset will tilt toward ownership rather than renting. Income is also a constraint on ownership high-value assets such as urban properties. Like other analyses of P2P platforms, Horton and Zeckhauser find that the existence of the platform increases social welfare (eg Edelman and Girardin 2015, Benjaafar et al 2015, Einav et al 2015).

The empirical literature on Airbnb is small but growing. Zervas et al (2014) group hotels into budget hotels likely to be competing with Airbnb rentals, and high-end hotels catering to business travellers. Looking at data for Austin, Texas, they found an 8-10% drop in hotel revenue in locations where Airbnb supply is highest. They also found that the lower-priced hotels and those not catering to business travellers were the most affected. The effect was uneven since rooms in private apartments are highly heterogeneous in their features. Hotels still commanded a premium over Airbnb because some customers prefer the quality, the consistency of service, and other standard attributes provided by hotels. A study on the Netherlands found a negative but small effect of Airbnb entry on hotel prices. (Hooijer 2016) (check the reference). Neeser (2015) looked at three Scandinavian countries and found no significant effect on average hotel room prices, but a small negative effect in the places where there had been most growth in Airbnb listings. Quattrone et al (2016) explore the geography of Airbnb in London, finding that listings on the platform are linked to socio-economic characteristics of neighbourhoods, with more listings in desirable areas with young populations and more residents who are employed, and born outside the UK. Listings are less likely to be found in more distant residential areas with more houses than flats. However, the listings have expanded over time from central areas to more distant areas. (Quattrone et al 2016).

We are not aware of any empirical work looking specifically at the private rental market. Furthermore, given that the hotel and rental market contexts in terms of both demand and supply can differ greatly between cities, it is important for policy makers to have evidence specific to their own locations.

3. The structure of the accommodation market

There are a number of regulatory issues at stake when it comes to understanding the market impacts of Airbnb. In terms of the impact on the incumbent hotel business, tourism is an important sector of the economy. The EU28 countries received 457 million

international tourists in 2014 compared to 331 million arrivals in 2000.⁵ While there are many factors contributing to its growth, digital technology has revolutionised the travel and tourism business, enabling individuals to construct their own trips from a far wider array of choices. The first stage in the technology-driven evolution was the growth of online travel agencies (OTAs), which have largely replaced traditional high street agencies. They improved competition among hotels by providing smaller hotels with a platform. But competition authorities have been concerned about the business model and structure of the industry. Booking.com is the most popular online hotel booking platform, especially in the US but globally ranking at 112 among all websites. It is the dominant player in the market and despite interventions by competition authorities, its pricing tactics still make it hard for a new entrant to gain market share through price competition (Coyle 2016).

Hoteliers complain that Airbnb specifically presents unfair competition because hosts listing on the platform can easily avoid the taxes and regulations applied to the formal hotel sector. The hoteliers see it as increasing the supply of short-stay accommodation competing directly with hotel rooms. Local authorities are most concerned about loss of tax revenues, safety issues, and in some cases also about the increased volume of visitors to already-crowded city centres.

City authorities may also be concerned about the other side of the coin, that the growth of Airbnb might reduce the supply of private rental accommodation available to residents, in tight housing markets. There have also been some issues about externalities such as additional noise and rowdy or anonymous visitors in residential areas. An additional issue is visitor safety, since some non-tourist residential areas could potentially be more dangerous. A hotel seems safer since there are staff and also other travellers. Meanwhile, some sorting is going on. The maps we present below show that highly demanded Airbnb properties are sparsely located, if not absent, in poorer or rougher areas of the cities. They are absent perhaps due to the fact that users are informed enough to avoid certain areas, while hosts in these areas will accumulate fewer visits and reviews. Still, it is difficult to disentangle the demand-side factors from those of the supply-side.

A number of European cities have recently tightened regulations applied to Airbnb rentals. Berlin has banned unregistered short-term rentals. In Brussels owners need permission from their building owners or commune. Amsterdam has limited the number of people who can jointly rent one property (to prevent noisy parties). Barcelona requires the host to be in residence during the rental period, or otherwise treats the property in the same way as a hotel. Many cities limit the amount of time during the year a property can be rented out through Airbnb-type platforms, a policy directed at preventing the crowding out of residents in the private rental market. Barcelona and Paris have fined

⁵ The sharing economy and tourism: Tourist accommodation. European Parliament Briefing September 2015.

Airbnb for various regulatory violations. By November 2016, Airbnb has agreed to collect tourism taxes in 200 cities, and aims to secure in total 700 cities that generate 90 percent of its revenue.⁶ According to the agreements the company collects taxes from users and remits to the city governments. Airbnb hosts in Paris now face an even tighter regulation that obliges Airbnb to hand over tax data automatically to the authorities, effectively forcing hosts to pay the required taxes.⁷

Other researchers have considered separate aspects of these issues. Although long-term renters' sensitivity to price will be affected by liquidity constraints, in equilibrium rental prices should be equal to (suitably normalised) property purchase prices. This rent-or-buy decision is the one analysed by Horton and Zeckhauser (2016). We do not consider the rent-or-buy decision further here as it is not one of the relevant regulatory concerns.

Einav et al (2015) present a stylised model of new flexible entry like Airbnb into a hotel market, where hotels have fixed upfront as well as variable costs, and the new entrants have variable costs only. Their results support the intuition that when demand is high, additional flexible supply is induced. This will reduce the equilibrium price and the profitability of owners of fixed supply (hotels). The higher fixed costs and the lower variable costs, the more flexible supply there will be. An additional element is the cost of visibility in the market, a fixed cost assumed to be equal for all suppliers. Lower visibility costs will increase total capacity and flexible capacity; but decrease fixed capacity, and also prices.

This is only part of the story, however. The context into which Airbnb is entering is one of inter-related but segmented property markets. The demand side in urban rental markets is normally segmented: demand for long-term rentals and short-term stays in cities have been largely (although not completely) distinct. The entry of Airbnb into the market is unlikely to affect long term rental demand, which will depend on factors such as employment and population growth; but it could increase demand for short stay accommodation if travellers either have sufficiently price elastic demand or are attracted by other characteristics (such as the greater ease of visiting with children). In any case, short and long stay demands will probably retain distinct characteristics, preserving demand-side segmentation.

Within short-stay demand there may additionally be other relevant market segments: less price sensitive business travellers and more price sensitive tourists. Despite the cost-advantage of Airbnb listings, hotels are obviously not always an inferior choice, so these segments may also be preserved. Business travellers are much more able or willing to pay

⁶ Financial Times, 20 November 2016. Retrieved on 28 December 2016 at <https://www.ft.com/content/c87a1a0a-aecf-11e6-a37c-f4a01f1b0fa1>.

⁷ Financial Times, 14 December 2016. Retrieved on 28 December 2016 at <https://www.ft.com/content/6f774046-bbb2-11e6-8b45-b8b81dd5d080>.

for convenience and reliability. For example, Airbnb hosts can cancel reservations at short notice and the platform does not penalize the hosts who renege on their promises, or compensate the users who find themselves nowhere to stay at short notice. The informality of the sharing economy does not (yet) sustain service norms. On the other hand, we always expect hotels to observe their promises. By screening out budget travellers, hotels may be better able to identify customers with less price-elastic demand and thus possibly even raise prices and obtain higher revenue thanks to the greater scope for price discrimination. Thus the entry of flexible low cost supply could in effect push up the prices and revenues of some hoteliers, though low-cost hotels may suffer.

The literature on segmentation in housing (or labour) markets focuses largely on differences in preferences and search costs on the demand side.⁸ However, the entry of Airbnb may be eroding supply side segmentation between hotels and rental apartments, as well as increasing the supply of flexible/informal short-term accommodation. Entry into the hotel market has always been expensive, requiring both significant financial investment and a number of one-off regulatory and other barriers (licensing, inspections, marketing, etc.) so supply is inelastic. Entry into property ownership (for own use or rental) is similarly costly (with different costs) and constrained by physical supply in large cities, but existing owners may be concluding that the Airbnb platform gives them the option of short-term rentals.⁹

There are therefore two margins of choice on the supply side to consider post-Airbnb entry into a market:

- for existing private owners who can now choose to supply spare capacity to short-term renters if they perceive demand to be sufficiently high and revenues to

⁸ See for example Islam et al 2009.

⁹ Demand will be a function of price p , and other characteristics k . These can include reliability, location, length of contractable stay and so on. (Demand can also be shifted by events exogenous to the market, of course.)

$$D = D(p, k)$$

Costs of providing accommodation include:

Upfront fixed costs $c(q)$ to provide q units (person-nights) of accommodation

Variable cost c_o per unit

Market visibility costs $b > 0$

A stylised picture of the market would assume hotels will have both fixed and variable costs, Airbnb hosts have variable costs only, and private landlords fixed costs only. All three kinds of suppliers will incur visibility costs.

- exceed the costs of joining the platform and providing the services such as key exchange and cleaning;
- for existing landlords who can choose to supply to short-term rather than long-term renters. Landlords will want to consider whether this is a more profitable option. They are also likely to face fewer regulatory constraints on both price and tenancy conditions if they switch. On the other hand, there may (in principle) be higher visitor taxes on short-term rentals.

Note, however, that the different regulatory concerns about the effects of Airbnb will not be simultaneously valid. If the entry of the platform is reducing the profitability of hotels, it is unlikely that it will be tempting private landlords to switch from long-term rentals into behaving more like hotels. In what follows we therefore look at the effects of Airbnb expansion on both hotel performance and private rental costs.

Hotel and Airbnb are generally believed to be competitors. Assume that hoteliers face downward sloping individual demand, i.e. each of them commands a certain degree of market power. Profit maximization requires marginal revenue equal marginal cost:

$$MC = MR = p(1 - \frac{1}{\epsilon})$$

where p is the price and ϵ is the price elasticity of demand. The prominence of Airbnb very likely causes some visitors to shift their demand away from hotels. A fall in demand then causes the marginal cost to fall. But if the demand now becomes less price elastic, the term in the parentheses decreases and the price may go up to restore the equilibrium. Therefore, a fall in demand for hotel rooms due to the booming of Airbnb may cause the room rate to increase, if the remaining customers are less price elastic. The overall effect on total revenue is ambiguous, which may also increase if the magnitude of the price rise overwhelms that of the fall of occupancy of hotel rooms.

Airbnb impacts the traditional rental market in a different way. Owners may supply their properties to the Airbnb platform instead of the traditional long-term rental market. The prospect of earning a higher return from the Airbnb platform causes the supply of the long-term leases to fall and also the rent to rise to match the opportunity cost. Still, short-term lease and long-term lease are not completely substitutes. Owners may prefer the certainty associated with long-term leases, while some of them prefer the flexibility of Airbnb.

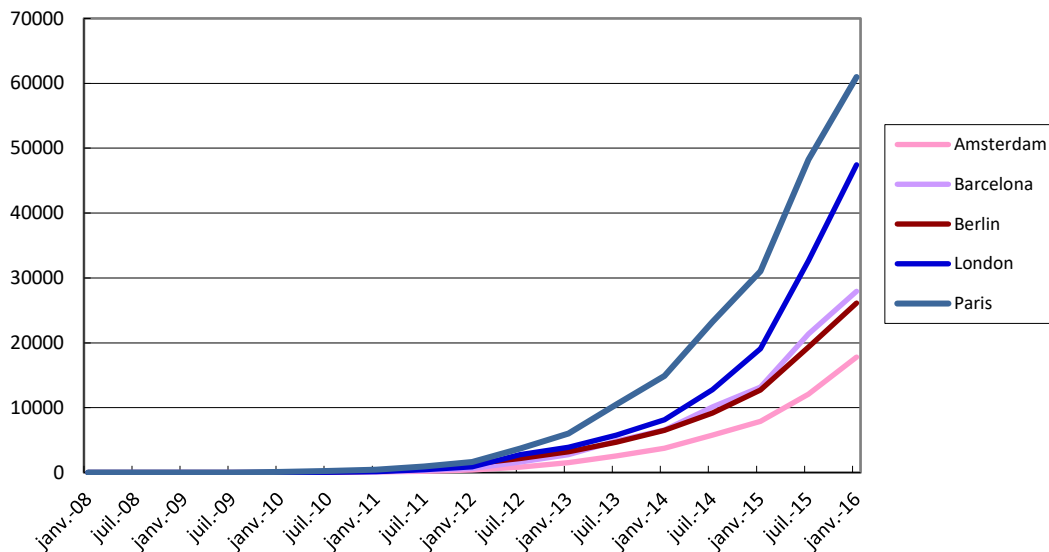
4. Description of the data

Airbnb

Number of listings, occupancy rates and average revenue of Airbnb hosts

According to the Airdna database, 227,093 listings were to be found in the 14 cities in April 2016.¹⁰ Figure 1 displays the number of listings in the 5 biggest cities in the sample from January 2008 to April 2016. Paris ranks the top with 65,217 listings (for perspective, the population the metropolitan region is roughly 12 million).¹¹ A mild catch-up in the smaller cities is evident; the average growth rate of the small cities (those with fewer than 10,000 listings up to April 2016) has outpaced that of the 5 big cities.¹² Properties on Airbnb are highly heterogeneous. The most frequent type of property is ‘apartment’, accounting for 87.8% of all listings, but it is not unusual for Airbnb users to spend a night on a boat or in a castle. The most common type of listing is ‘entire home/apartment’, reaching 65% of the total number listings. However, the cities show a considerable variation in this respect, ranging from just 36% in Manchester to 87% in Paris.

Figure 1: Total No. of Listings



Judged by the performance of the Airbnb listings in the sample from April 2015 to March 2016, at any given time most of the listed properties are not rented. The average occupancy rate was about 30% during the 12 months of the sample period and is significantly influenced by seasonal fluctuations of demand. Taking Paris as an example, the average occupancy rate of a listed Parisian property was 35%. Among those having at least one successful transaction, 23% of them had only one customer every ten days.

¹⁰ The listing is “active” if it has at least one transaction during last 12 months. We will stick with those active listings throughout the analysis.

¹¹ The number of hotel rooms in Paris was roughly 76,600 in 2010.<http://www.hvs.com/Content/3131.pdf>

¹² The big 5 are Paris, London, Berlin, Barcelona and Amsterdam.

Other cities exhibit a similar pattern (see Table 1).

Table 1	Average Occupancy Rate	Proportion of Listings with an occupancy rate			
City		less than 10%	less than 50%	more 90%	than
Amsterdam	39.42%	16.48%	65.40%	2.49%	
Berlin	36.44%	20.32%	69.48%	3.44%	
Barcelona	35.18%	21.91%	70.83%	1.73%	
Paris	35.07%	22.74%	71.10%	1.00%	
Glasgow	33.88%	21.03%	74.49%	3.69%	
London	33.30%	24.31%	73.47%	1.30%	
Nantes	33.27%	23.91%	73.91%	1.08%	
Manchester	31.25%	26.01%	76.73%	2.51%	
Edinburgh	30.00%	27.29%	78.35%	2.19%	
Strasbourg	29.80%	28.58%	77.84%	2.02%	
Toulouse	28.69%	26.27%	81.05%	2.60%	
Munich	26.26%	37.45%	81.50%	1.24%	
Frankfurt	25.04%	33.18%	84.68%	4.41%	
Cologne	23.86%	35.93%	86.24%	2.47%	

Revenue is also unevenly distributed among hosts (See Table 2). For example, among those active listings in Paris, almost 27% have earned less than US\$1,000, while just 3.4% earned more than US\$30,000 during the past year. This suggests a wide range of behaviours on the part of owners.

Table 2	Average Annual Revenue US\$	Proportion of Listings with an annual revenue		
City		Under US\$1,000	Under US\$10,000	Over US\$30,000
London	7928.88	23.48%	72.86%	5.73%
Amsterdam	7792.49	15.26%	73.00%	4.34%
Edinburgh	6714.75	19.35%	76.67%	2.82%
Paris	6535.50	26.82%	79.47%	3.39%
Glasgow	6268.78	22.44%	78.41%	2.33%

Barcelona	6163.10	26.11%	78.66%	2.40%
Manchester	5594.82	29.64%	80.41%	2.42%
Berlin	3858.84	40.10%	88.44%	1.02%
Munich	3754.48	36.59%	89.71%	1.03%
Toulouse	3731.30	29.22%	90.92%	0.22%
Frankfurt	3207.95	34.57%	93.28%	0.33%
Cologne	3149.16	39.10%	93.34%	0.27%
Nantes	2798.53	38.75%	94.59%	0.00%
Strasbourg	2663.29	43.84%	94.89%	0.07%

Reputation

An effective evaluation system is fundamental to the success of any online platform. Airbnb, like other platforms, has an evaluation system for both hosts and visitors. It works as follows: A user books a property through Airbnb. The telephone number and the exact address are revealed to the user only after confirmation. If the host cancels a booking before the visit date, an automatic comment is posted on the wall of reviews of the host:

The host canceled this reservation X days before arrival. This is an automated posting.

The host manages the reception of the visitor (access to keys). After the stay, both the host and the visitor will receive an email with a link to an e-form through Airbnb.¹³ The visitor is asked to rate six aspects of the property: Accuracy, Communication, Cleanliness, Location, Check-in, and Value. A final score, from 0 to 5, is then computed accordingly. Besides the numerical score, the visitor is asked to comment, including the location, the facilities, the environment, and the host's friendliness. Only if both parties have written the review, the reviews will be shown to both and the public. If only one party has written a review, the review will be shown after the 14-day of evaluation period.

The original system is similar except that the review is shown to all once the review is written, regardless whether the counterparty has written a review. The new system (launched in July 2014) is meant to promote more honest and transparent evaluation. However it seems not producing an effect they expected. Since leaving a review is not mandatory, a visitor who had bad experience may not bother to comment. A bad comment from the user may backfire because potential hosts may take that into account before accepting a request.

¹³ There are some users reporting that they received the email for evaluation only after sending a request to Airbnb. Without the email, no host or user can get access to the evaluation system even the stay has finished.

Bilateral evaluation system is plagued with problems, which seems to create a fake ‘feel good’ environment. Listings are not very differentiable in terms of ratings. This phenomenon is already well-recognized in the literature (Dellarocas and Wood, 2008; Bolton et al, 2013; and Fradkin et al. 2014). Zervas, Proserpio and Byers (2015) compare Airbnb and TripAdvisor, which does not use a bilateral evaluation system but allows unilateral comments by visitors, and they find that users tend to give higher ratings on Airbnb. Luca (2016) reviews the design choices available to reduce the bias in reviews but observes that there are inescapable trade-offs (such as the amount versus the quality of information provided by reviewers).

In practice, visitors seem to use the length of time a property has been listed, or the number of reviews posted, rather than the actual rating score to evaluate properties. Figure 2 shows the average annual revenue and the occupancy rate from April 2015 to March 2016 of all listed entire homes/apartments in Paris, sorted by the date of first being listed on Airbnb. A negative trend is clear.¹⁴ Figure 3 plots the average number of reviews and the average rating of the listings of the same period. The sharp fall in number of reviews is not surprising since a new entry takes time to accumulate visitors and reviews. But old and new listings are almost identical in terms of ratings. Thus longer-listed properties do not systematically receive higher ratings, but have accumulated larger numbers of reviews and are thus able to attract more customers and earn higher revenues. Users seem not rely on the rating for selection but instead on the number of reviews and/or longevity of the listing as a measure of trustworthiness. This is consistent with findings about the ineffectiveness to date of online ratings in some other contexts, due to either gaming of the system or a reluctance to post negative reviews.¹⁵

14 Fluctuations in 2008 and 2009 are mainly due to the small number of listings and thus are of less significance.

15 Surveyed in Dellarocas et al (2006)

Figure 2: Revenue and Occupancy Rate
by the Creation Date of the Listings

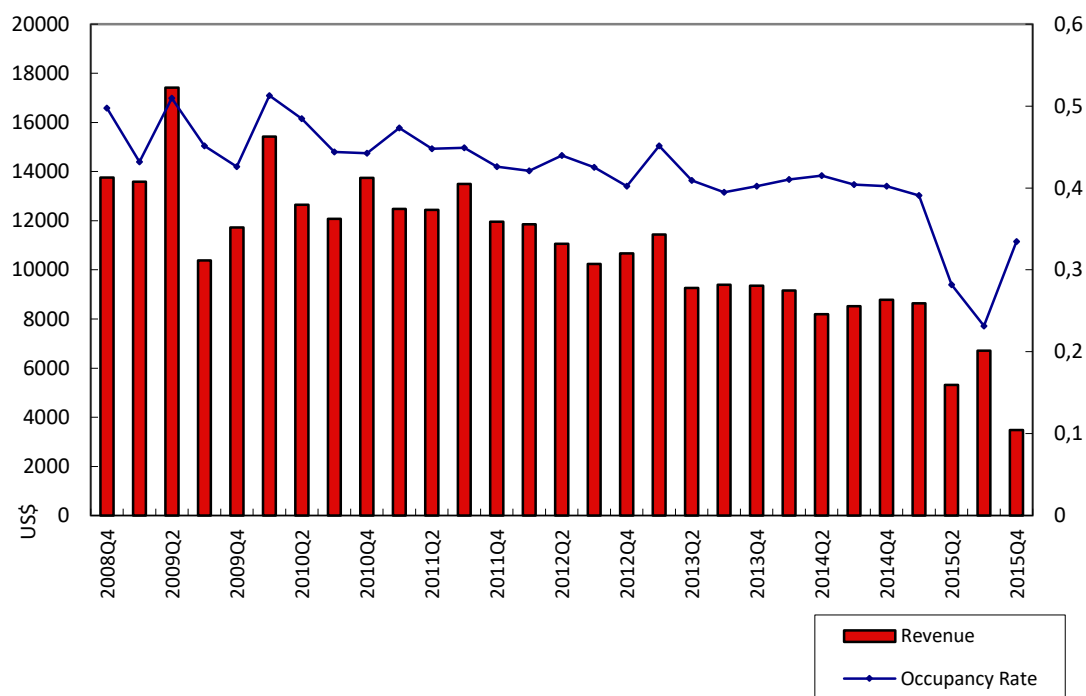
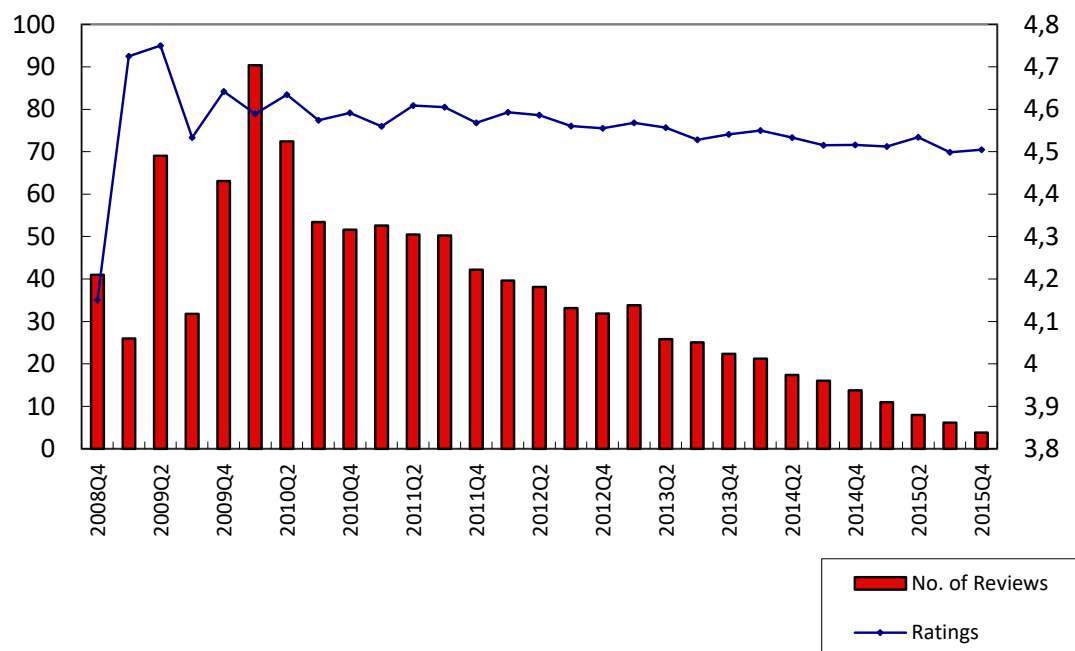


Figure 3: No. of Reviews and Rating
by the Creation Date of the Listing



Location

The location of a listing will certainly influence its revenues. Figures 4 to 7 map the listings with occupancy rate above 75% in Berlin, London, Paris and Toulouse respectively.¹⁶ One of the advantages Airbnb claims to provide is that it directs some of the economic benefit of tourism to local communities outside city centres. Loosely speaking, these maps seem to confirm its claim. Take London as an example. One previous study of web scraped Airbnb data for London concluded that the listings on the site cover a far wider geographical area than hotels, which are concentrated in the centre and towards the west of London. It found that the renters of rooms and those of whole properties had different socio-demographic characteristics and were concentrated in different kinds of neighbourhoods: “Properties are more likely to be concentrated in tech-savvy and well-to-do areas with young renters. In practice, Airbnb listings are very different among them though. A clear distinction that the website makes is between entire homes/ apartments and private rooms. ... We observe significant differences: Airbnb rooms tend to be offered in areas with highly-educated non-UK born renters, while homes tend to be offered in areas with owners of high-end homes in terms of house price.” (Quattrone et al 2015)

Prices

Travellers using Airbnb can find accommodation at a lower cost than hotels and with different attributes. For example, in our dataset, the cost of a standard private room in Paris can be as low as US\$30 (the median rate is US\$54), whereas a single room in a budget hotel in Paris will cost at least US\$60. An entire home sleeping 3-4 people may cost US\$60 a night in Paris on Airbnb (the median rate is US\$96), making a family stay in the city far more affordable than booking two rooms in a hotel. This could help explain why the occupancy rate for entire homes is in general higher than for private rooms. In these cases, Airbnb is likely bringing into the market some visitors who would not otherwise have been able to afford to make the trip. There are also some expensive rooms (>US\$100 per night) and homes (>US\$200 per night) listed. The people hiring these properties could easily afford hotels and so must choose Airbnb for other characteristics, such as personalization (hotels can be bland and rarely enable much interaction with local residents), or location (hotels are clustered in central business districts). The rates (and occupancy) for the 14 cities for the 18 month period in our data set show few signs of any trend but they do display some clear seasonal variation – such as Oktoberfest in Munich and New Year (Hogmanay) in Edinburgh. In most of the 14 cities the rate is stable but some cities (e.g. Nantes, Glasgow) shows a slight downward trend.

Multiple Listings

While the idea of home sharing is becoming popular all over the world, some critics argue that Airbnb is a platform for owners to circumvent existing regulations on leases. One insight into this argument comes from looking at the proportion of the hosts listing

16 All maps are drawn in the scale 1:120,000.

multiple properties on the website. Relatively few hosts have multiple listings. In Paris, for example, 91% of the hosts list just one property; the proportion is substantially lower in some of the other cities. Table 3 shows the extent of multiple listings in the 14 cities.

Table 3	1 listing	2 Listings	3 Listings	4 Listings	5 or more Listings
Paris	90.97%	6.73%	1.16%	0.36%	0.77%
Nantes	89.03%	8.61%	1.60%	0.35%	0.42%
Cologne	88.55%	8.33%	1.46%	0.66%	0.99%
Amsterdam	88.53%	7.92%	1.85%	0.69%	1.01%
Strasbourg	88.53%	9.01%	1.27%	0.47%	0.72%
Toulouse	87.55%	9.30%	1.53%	0.37%	1.25%
Munich	87.30%	9.47%	1.81%	0.79%	0.63%
Berlin	86.18%	9.83%	2.19%	0.72%	1.07%
Frankfurt	86.18%	10.34%	1.88%	0.86%	0.74%
Glasgow	83.50%	11.97%	2.45%	1.09%	1.00%
London	80.89%	12.03%	3.12%	1.27%	2.69%
Manchester	78.61%	13.18%	3.72%	1.62%	2.87%
Edinburgh	77.88%	14.03%	4.11%	1.66%	2.31%
Barcelona	69.37%	16.57%	6.11%	2.65%	5.30%

Figure 4: Berlin

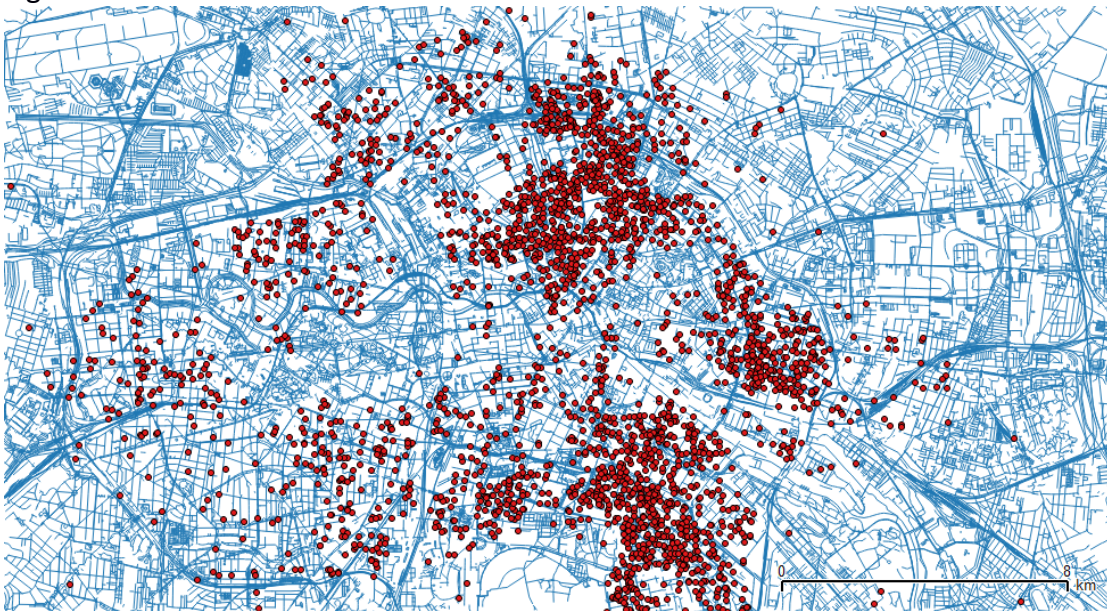


Figure 5: London

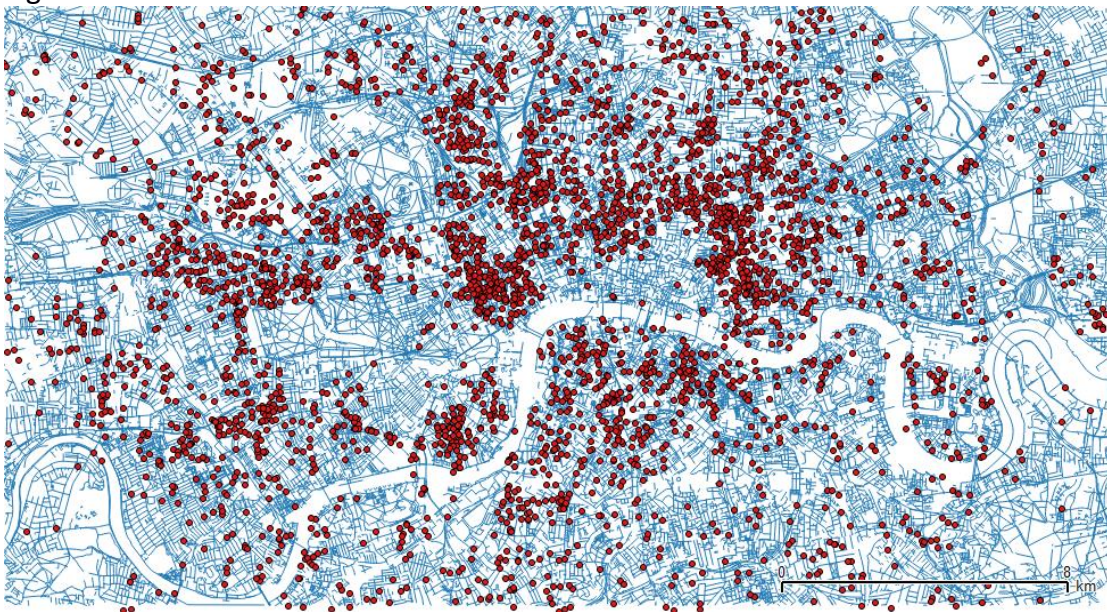


Figure 6: Paris

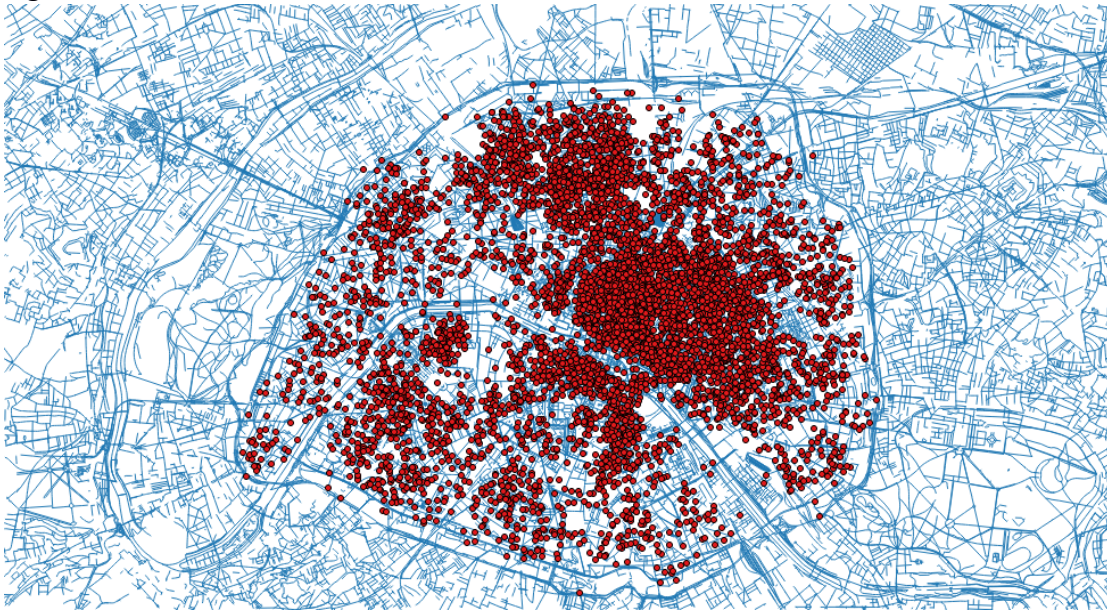
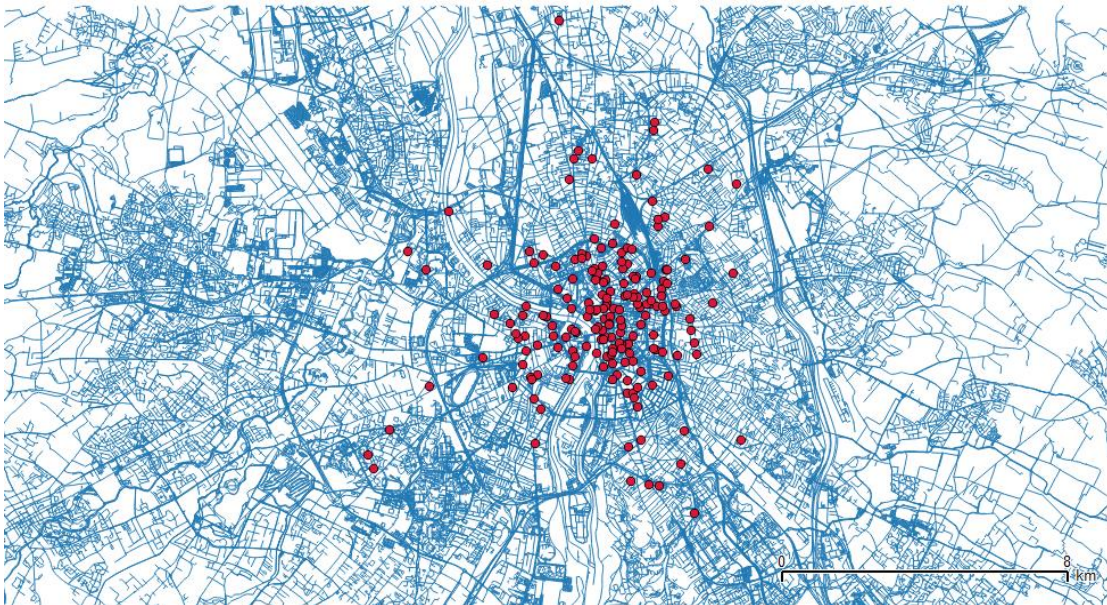


Figure 7: Toulouse



5. Estimation: hotels

In this section, we turn to econometric estimates of the impact of Airbnb activities on the performance of hotels in the 14 European cities.

To measure the actual extent of Airbnb activities, it would have been ideal to have the data on all active listings throughout the period since launch. However, the data were not collected at the time. Instead, the information we have only shows us they were created some time ago and still listed at the time of data collection. That means we cannot retrieve the information on currently unlisted properties. We therefore have to measure Airbnb activity by the stock of listings in a specific month, given that they were listed at the time of data collection, following Zervas et al. (2016). From the information scraped by Airdna, we can identify the earliest date each property is listed on the Airbnb platform. Some properties were never active, judging by the occupancy rate and the number of comments. Some of them had been active for a while but were inactive between April 2015 and March 2016 (over these 12 months Airdna computed the annual revenue and the occupancy rate). To screen out the inactive listings, we exclude those listings which do not have any reviews since listed AND are inactive during the 12 months. In other words, we make sure that those remain in the sample either have at least one review or are shown as active during the specified 12 months.

As an illustration, Figure 8 displays the total number of Airbnb listings in Paris from January 2003 to April 2016. The number of listings took off in September 2008 and grew almost-exponentially; the series is clearly non-stationary.

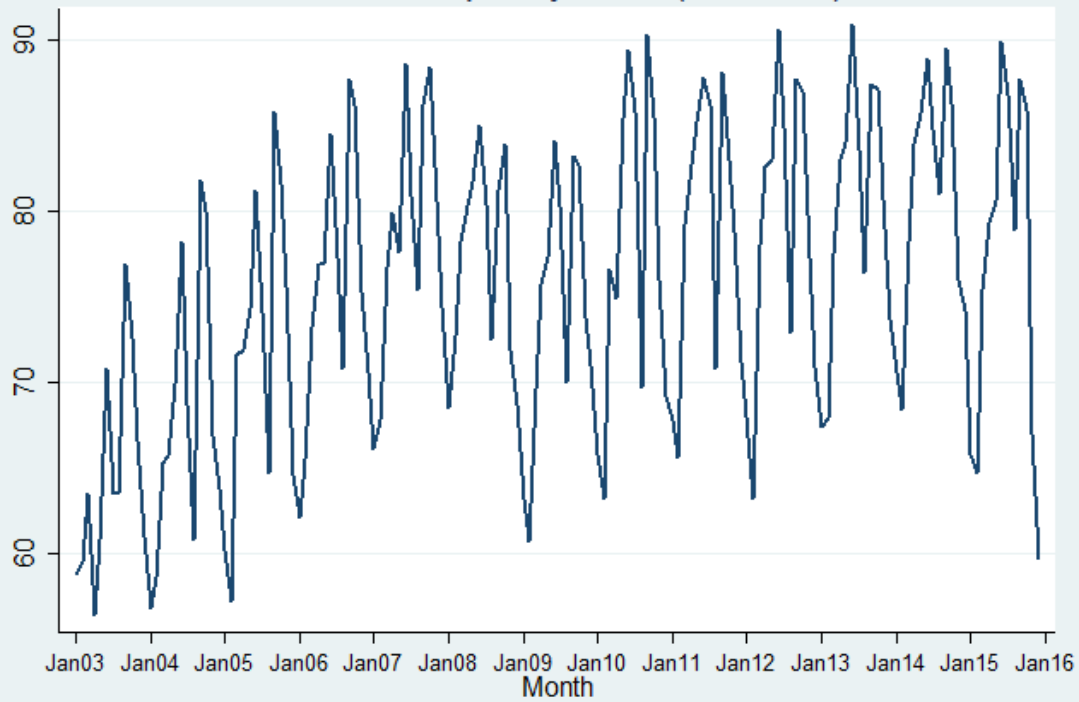
Figure 8



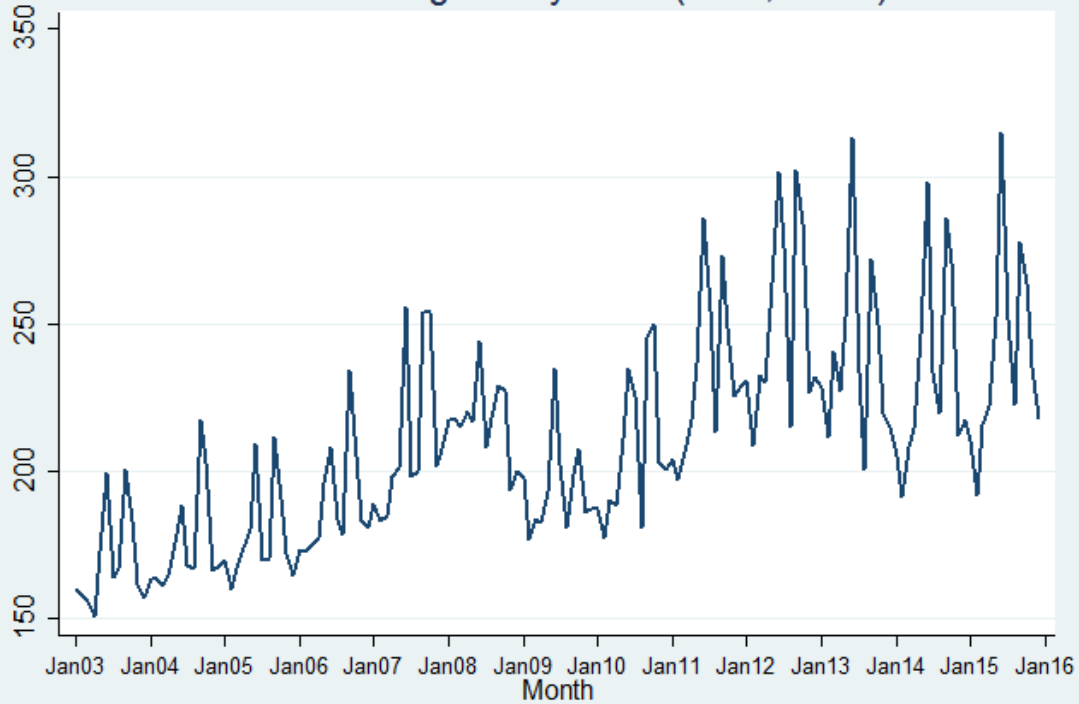
Our data on hotels were provided by the information company STR. We have monthly data from January 2003 to April 2016 for all 14 cities apart from Nantes. While not all hotels responded to STR surveys, the number of responses suggests the survey is representative, and these data are widely used by researchers. We therefore have data for the average daily rate (ADR) received, total hotel revenue, and the average occupancy rate. Figure 9a to 9c display these series for Paris as an illustration.

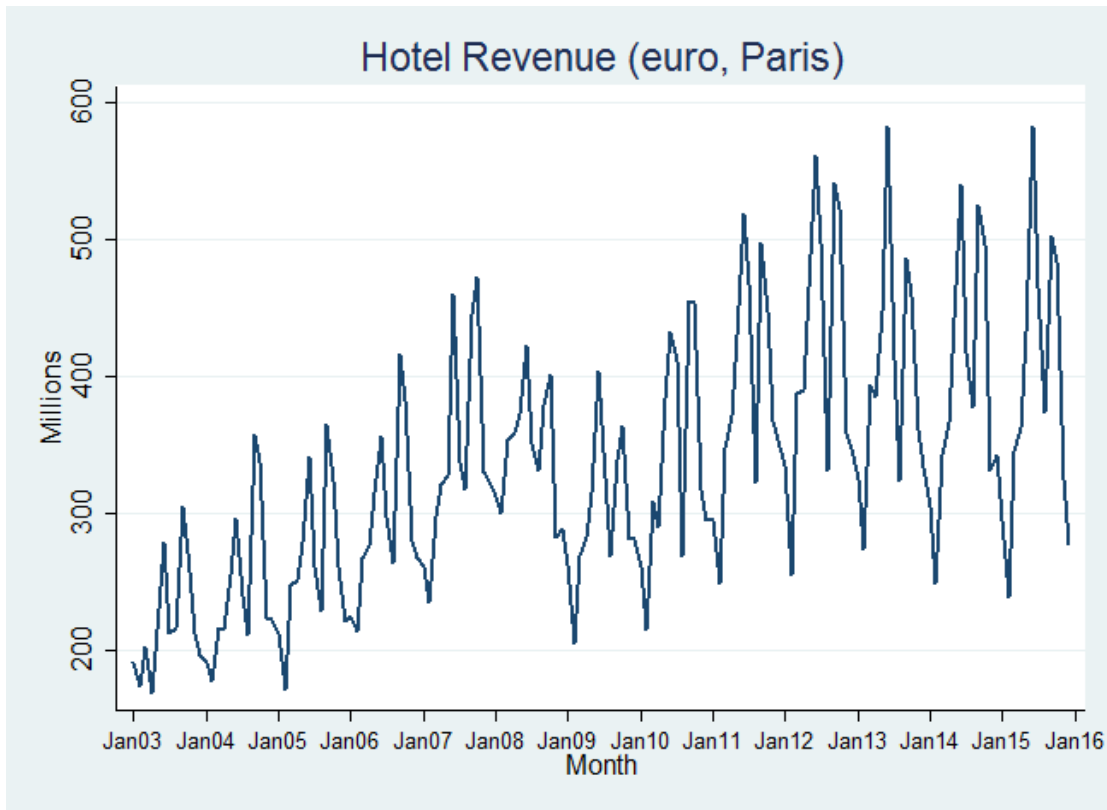
Figure 9a-9c

Hotel Occupancy Rate (% , Paris)



Hotel Average Daily Rate (euro, Paris)





There are clearly strong seasonal fluctuations: local peaks are usually found every June and September. The average daily rate seems to follow an upward trend, while the total revenue follows a similar. The average occupancy rate varies roughly between 60% and 90%, and again a dip towards 2016 is apparent. We report below on the formal tests for stationarity of these series.

Other Variables

Following Zervas et al. (2016), we expect that unemployment rate and the population of the city will affect hotel performance. However, data for these two variables are not readily available at the city level. We searched for the regional level data from their relevant national statistics office.¹⁷ However, not all of provide data for the whole period

17

Quarterly unemployment rate at department level of France since 2003: <http://www.bdm.insee.fr/bdm2/choixCriteres?codeGroupe=713>

Monthly unemployment rate at state level of Germany since 2005: <https://www-genesis.destatis.de/genesis/online>

Monthly unemployment rate at region level of the UK since April 2011: <http://www.ons.gov.uk/ons/rel/lms/labour-market-statistics/index.html>

from January 2003 to April 2016. To supplement the national sources, we rely on Eurostat, which provides yearly unemployment rates at the regional level (NUTS2) until 2015.¹⁸ Based on the quarterly figures, monthly figures are computed by linear interpolation.¹⁹ By assuming that the rate for the major cities of the region dominates the regional rate, the unemployment rate at the regional level is taken as a proxy for the rate at the city level.²⁰

Population size is trickier still. Cities have varying definitions of their boundary. Depending on the boundary they employ, figures from different sources are often inconsistent. Eurostat has collected the information from member states concerning the demographic variables at the city-level (NUTS3). However, the dataset is plagued with missing observations and does not stretch back to 2003. Instead, we therefore rely on the data on yearly population for Metropolitan Regions, also gathered by Eurostat.²¹ This covers all the cities from 2003 to 2015. We extrapolate the population in 2016 by a simple linear regression on a time trend. Since metropolitan regions are NUTS level 3 approximations of the Functional Urban Areas (city and commuting zones), it is arguably the most accurate data on city-level population.²²

Estimation

As in Zervas et al (2016), we estimate the following model:

$$HotelPerformance_{it} = bAirbnb_{it} + d_i + Xg + e_{it}$$

where e_{it} are the unobserved random errors. *Hotel Performance* refers to either the average occupancy rate (expressed in percentage points), the log of average daily rate, or

Quarterly unemployment rate at region level of Spain since 2003:

<http://www.ine.es/jaxiT3/Tabla.htm?t=4247&L=1>

Monthly unemployment of the Netherlands since 2003: <https://www.cbs.nl/en-gb/figures>

18 See the definition of NUTS2 in <http://ec.europa.eu/eurostat/documents/3859598/5916917/KS-RA-11-011-EN.PDF>

19 When the two sources do not match closely at the discontinuity, a uniform incremental amount is added onto or subtracted from the series of Eurostat to eliminate the discrepancy.

20 We suppose that the figures are the annual average of the year and attach them to the mid (June) of the corresponding year. We compute monthly unemployment rates and monthly population from the yearly figures by a linear interpolation.

21 See <http://ec.europa.eu/eurostat/web/population-demography-migration-projections/population-data/main-tables>

22 Note that all figures are in thousands.

the log of total hotel revenue.²³ To avoid any undefined values, we add one to the number of Airbnb listings before taking the natural logarithm. Apart from the city fixed effects α_i , we include the log of population and the unemployment rate as control variables (X). We used two ways to capture the time fixed effects. First, we included time dummies for each month in the estimation. In total 159 binary variables were thus added into the regression. As this greatly reduces the degrees of freedom, secondly, we included a linear time trend and 11 calendar month dummies. This specification reduces the number of variables on the right-hand side and allows for seasonal regularities.

The first method is used for the odd numbered columns of Table 4, while the even ones display the results of the second method.

Surprisingly, given the popular assumption, Airbnb activities have a *positive* impact on hotel performance in this specification. For example, focusing on the second method of time detrending, a 10 percentage point increase in Airbnb listings causes on average a 5.7 percentage point increase in hotel occupancy rate, but a 0.15 percentage point *increase* in ADR, and a 0.27 percentage point *increase* in total revenue. The unemployment rate enters negatively into the regressions, as expected. Population does not show a significant impact on ADR and total revenue, but a negative correlation with occupancy rate is apparent.

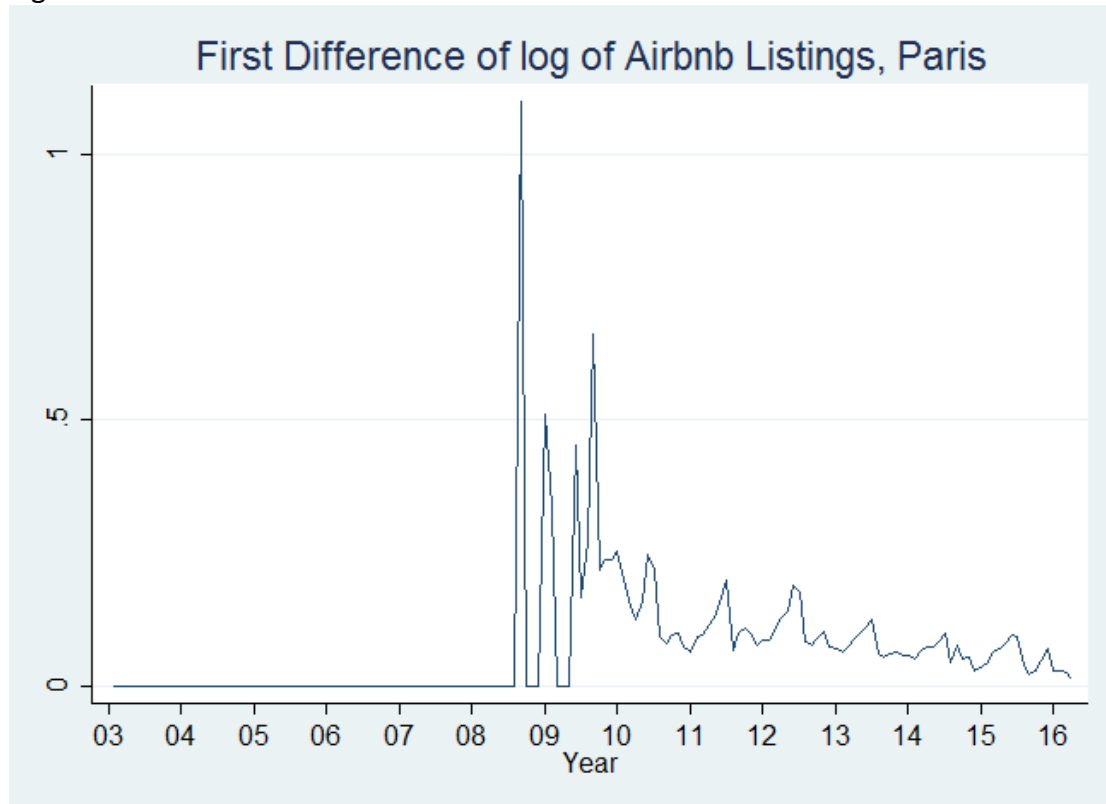
However, since the number of Airbnb activities soared rapidly during the period covered, it is almost certain that the series is non-stationary, so the first specification (although used by other authors) is unsatisfactory. The three measurements of hotel performance may also be non-stationary. Results in the existing literature have not considered the consequences of non-stationarity, which may be a drawback with the previous estimates. To illustrate the consequences, we report the first difference estimation in the Table 5, which shares the same structure with Table 4. In this case we do not find any significant correlation between Airbnb activities and the hotel occupancy rate, although the sign is negative as would be expected if they are substitutes. New Airbnb listings (as the series is first differenced) seem not to influence hotel average daily rate and total revenue. A change in the unemployment rate shows the expected sign: a higher unemployment rate indicates a worsening health of the general economy, which also affects hotel performance.

However, although the first differencing deals with the issue of non-stationarity, the economic meaning of the results is more obscure. First, the series for Airbnb listings started at zero and grew very rapidly after September 2008. The log-difference transformation approximates the percentage change of the variable. As a result, we find very big values of this variable around when Airbnb was launched but then relatively small values towards 2016, as displayed in the case of Paris in Figure 10. However, one would

23 Note that Zervas et al. (2016) were working with individual hotel level dependent variables.

expect the impact of Airbnb activities to be more pronounced when the pool of Airbnb listings has become sufficiently big relative to the size of the accommodation market. Moreover, the first difference model takes away the effect of the stock of Airbnb listings. New additions to the stock may not significantly influence the hotel market because they might not be active right in the month they were listed.

Figure 10



While the first-difference model does not deliver meaningful results, we try including the first-difference of the log of Airbnb activities into the baseline estimation to check if both the change and the level of the activities have an impact on the hotel performance. Table 6 illustrates the results. The inclusion of the change increases the significance of the coefficients, while their magnitudes remain more or less the same. The change itself does not significantly explain the hotel performance, except for ADR and total revenue with the second method of detrending. The sign is negative, meaning that a larger increase in Airbnb activities reduces the ADR and total hotel revenue, after controlling for seasonal patterns. Meanwhile, the level of Airbnb activities remains significant but positive. The results are hard to interpret so we consider that a better way to estimate the impact is to explicitly deal with the potential cointegration relationship.

Therefore we next explore the possibility that there is cointegration relationship between Airbnb listings and hotel performance.

Since we have a long panel dataset of moderate size, we selected the Levin-Lin-Chu (LLC) test for the stationarity of the series (Levin et al., 2002; Baltagi, 2008). However, since the test requires a balanced panel dataset, we dropped Nantes from the sample. This reduced the total number of observations to 2,080. We allowed at most 12 lags in the augmented Dickey-Fuller (ADF) regressions because we suspect that the seasonal effect is strongly affecting the series. The choice of lags was then made by minimizing the Akaike Information Criterion (AIC). In all the tests we also included panel-specific means with or without time trends.

Table 7 shows the test results. We cannot reject the null hypothesis that the panels contain unit roots. In other words, all of the series must be supposed to be non-stationary. The usual fixed effect OLS estimates may deliver biased results.

We therefore applied the cointegration test developed by (Pedroni 1999, 2001, 2004), which is designed for nonstationary heterogeneous long panels. Nantes was still excluded to keep the panel dataset balanced. Since we have a reasonably long panel ($T=160$), we believe that all tests are roughly equally powerful, and thus only report the rho-statistics and the t-statistics, both panel and group, out of the seven statistics, which are normalized to $N(0,1)$ under the null of no cointegration. Since these four statistics diverge to negative infinity under the alternative hypothesis, the left tail of the normal distribution is used to reject the null. Results are shown in Table 8. All statistics lead us to reject the null hypothesis, which means that cointegration relationships exist between Airbnb activities and the hotel performance variables.

To estimate the cointegration relationship, we use the panel dynamic OLS (hereafter PDOLS) (Pedroni, 2001) and the augmented mean group estimator (hereafter AMG) (Eberhardt, 2012). The former is an extension of the individual time-series dynamic OLS (DOLS). The idea is to conduct a DOLS regression in which leads and lags are included to capture the dynamic process in each city, and then the beta coefficients and the associated t-statistics are averaged over the entire panel by the Pedroni's group-mean method (Neal, 2014). However, the DOLS estimator is biased in the presence of cross-sectional dependence in the data, known as common shocks. The latter allows the unobservable common shocks to be accounted for. The main principle of the estimator is first to estimate the coefficients of the time dummies, and then the estimated process is subtracted from the dependent variable. Finally, the coefficients are obtained by averaging the results of the group-specific regressions across the panel. Eberhardt and Teal (2010) have a detailed discussion of the estimator.

The results are shown in Table 9. They show a negative, though not statistically significant, impact of Airbnb activities on the hotel occupancy rate, as shown by column 2 where the AMG is employed. A 10 percentage point increase in Airbnb listings causes on average a 6.9 percentage point fall in the average occupancy rate, which is considerable. The sign of unemployment rate is as expected but not statistically significant. The significant

coefficients on the common shocks in the AMG estimation justify the use of the estimator and imply that all panels follow a common dynamic process.

However, both estimators show a *positive* impact of Airbnb activities on the ADR. A 10 percentage points increase in Airbnb listings causes on average 0.35 percentage point rise in the ADR, as shown by the AMG in column 2. If a room costs 100 euros per night, the impact is expected to be 0.35 euro, which seems quite small but the overall effect on total revenue could be very large. Both population and unemployment enter the regressions negatively. In column 4, while the common shock is highly significant, the group-specific time trends also help explain the variation in the ADR.

Concerning total hotel revenue, Airbnb activities exert a weak positive impact. A 10 percentage point increase in Airbnb listings causes on average 0.16-0.233 percentage point rise in the total revenue. The impact of the other variables is similar to their impact on ADR.

6. Estimation: Rental Market

Airbnb activities may also impact the rental market. As discussed above, property owners could easily get access to a pool of potential short-term tenants through the platform of Airbnb. They might then withdraw from the long-term rental market and channel their properties to the short-term market. Consequently, the supply of the properties in the traditional long-term market would shrink and the rents go up.

Unfortunately we could not find comparable data on rents in all 14 cities. The limitation of data leads us to focus on Germany and the UK. The Office for National Statistics provides an index of private housing rental prices back to 2011 at region-level, while the Federal Statistical Office of Germany has computed a similar index since 2005 at state-level. Since the cities of concern are the leading cities of their corresponding region/state, we assume that the two indices accurately reflect the change of the rental prices of the cities. We combine the two sources by normalizing the index to 100 at January 2011. Note that the indices do not consider between-city variations—all cities score 100 at January 2005. Between-city analysis will only be meaningful if we study the impact of Airbnb activities on the change in rental prices.

Since a regression on the rental index at level is flawed, we are left with first-difference model. Similarly to the previous section, we include population, unemployment rate, and time fixed-effect in addition to the Airbnb activities on the right-hand side of the regression. Table 10 reports the results where the standard errors are adjusted for clustering in city.

Column 1 reports the estimation of the sub-sample for Germany, and column 2 that for the UK, while column 3 shows the result of the whole of this sample. We do not find a

significant correlation in the sub-sample for Germany, but a positive and significant correlation between Airbnb activities and rental prices in the UK. A 1 percentage point increase in the number of Airbnb activities there is on average associated with a rise in the rental index of 0.22. But the correlation is again insignificant in the whole sample. As the impact varies considerably across the two countries, the results must be interpreted very cautiously.

Since the series of rental index in the UK begins in January 2011, the first-difference model makes better economic sense because the initial period of the launch of Airbnb had been passed (there were 144 properties listed in London by January 2011). In column 4, we restrict the Germany sub-sample to cover only the period since 2011 to see if the period of the investigation matters. Comparing with the result of column 2, we find the coefficient of Airbnb activities is slightly bigger in magnitude and remains insignificant, indicating that the positive effect on rents is absent in. This may reflect the differences in regulations concerning the rental market and Airbnb activities. A more detailed investigation into the local market conditions and regulation is necessary before we can judge whether Airbnb encroaches the long-term private rental market.

7. Discussion and Conclusion

It is widely presumed that Airbnb has had an adverse effect on hotels since the two forms of short-term accommodation are assumed to be substitutes. However, our results, taking due account of the time series properties of the data, suggest that Airbnb activities may not be as harmful as presumed to the hotel industry.

One possible explanation is that Airbnb reduces the demand by budget tourists for hotels, which can however then charge a higher price to other travellers whose demand is less price-elastic. Hotels would then enjoy a higher average daily rate but might or might not enjoy higher revenue, depending on the relative change in price and quantity. We would expect the occupancy rate to fall and the ADR to rise, exactly as in our results, but the effect on the total revenue to be ambiguous, which is positive in our estimation.

As shown by previous study by Zervas et al. (2016), low-cost budget hotels in Texas were more affected by Airbnb than high-end hotels. We expect the same pattern in Europe but unfortunately we do not have hotel level data to explore this in detail. Economic reasoning suggests the negative impact on hotels would be more pronounced among low-end hotels, and the positive impact on price and total revenue concentrated among the high-end. This will be a question for future research.

However, the evidence available does not support hoteliers' arguments that regulators should act in order to prevent Airbnb from expanding in the market. In any case, regulatory action should be directed to total surplus or consumer surplus, rather than the

profit of incumbents, and there is every indication that the platform greatly benefits visitors as well as hosts. Our results suggest that it is not even the case that all hoteliers are harmed in terms of their revenues and profitability by the entry of Airbnb, and that the assumption about straightforward substitutability between hotel rooms and Airbnb properties is not valid. The erosion of the previously sharp segmentation between short-term and long-term accommodation is perhaps enabling a re-segmentation of the market into high-end and low-end offers. By collecting data from a number of different sources, and considering carefully the time series properties, we have presented evidence that a rise in Airbnb activities is in general associated with a fall in the hotel occupancy rate, but with an increase in the average daily rate and total hotel revenue. On the other hand, Airbnb activities have different impacts on the rental market in different cities, hinting at the importance of local conditions. Our results here are tentative given the lack of availability of more data on rents. However, they do indicate that regulators should give due regard to local market conditions. The number of Airbnb listings in the German and UK cities in 2015-16 was small relative to the total housing stock, but our results may indicate that in the UK the supply of rental accommodation is so constrained that some substitution by property owners from long-term to short-term supply had an upward impact on rents in the latter segment. However, even if this tentative result were confirmed, the policy lesson would concern measures to increase the supply of housing rather than restricting the choice by owners over their use of the properties.

There is in addition a range of regulatory questions outside the scope of our results here, including the collection of taxes, neighbourhood disamenities from an increase in visitor numbers, and possible safety issues.

Table 4 : Baseline Estimation

	1	2	3	4	5	6
	Occupancy		ADR		Revenue	
Airbnb	.820	.570*	.030**	.015**	.042**	.027***
	(1.62)	(2.10)	(2.30)	(2.75)	(2.28)	(3.78)
Unemployment	-.349***	-.405***	-.020***	-.023***	-.025***	-.029***
	(-3.14)	(-4.23)	(-3.17)	(-3.48)	(-3.63)	(-4.25)
Population	-87.6*	-85.1*	-.566	-.414	-1.86	-1.69
	(-1.83)	(-1.89)	(-.53)	(-.39)	(-.90)	(-.84)
Time FE	Y	N	Y	N	Y	N
Month FE	N	Y	N	Y	N	Y
Linear Trend	N	Y	N	Y	N	Y
No. of Obs.	2122	2122	2122	2122	2122	2122
Within R-sq	.619	.569	.411	.332	.606	.551
Between R-sq	.193	.193	.467	.446	.796	.798
Overall R-sq	.019	.020	.246	.224	.704	.705
Robust SE are computed and t-statistics are shown in parentheses.						
* p<10% ** p<5% *** p<1%						

Table 5: First-Difference Model

	1	2	3	4	5	6
	Occupancy		ADR		Revenue	
D.Airbnb	-.650	-.636	.020	.015	.009	.006
	(-.41)	(-.45)	(.67)	(.59)	(.19)	(.14)
D.Unemploy	-1.00	-1.09	-.015	-.002	-.003	-.018
	(-1.44)	(-1.63)	(.77)	(-.10)	(-.15)	(-.81)
D.Population	28.1	80.1	1.65	3.15	1.62	3.72
	(.08)	(.24)	(.26)	(.50)	(.16)	(.38)
Time FE	Y	N	Y	N	Y	N
Month FE	N	Y	N	Y	N	Y
No. of Obs.	2108	2108	2108	2108	2108	2108
R-sq	.470	.416	.341	.301	.407	.361
Robust SE are computed and t-statistics are shown in parentheses.						
* p<10% ** p<5% *** p<1%						

Table 6: First-differenced ln(Airbnb) included

	1	2	3	4	5	6
	Occupancy		ADR		Revenue	
Airbnb	.799***	.566***	.030***	.015***	.042***	.026***

	(4.91)	(6.09)	(9.04)	(7.84)	(8.28)	(9.10)
Unemployment	-.353***	-.410***	-.020***	-.023***	-.025***	-.028***
	(-5.68)	(-6.64)	(-16.2)	(-18.65)	(-12.88)	(-14.87)
Population	-87.6***	-84.9***	-.608***	-.447**	-1.88***	-1.69***
	(-9.17)	(-8.70)	(-3.16)	(-2.27)	(-6.36)	(-5.59)
D.Airbnb	1.25	.283	-.028	-.069***	-.015	-.075**
	(.95)	(.23)	(-1.06)	(-2.84)	(-.37)	(-2.01)
Time FE	Y	N	Y	N	Y	N
Month FE	N	Y	N	Y	N	Y
Linear Trend	N	Y	N	Y	N	Y
No. of Obs.	2109	2109	2109	2109	2109	2109
Within R-sq	.615	.564	.413	.337	.604	.549
Between R-sq	.192	.192	.471	.454	.796	.798
Overall R-sq	.020	.021	.254	.234	.706	.706
Robust SE are computed and t-statistics are shown in parentheses.						
* p<10% ** p<5% *** p<1%						

Table 7: LLC Stationary Test

	1	2	3	4	5	6
	Occupancy		ADR		Revenue	
Average Lags of ADF	11.77	11.77	11.85	11.85	11.85	11.85
Linear Trend	N	Y	N	Y	N	Y
Adj. t-stat	23.6	46.8	8.12	13.3	2.60	26.1
Number of lags of the ADF regression is chosen by AIC.						

Table 8: Pedroni's Test of Cointegration

	1	2	3	4	5	6
	Occupancy		ADR		Revenue	
Unemployment	N	Y	N	Y	N	Y
Population	N	Y	N	Y	N	Y
Panel rho-test	-53.4	-36.9	-39.6	-34.5	-51.5	-36.0
Group rho-test	-45.3	-36.0	-39.4	-33.6	-44.6	-35.1
Panel t-stat	-29.2	-27.6	-23.8	-26.9	-28.4	-28.0
Group t-stat	-30.2	-29.6	-26.8	-28.8	-29.9	-30.3
Number of lags of the ADF regression is chosen by AIC.						

Table 9: PDOLS and Augmented Mean-Group Estimation

	1	2	3	4	5	6
	Occupancy		ADR		Revenue	
	PDOLS	AMG	PDOLS	AMG	PDOLS	AMG

Airbnb	.565	-.634***	.016***	.035***	.016*	.023**
	(.76)	(-2.46)	(3.01)	(3.14)	(1.87)	(2.35)
Unemployment	-.406***	-.534**	-.041***	-.079	-.045***	-.016**
	(-3.16)	(-2.21)	(-9.14)	(-1.40)	(-7.41)	(-2.01)
Population	-55	45.8	-4.30***	-7.72**	-4.60	-8.67***
	(.004)	(.71)	(4.99)	(-2.12)	(-1.18)	(-3.29)
Common Shock		.999***		.936***		.974***
		(10.9)		(9.30)		(12.4)
Group-specific Trend		.011		.005**		.006***
		(.80)		(2.13)		(2.84)
No. of Obs.	2015	2080	2015	2080	2015	2080
t-statistics are shown in parentheses.						
* p<10% ** p<5% *** p<1%						

Table 10: Airbnb on the Rental Market by First-Difference Model

	1	2	3	4
	Germany	UK	Both	Germany
D.Airbnb	-.028	.2201**	-.044	-.038
	(-.74)	(3.67)	(-.93)	(-.81)
D.Unemployment	-.037	-.023	.018	.130
	(-.66)	(-1.68)	(.86)	(1.01)
D.Population	21.1	253.6	50.87	-9.648
	(1.82)	(1.42)	(1.29)	(-.052)
No. of Obs.	540	252	792	252
R-sq	.301	.442	.194	.310
t-statistics are shown in parentheses.				
* p<10% ** p<5% *** p<1%				

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