Dear Guests, Please Pay for my License – Analyzing the Heterogenous Cost-Pass-Through of Commercial and Non-Commercial Rental Suppliers in Response to Regulatory Policies

Michelle Müller
Paderborn University, Germany
Michelle.Mueller@wiwi.upb.de

Jürgen Neumann
Paderborn University, Germany
Juergen.Neumann@wiwi.upb.de

Dennis Kundisch
Paderborn University, Germany
Dennis.Kundisch@wiwi.upb.de

Abstract

Peer-to-peer rental markets have been shown to adversely impact the traditional hospitality industry and housing affordability, fueling the demand for regulation. While localities have implemented policies to address these issues, little is known about how rental suppliers respond to those regulations. Analyzing a policy implemented in New Orleans, which introduced annual bring-to-market costs while simultaneously banning listings from one city-center neighborhood, we reveal that hosts increase their prices as a result of the policy. We show that non-commercial hosts completely pass their additional costs onto their consumers. By contrast, commercial hosts with legalized listings located in the city center only partially pass on their costs to their guests, while decreasing prices in the rest of the city. Our results indicate that the policy falls short of reducing pressure on housing affordability in the city center, as peer-to-peer renting remains attractive when bring-to-market costs can easily be passed through to consumers.

1. Introduction

Peer-to-peer rental markets propose a new approach to temporarily delivering unused housing inventory from private owners to renters. Enabled by information technology and online marketplaces, peer-to-peer rental platforms (e.g. AirBnb) pave the way for improved usage efficiency of accommodations [1]. Meanwhile, the rapid growth of peer-to-peer rental platforms has famously disrupted traditional industries. Scholars have already uncovered the economic consequences resulting from the emergence of such markets, especially on residential house prices and rents [2] and the hotel industry [3]. These studies find that peer-to-peer rental market entries are blamed for raising housing prices and rents, while simultaneously reducing hotel revenues.

Both scholarly [4] and anecdotal evidence [5] points towards a range of heterogeneous types of hosts, from individuals renting out their private homes to commercial suppliers with professional renting experience. However, only the former represent the set of hosts originally intended as the supply side of the most popular of such platforms, AirBnb [4]. Here, the intention is that individuals share their private spaces and enable paying guests to gain a genuine local experience [6]. In contrast, professional suppliers (e.g., hostels or vacation home providers) are seen to rent out standardized accommodations, abusing peer-to-peer rental platforms merely as a second mainstay to generate additional income [4, 7]. Anecdotal evidence also points to the increasing number of hosts with hundreds of listings [5]. These commercial suppliers, in particular, have heated up the public debate on commercialization of peer-to-peer rental platforms [8].

Naturally, these trends have attracted the attention of municipal governments, many of which having brought in regulatory policies with measures aimed at regulating the economic activity of peer-to-peer rentals in local markets [8]. Examples of such measures include restricting the areas in which they can operate (e.g., implemented Barcelona and Anaheim), or by levying additional fixed costs onto hosts in the form of licenses (e.g., implemented in Seattle and Denver). However, many of the governments are struggling with the enforcement of the regulations, resulting in ongoing disputes between local governments and peer-to-peer rental platforms (e.g., AirBnb) about removing illegal listings [9].

So, how do peer-to-peer rental suppliers, e.g., Airbnb hosts, in general respond to regulatory policies? For example, do they increase prices in cities which place restrictions on renting out private accommodation to temporary guests? Do commercial suppliers—as key drivers for the demand of regulatory action—react differently to these policies compared to private suppliers, such that commercializing debates cool down afterwards? Even though the aforementioned literature has informed us about the impact of peer rental markets on various traditional industries, there is little empirical

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research to date on how suppliers have responded to regulatory policies. This lack of knowledge presents a handicap to scholars, legislators, and consumers. For legislators, apart from the income generated from levies, their main aim is to mitigate the negative externalities, e.g., to avoid increases in housing prices and rents. Prior theoretical work [1] suggests that if bring-to-market costs (e.g., cleaning, managing the check-in, taxes) are borne by peer-rental suppliers, acquiring a property merely for the sake of peer-renting becomes relatively unappealing. This, in turn, can keep the increase in housing prices and rental rates at bay, which is a key aim for legislators. However, if bring-to-market costs can be passed through to guests partially or completely by increasing rental prices, peer-renting would still remain attractive. Hence, policymakers may fail to reduce the pressure on the housing market if bring-to-market costs can easily be passed through to the consumers.

To shed light on the potentially different pricing responses by peer rental suppliers, we examine a regulatory policy in New Orleans that was announced in December 2016 and implemented in April 2017 [10]. This policy banned peer-to-peer rental suppliers from the French Quarter neighborhood, a popular tourist destination located in the city center. However, all listings in the remaining neighborhoods were legalized by establishing bring-to-market costs in form of annual licenses. The New Orleans city council aimed to address commercialization issues by offering different types of licenses. Commercial hosts, for example, have to pay $500 for their annual license for each listing, whereas a license for hosts being physically present during guest stays only costs $200 per year. We argue that the policy fundamentally reduces peer-to-peer rental supply in the French Quarter while simultaneously shifting the demand to legalized neighborhoods. As the supply in the rest of the city may either increase due to the legalization or decrease due to the bring-to-market costs, it remains unclear how different types of hosts will set prices in response to this new market situation. Hence, the aim of our study is to analyze the impact of these policy regulations on the prices charged by different types of peer rental suppliers. Thus, we formulate the following research question: *How do commercial and non-commercial peer rental suppliers set prices in response to a policy shift which affects supply, demand and bring-to-market costs?*

Applying a difference-in-differences (DID) estimation strategy, we find that hosts on average respond to the policy shift by increasing prices up to 3.4%. Moreover, we demonstrate that most of the non-commercial hosts completely pass their additional costs to their guests. By contrast, we find that commercial hosts that are located in the vicinity of the French Quarter (where such rentals are banned) partially pass their additional bring-to-market costs to their guests, while even decreasing prices in the rest of the city.

This paper makes several contributions to the literature. To the best of our knowledge, we are the first to present empirical evidence that peer-to-peer rental suppliers do not always partially pass additional bring-to-market costs onto their guests as suggested by theory [1]. While non-commercial suppliers completely pass the costs onto their guests, commercial suppliers set prices according to changes in demand and supply, which may even result in decreased prices for some regions. Although our findings contradict the predictions by theory, they match with previous literature pertaining to the heterogeneous price setting behavior of suppliers on peer-to-peer rental markets [7, 11]. These studies had revealed that commercial hosts behave mostly as predicted by economic principles, by adjusting their prices more frequently than non-commercial hosts in response to fluctuations in demand and supply. Our research also informs policy makers about the economic consequences of a policy which simultaneously introduces bring-to-market costs while banning supply from one specific neighborhood. Even though the policy makers in our study aimed to reduce peer-to-peer rental activity in the city center, neighborhoods located in the vicinity of the French Quarter, where such activity was banned, still remain an attractive location for peer-to-peer rental, especially for commercial suppliers. Thus, our results indicate that regulatory policies will only shift the problems associated with peer-to-peer rentals from one area to another.

2. Related Literature

We contribute to the literature stream on policy regulations for peer-to-peer short term rentals, where only a few empirically investigate the effect of actually implemented policy regulations. Alyakoob and Rahman (2021) investigate a policy shift in New Orleans that regulated short term rentals by introducing licensing costs [12]. Simultaneously, the city imposed a location restriction by banning short term rentals from the French Quarter, a tourist hotspot. They find that supply (i.e., the number of listings on Airbnb) in this area decreased after the policy shift had been implemented, while demand for short term rentals increased in adjacent districts. Considering policy shifts in multiple US cities, Chen et al. (2021) analyze changes in supply on Airbnb. A regulation implemented by some cities that require hosts to be present in the city when renting out their property has not been found to significantly affect supply [13]. By contrast, license costs levied on suppliers negatively affect supply in the short term but increases it in the long term [13]. Furthermore,

regulating the peer-to-peer rental market by requiring hosts to adhere to standards for health and safety (e.g., installing fire alarms) effectively reduces the number of listings in non-affluent neighborhoods [13]. Moreover, limiting hosts to rent out only one property is associated with both reduced rents in the long-term rental market and lowered home values in the for-sale housing market [14]. Policy shifts in general are associated with an overall decrease in the demand for short-term rentals in a city [15]. While these studies mainly focus on supply and demand, there is also evidence that rental suppliers increase their prices in response to a policy raising taxes being introduced. Airbnb hosts in particular react to a tax increase for short-term rentals by raising their prices and passing on (most of) their additional costs to consumers [16]. As outlined above, policy interventions often entail changes to demand and supply which in turn can affect price setting behavior. However, pricing responses by different types of hosts towards these kinds of policies have not yet been investigated. Therefore, this study is, to the best of our knowledge, the first to investigate how commercial and non-commercial suppliers, respectively, differ in their price reactions towards a policy shift.

3. Theoretical Background

Our empirical analysis builds on theoretical work that sheds light on the economic effects when bring-to-market costs are introduced to a sharing market [1]. This theoretical model suggests that such an introduction is associated with a decrease in supply. As renting out a good suddenly entails additional costs for suppliers, it becomes less attractive to stay in the market. Thus, a trend towards own-use will be likely to occur in such a sharing market, resulting in a subsequently lowered supply side. A reduction in supply would imply an increased rental price in market equilibrium and therefore, the bring-to-market costs can be partially passed-through to the consumer. However, the degree of this pass-through depends on the elasticity of the demand- and supply side [1]. For example, if demand elasticity in a sharing market is sufficiently high compared to the supply elasticity, then the supply side could not pass through the additional bring-to-market costs, as demand would be drastically reduced in case of a price increase. By contrast, if supply elasticity is sufficiently high compared to the demand-side elasticity, then costs could be completely passed through to the consumers due to a surplus of demand. However, as neither the demand side nor the supply side will react completely inelastically in a real-world market setting, costs can always be passed through, up to a certain point [1]. Hence, if bring-to-market costs are exogenously introduced to a peer-to-peer rental market, theory hypothesizes that suppliers can partially pass those additional costs onto their consumers:

Hypothesis 1 (Partial Cost Pass-Through Hypothesis): When additional bring-to-market costs are introduced to a peer-to-peer rental market, suppliers partially pass these costs to their guests by increasing rental prices.

We extend these theoretical insights with empirical evidence pertaining to heterogeneity among the supply side in sharing markets [7, 11]. As research has already pointed out, commercial hosts with renting experience base their pricing behavior on seasonal demand patterns as well as on fluctuations in supply [7, 11]. Thus, commercial hosts tend to solve their profit maximization problem by setting prices according to changes in demand and supply, respectively. However, there is empirical evidence that non-commercial hosts with only little renting experience will exhibit price inefficiencies as they fail to charge higher prices in demand-peaking seasons [11]. So, when bring-to-market costs are introduced in a peer-to-peer rental market, empirical research suggests that different host types will also differ in their price setting as a response. In that sense, non-commercial suppliers will not act strategically by taking demand and supply changes into account. For example, they might oversee that there is a decrease in supply in the banned regions, a potential increase in supply in other regions due to the legalization, and a shift of demand from the banned neighborhood towards other regions. Instead, they may consider only their individual increase in bring-to-market costs. Hence, a complete cost-pass through of the additional costs by increasing rental prices is likely to occur for non-commercial hosts. By contrast, we hypothesize that commercial suppliers will act more strategically by considering both demand- and supply changes as well as the additional bring-to-market costs when setting prices. Given the substantial differences in price setting behavior stemming from different host types on peer rental markets, we suggest that the supply side reacts heterogeneously to the introduction of bring-to-market costs: *Hypothesis 2 (Differences for Host Types Hypothesis): When demand and supply are kept constant, non-commercial peer-to-peer rental suppliers pass on the additional bring-to-market costs to a larger extent to their guests, compared to commercial rental suppliers.*

4. Research Environment

We analyze a policy shift in New Orleans, Louisiana, where regulators exogenously introduced additional bring-to-market costs to the short-term rental market in form of annual licenses for suppliers. In December 2016, following intensive discussions between AirBnb and New Orleans city council

members, the city's government voted to legalize and regulate short-term rentals. Previously, although these were indeed deemed illegal, AirBnb was nonetheless active in the city [12]. With effect from April 2017, the regulatory policy proposed by the city council essentially consisted of three parts [10]. First, it banned Airbnb activity from the French Quarter, a neighborhood that is particularly popular among tourists. Second, it legalized Airbnb activity in the rest of the city, requiring hosts to be licensed. Third, every Airbnb host needs to obtain an annual short-term rental (STR) license that comes in three different versions, with different restrictions for the host: accessory STR ($200), temporary STR ($50-$150), and commercial STR ($500). An accessory STR requires the owner occupant to be present during all of the occupancy and a temporary STR only allows a maximum of 90 rental nights per license per year. On the contrary, a commercial STR has no limitations on the number of rental nights per year and the owner does not need to be present during the rental period [10]. Given a time lag of four months between the announcement of the regulatory measure (December 2016) and the actual implementation (April 2017), we analyze this policy change over a one-year period, from August 2016 to August 2017. Thus, we have the opportunity to examine price setting behavior in the time before the announcement, during the four months between the announcement and the policy's coming-into-effect, and in the first five months following its implementation. Figure 1 shows the timeline of events.

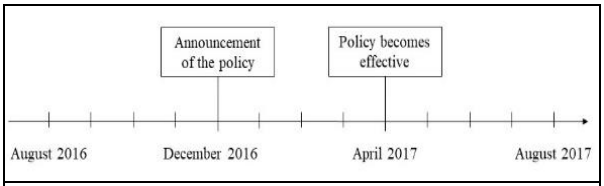

Figure 1. Timeline of Events

5. Empirical Analysis

5.1. Data

We collect monthly panel data from insideairbnb.com for all Airbnb listings available in New Orleans (our treatment city) and Portland, New York, and San Francisco (our control cities[1]) between August 2016 and August 2017 [17]. This dataset is used in various empirical studies on AirBnb [12, 15] and contains accommodation-level, host-level, review-level and booking rule-level information for each listing. The accommodation attributes include the listing price, the number of baths, bedrooms, guests, and amenities offered (e.g., wifi, smoke detectors), the distance to the city center, and dummies for the room type. Information on booking rules contain indicators for the possibility to instantly book the listing, the requirement to pay a cleaning fee and whether or not the listing requires a deposit. On a host level, we obtain data on how many months a host has been registered on Airbnb, whether they have acquired a superhost badge at a given month, whether their account has been verified with an official ID, and on their response behavior. We also have variables on the online ratings of a listing, for the overall rating as well as the six-dimensional ratings (e.g., cleanliness, communication, location).

We enriched our panel dataset with publicly available data from the New Orleans Government indicating which hosts purchased a license for their listing during our observation period [10]. The resulting dataset allows us to not only distinguish legal from illegal listings, but also to observe which listings are linked to a commercial STR license, a temporary STR license, and an accessory STR license. We define commercial hosts as those who obtained a commercial STR license, as this type of license restricts only a few activities on AirBnb and therefore opens up space for commercial renting. Hosts with a temporary- or accessory STR license represent our subsample of non-commercial hosts, as managing properties is highly restrictive in terms of renting duration and the physical presence for hosts.

To gain a better understanding about the underlying market situation that hosts face when a regulatory policy is implemented, we additionally compute variables to proxy the demand and supply for each listing in each month. To proxy the demand a particular listing enjoys, we use the number of new reviews a listing obtains in a month multiplied by the minimum number of nights guests have to stay when booking the listing [2, 3, 12]. As AirBnb only allows reviews of guests who have spent at least one night at a listing, this measure is a lower bound metric for the demand of a listing ($DEMAND\_LOWER$). As an upper bound for the demand of a listing, we examine the listing's calendar, counting the number of days a listing was unavailable over a period of a month, either because the listing was fully booked or because the host was not offering any listing on a given day ($DEMAND\_UPPER$). To proxy the supply of listings available on Airbnb, we count the number of other Airbnb listings within a 1-mile radius around the focal listing in each month. This measure is captured in the variable $SUPPLY\_LOCAL$ and enables

[1] Note that these cities were also subject to regulations prior to our observation period. However, when the regulations in New Orleans were implemented, there was no major adaption of the already existing policies.

us to control for the competitive landscape around a focal listing in a fine-grained manner. Moreover, we compute a variable indicating how many listings are located in the center of each city in our dataset by counting the number of listings within a maximum distance of 1 mile to the city center (*SUPPLY_CITYCENTER*). We also create a variable that additionally considers the number of illegal listings in the city center (i.e., listings located in the banned French Quarter) for listings located in New Orleans (*SUPPLY_CENTER_FQ*). Finally, we compute the total number of listings for each city and each month, representing a more general proxy for supply (*SUPPLY_MARKET*).

To rule out that hosts enter Airbnb due to the policy shift, we only include listings in our dataset that were set up before the policy implementation in April 2017 (our main treatment). Moreover, we excluded the illegal listings located in the French Quarter from our sample. In total, our panel data set comprises 87,122 listings operated by 66,624 hosts. Of the 6,968 listings that are located in New Orleans, we found 2,072 listings (29.7%) that are also represented in the STR licenses dataset. Of those, 267 (3.8%) can be linked to a commercial STR license, 1,045 (15.0%) to a temporary STR license, and 760 (10.9%) to an accessory STR license.

Table 1. Summary Statistics

	Mean	Std. Dev.
PRICE	164.73	259.89
NUM_GUESTS	3.03	2.01
SHARED_ROOM	0.03	0.16
PRIVATE_ROOM	0.43	0.50
WHOLE_ROOM	0.54	0.50
DEMAND_LOWER	5.87	10.01
DEMAND_UPPER	20.56	11.04
SUPPLY_LOCAL	1837.7	1334
SUPPLY_CITYCENTER	1821.3	598.3
SUPPLY_CENTER_FQ	1849.2	554.78
SUPPLY_MARKET	30615	155867
IS_SUPERHOST	0.13	0.34

Table 1 reports an excerpt of the summary statistics of our panel dataset. The statistics represent monthly averages from our observation period spanning 13 months.

5.2. Main Variables

As the dependent variable, we use the listing price in $US for one night (*PRICE*). Our two main independent variables are *TREAT_LICENSE* and *TREAT_BAN*. The regulatory policy we analyze in New Orleans essentially consists of two components, namely the French Quarter ban on the one hand and the requirement to obtain a license in the rest of the city on the other. We assume that all of the listings in New Orleans should be affected by the licensing system, as each host is obliged to purchase a license after the policy had come into effect. Therefore, the first treatment variable *TREAT_LICENSE* equals 1 if the listing is located in New Orleans and is thus required to be licensed, and 0 if it is located elsewhere. Conversely, we assume that the second component of this policy, the French Quarter ban, is particularly influential for listings located in the nearby neighborhood, as demand may shift from the banned region to adjacent legalized listings after the policy implementation [12]. That is why our second treatment variable (*TREAT_BAN*) is set to 1 if the listing is located near the French Quarter, with a maximum distance of one mile, and 0 otherwise. Figure 2 depicts the geographical distribution of our treatment groups.

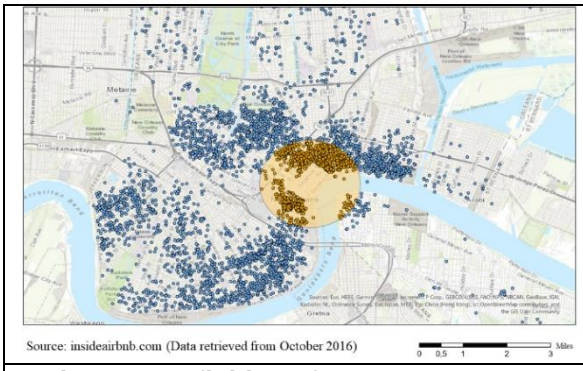

Figure 2. Definition of Treatment Groups

The blue bubbles represent all listings for which the variable *TREAT_LICENSE* equals 1 and *TREAT_BAN* equals 0. The orange bubbles show all listings that have *TREAT_BAN* as well as *TREAT_LICENSE* set to 1. In that sense, all listings located near the French Quarter (the orange bubbles) are affected by both the French Quarter ban (*TREAT_BAN*) and the licensing system (*TREAT_LICENSE*). The construction of our treatment groups allows us to differentiate between the two components of the regulatory policy and their corresponding relationship with host's pricing behavior. However, due to the fact that all listings that are affected by the French Quarter ban are also affected by the licensing system, we only observe the effect of *TREAT_BAN* in relation to the effect of *TREAT_LICENSE*.

5.3. Empirical Model

We estimate a DID model with multiple interactions between our treatment specifications and monthly time dummies, as depicted in equation 1.

$$\ln(PRICE_{it}) = \beta_0 + \sum_{j=1}^{T} \alpha_j \cdot MONTH_{itj} * TREAT\_LICENSE_i + \sum_{j=1}^{T} \delta_j \cdot MONTH_{itj} * TREAT\_BAN_i + + \sum_{j=1}^{T} \theta_j \cdot MONTH_{itj} + \beta_3 \gamma_{it} + \delta_i + \varepsilon_{it} \quad (1)$$

$ln(PRICE_{it})$ represents the natural logarithm of the price for one night of listing i in month t. Then, we incorporate month dummy variables in our specification, where the dummy $MONTH_{itj}$ represents a single month j that is set to 1 if t equals j. The key variables of interest are the interactions $MONTH_{itj} * TREAT\_LICENSE_i$ and $MONTH_{itj} * TREAT\_BAN_i$ which represent the DID estimators and capture the average treatment effect on the treated (ATT) listings. Here, we leave out December 2016 (the policy announcement month) and its respective interaction terms from our regression, such that they serve as a reference point for the interpretation of subsequent (and prior) prices [14]. We also add listing fixed effects δ_i which capture both of our treatment variables and allow us to control for time-constant heterogeneity across listings. Finally, γ_{it} is a vector of control variables (host-level, accommodation-level, and booking-level information) and ε_{it} is a random error term.

In a second model, we add the demand proxies for each listing ($DEMAND\_LOWER, DEMAND\_UPPER$), as well as our supply variables ($SUPPLY\_LOCAL$, $SUPPLY\_CITYCENTER$, $SUPPLY\_CENTER\_FQ$, $SUPPLY\_MARKET$) from the preceding month ($t-1$) for each listing i into our vector of control variables, which may elucidate the mechanisms behind hosts' price setting behavior. When we control for all these variables and thus keep them constant, we can conclude how many hosts change their prices irrespective of policy-driven changes in $DEMAND$ and $SUPPLY$. Therefore, this controlling mechanism allows us to observe how much of the hypothesized partial cost pass-through can be explained by fluctuations in $DEMAND$ and $SUPPLY$ following the introduction of the policy.

5.4. Results

Table 2 presents our empirical results when estimating equation (1). First, the insignificant coefficients of the interaction terms in nearly all columns before December 2016 indicate insignificant trends before the policy was announced, which supports the common trends assumption [18]. In the following, we discuss the policy effect on all listings in New Orleans (column (1) and (2)), on listings of commercial suppliers (column (3) and (4)), and on listings of non-commercial suppliers (column (5) – (8)) separately.

5.4.1. Policy Effect on all Listings in New Orleans. Column (1) displays the results for the model assessing the general policy effect on all listings (i.e., listings with and without a valid license) in New Orleans without controlling for $DEMAND$ and $SUPPLY$. We find a significant price increase of 1.3% immediately after the announcement of the policy shift in January 2017, compared to the prices in December 2016. This price increase grows to 3.4% in April 2017 and diminishes gradually in magnitude to 0.1% by June 2017 but remains positive and statistically significant. The mostly insignificant coefficients for the interactions between $TREAT\_BAN$ and the respective months in column (1) indicate that listings located in the vicinity of the French Quarter do not respond differently to the policy in terms of prices, compared to all the other remaining listings in New Orleans. In column (2), we assess the underlying mechanisms behind hosts' price setting behavior by simultaneously controlling for each listing's $DEMAND$ and $SUPPLY$. We see that, except for the interactions of January 2017 and June 2017 with $TREAT\_LICENSE$, the coefficients still remain positive and significant and are on a similar level as in column (1). This means due to facing additional costs arising from STR licenses, keeping demand and supply constant, Airbnb hosts increase their prices over a period of at least 6 months and therefore pass on the additional bring-to-market costs to their guests. To break down the additional amount of dollars that each listing generates, we multiply the base month price (December 2016) by our estimate of the price increase in month t and by the average lower bound demand per listing in month t. During the time span from January 2017 to August 2017, this results in approximately \$128 of additional revenue per listing in New Orleans. Considering that hosts have to pay \$500 for an annual commercial license, \$200 per year for an accessory license, and between \$50 (with homestead exemption) and \$150 (without homestead exemption) for a temporary license, we generally find support for *Hypothesis 1 (Partial Cost Pass-Through Hypothesis)*. However, AirBnb hosts increase their prices even after controlling for monthly demand and supply which is not captured by the theory we aim to test.

5.4.2. Policy Effect on Listings with a Commercial STR License. In the following columns, we obtain a more nuanced picture of the policy's effect on listing prices by estimating the regression separately for listings assigned to a specific license type. Column (3) depicts the policy effect on listings with a commercial STR license (i.e., commercial hosts). Here, we even observe decreasing prices in New Orleans outside the French Quarter after the policy has been implemented.

Table 2: Regression Results								
Variable	All Listings		Commercial License Listings		Temporary License Listings		Accessory License Listings	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$ln(PRICE)$	$ln(PRICE)$	$ln(PRICE)$	$ln(PRICE)$	$ln(PRICE)$	$ln(PRICE)$	$ln(PRICE)$	$ln(PRICE)$
$DEMAND_{t-1}$		✓		✓		✓		✓
$SUPPLY_{t-1}$		✓		✓		✓		✓
$Sep'16 \cdot TREAT\_LICENSE$	-0.001	-0.012*	-0.002	-0.002	-0.005	-0.000	0.011	0.000
	(0.004)	(0.007)	(0.016)	(0.020)	(0.007)	(0.019)	(0.008)	(0.012)
$Oct'16 \cdot TREAT\_LICENSE$	-0.006	-0.017***	-0.003	-0.003	-0.012*	-0.009	-0.001	-0.010
	(0.003)	(0.006)	(0.015)	(0.019)	(0.007)	(0.017)	(0.007)	(0.010)
$Nov'16 \cdot TREAT\_LICENSE$	0.007**	-0.001	-0.004	-0.001	-0.002	-0.008	0.012	0.001
	(0.003)	(0.004)	(0.014)	(0.015)	(0.006)	(0.008)	(0.008)	(0.007)
$Dec'16 \cdot TREAT\_LICENSE$ *(Policy Announcement)*	*omitted*							
$Jan'17 \cdot TREAT\_LICENSE$	0.013***	0.006*	-0.004	-0.004	0.004	-0.001	0.013**	0.004
	(0.003)	(0.003)	(0.013)	(0.013)	(0.006)	(0.006)	(0.006)	(0.006)
$Feb'17 \cdot TREAT\_LICENSE$	0.029***	0.018***	-0.004	0.011	0.027***	0.015**	0.035***	0.021***
	(0.013)	(0.004)	(0.013)	(0.014)	(0.006)	(0.007)	(0.006)	(0.006)
$Mar'17 \cdot TREAT\_LICENSE$	0.034***	0.037***	0.008	0.016	0.041***	0.038***	0.039***	0.040***
	(0.003)	(0.003)	(0.012)	(0.012)	(0.006)	(0.006)	(0.006)	(0.006)
$Apr'17 \cdot TREAT\_LICENSE$ *(Policy Implementation)*	0.032***	0.038***	0.009	0.022*	0.037***	0.047***	0.040***	0.045***
	(0.003)	(0.003)	(0.012)	(0.012)	(0.006)	(0.007)	(0.006)	(0.006)
$May'17 \cdot TREAT\_LICENSE$	0.022***	0.024**	-0.029**	-0.012	0.033***	0.074**	0.026***	0.030*
	(0.003)	(0.012)	(0.014)	(0.031)	(0.006)	(0.037)	(0.005)	(0.017)
$Jun'17 \cdot TREAT\_LICENSE$	0.010***	0.018	-0.033*	-0.009	0.020***	0.063*	0.016***	0.024
	(0.003)	(0.011)	(0.017)	(0.027)	(0.006)	(0.035)	(0.006)	(0.017)
$Jul'17 \cdot TREAT\_LICENSE$	0.005	0.007	-0.055***	-0.023	0.017**	0.078	0.010*	0.014
	(0.004)	(0.018)	(0.017)	(0.042)	(0.007)	(0.058)	(0.006)	(0.027)
$Aug'17 \cdot TREAT\_LICENSE$	-0.000	-0.035	-0.038**	-0.032	0.014**	0.098	0.005	-0.023
	(0.004)	(0.036)	(0.016)	(0.079)	(0.007)	(0.111)	(0.006)	(0.053)
$Sep'16 \cdot TREAT\_BAN$	0.015**	0.005	-0.010	-0.017	0.016	0.015	0.024	0.011
	(0.007)	(0.007)	(0.026)	(0.026)	(0.016)	(0.018)	(0.017)	(0.017)
$Oct'16 \cdot TREAT\_BAN$	0.015**	0.010	0.018	0.000	0.023	0.025	0.020	0.018
	(0.007)	(0.007)	(0.022)	(0.023)	(0.015)	(0.017)	(0.013)	(0.014)
$Nov'16 \cdot TREAT\_BAN$	0.011	-0.001	0.010	-0.008	0.010	0.015	-0.001	0.006
	(0.007)	(0.007)	(0.020)	(0.021)	(0.015)	(0.016)	(0.014)	(0.013)
$Dec'16 \cdot TREAT\_BAN$ *(Policy Announcement)*	*omitted*							
$Jan'17 \cdot TREAT\_BAN$	-0.008	-0.009	0.025	0.003	-0.019	-0.014	0.001	0.003
	(0.006)	(0.006)	(0.019)	(0.018)	(0.016)	(0.018)	(0.012)	(0.012)
$Feb'17 \cdot TREAT\_BAN$	-0.002	-0.007	0.003	-0.012	-0.021	-0.017	0.004	0.001
	(0.006)	(0.006)	(0.019)	(0.018)	(0.016)	(0.017)	(0.013)	(0.012)
$Mar'17 \cdot TREAT\_BAN$	0.001	-0.009	0.025	-0.001	-0.019	-0.013	0.009	0.001
	(0.006)	(0.006)	(0.019)	(0.017)	(0.015)	(0.016)	(0.013)	(0.012)
$Apr'17 \cdot TREAT\_BAN$ *(Policy Implementation)*	0.010	0.007	0.027	0.010	0.020	0.024	0.001	0.002
	(0.006)	(0.006)	(0.018)	(0.018)	(0.015)	(0.015)	(0.013)	(0.013)
$May'17 \cdot TREAT\_BAN$	0.005	0.002	0.055***	0.039**	0.017	0.021	0.005	0.007
	(0.006)	(0.006)	(0.019)	(0.020)	(0.015)	(0.015)	(0.012)	(0.012)
$Jun'17 \cdot TREAT\_BAN$	0.008	0.003	0.047**	0.027	0.023	0.027*	-0.006	-0.004
	(0.006)	(0.006)	(0.022)	(0.021)	(0.015)	(0.015)	(0.013)	(0.013)
$Jul'17 \cdot TREAT\_BAN$	0.011	0.007	0.054**	0.034	0.030*	0.033*	-0.003	0.000
	(0.008)	(0.008)	(0.023)	(0.022)	(0.017)	(0.017)	(0.014)	(0.014)
$Aug'17 \cdot TREAT\_BAN$	-0.007	0.003	0.160***	0.144***	0.018	0.021	-0.007	-0.005
	(0.010)	(0.010)	(0.035)	(0.035)	(0.017)	(0.018)	(0.015)	(0.014)
Listing Controls	✓	✓	✓	✓	✓	✓	✓	✓
Monthly Fixed Effects	✓	✓	✓	✓	✓	✓	✓	✓
Listing Fixed Effects	✓	✓	✓	✓	✓	✓	✓	✓
N	702,118	611,974	646,904	566,917	655,815	574,977	652,826	572,387
R^2	0.980	0.983	0.981	0.983	0.981	0.983	0.981	0.983

*Note: Interaction terms of Aug'16 are dropped due to the demand- and supply lag computations. The large number of observations (N) arises due to the panel data structure used for the analyses. Robust standard errors are in parenthesis. *** p<0,01, ** p<0,05, * p<0,1.*

Starting in May 2017, listing prices drop by 2.9%, whereby the coefficients remain negative and statistically significant until August 2017. However, listings of commercial hosts that are located with spatial proximity to the French Quarter experience an increase in prices. For example, in June 2017, commercial listings located in adjacent neighborhoods to the banned French Quarter raise their listing price by about 1.4% (-0.033 + 0.047 = 0.014, the sum of coefficients for the interaction terms of $TREAT\_LICENSE$ and $TREAT\_BAN$). When controlling for $DEMAND$ and $SUPPLY$ (see column (4)), the interaction terms between the months and $TREAT\_LICENSE$ mostly become insignificant and smaller in magnitude. Thus, our results suggest that the decreasing prices we observe from commercial listings can be primarily attributed to policy-related changes in demand and supply. We also calculate the additional amount of dollars each commercially-licensed listing generates after the policy's announcement. During the time span from January 2017 to August 2017, the average revenue per listing due to policy-related price changes is approximately $231 (for listings located in New Orleans' city center) and -$56 (for other listings in New Orleans). We conclude that a partial cost pass-through is also observable for hosts with a commercial STR license located in the vicinity of the French Quarter but not for commercial hosts located in the rest of New Orleans. Moreover, we provide evidence that the pricing behavior of commercial hosts is mainly driven by policy-related changes in $DEMAND$ and $SUPPLY$.

5.4.3. Policy Effect on Listings with a Temporary or Accessory STR License. As column (5) and column (7) depict, hosts managing properties with either a temporary or an accessory STR license (i.e., non-commercial hosts) change their prices in response to the policy. In particular, temporary licensed listings significantly increased their prices over a period of 7 months (February 2017 – August 2017), compared with 6 months (January 2017 – July 2017) for hosts with an accessory license. In both models, price rises peak in April 2017 with a 4.7% increase for temporary STR listings and 4.0% for accessory STR listings. Unlike commercially-licensed listings, properties with a temporary or accessory STR license located near the French Quarter do not ask for higher prices compared to listings located outside this area. When controlling for $DEMAND$ and $SUPPLY$ (see column (6) and column (8)), temporary and accessory licensed listings still exhibit an increase in prices for a period of at least 3 months (February 2017 to May 2017). This suggests that non-commercial hosts increase their prices irrespective from supply and demand. However, the price elevations observed in June 2017 for example, are mainly applicable to changes in $DEMAND$ and $SUPPLY$. The higher price levels for those listings result in additional revenues of approximately $373 for a temporary licensed listing and $145 for an accessory licensed listing from January 2017 to August 2017. Note that these values only represent a lower bound for the additional revenue, as it is computed by using $DEMAND\_LOWER$ and the respective price increases after the policy has been announced. However, as a temporary STR license costs between $50 (with homestead exemption) and $150 (without homestead exemption), our results indicate that hosts managing a temporary licensed property pass on all of the additional license costs to their guests, even generating additional income as a result of the policy. By contrast, accessory licensed listings recoup at least 72.5% of the license costs within the following eight months after the policy announcement. As an accessory license allows listings to be rented out over the whole year, it seems plausible that these hosts also recoup the additional costs entirely within a licensing year.

Our results reveal that the underlying mechanisms for price changes differ per license type. While hosts with a temporary- or accessory-licensed property respond to the policy by increasing prices and completely pass their additional costs onto their guests, irrespective from changes in $DEMAND$ and $SUPPLY$, for hosts with a commercial license outside the city center, the flux in $DEMAND$ and $SUPPLY$ plays a major role for their pricing responses, resulting in even lower prices after the policy has been introduced. Given the sizeable differences in price setting behavior that are found for hosts with different licenses, we also find support for *Hypothesis 2 (Differences for Host Types Hypothesis)*.

5.5. Robustness Checks

One potential concern could be that our results are confounded because the listings in New Orleans are systematically different from those in our control group. To alleviate this concern, we identify listings in the control group cities that are statistical twins of the New Orleans ones, using propensity score matching (PSM) [19]. We apply a kernel matching algorithm, use the aforementioned control variables as matching variables and matched the variables for the last month before the policy was implemented (March 2017). Assessing the relative bias before and after matching each covariate, we see that our PSM has substantially reduced the bias between the treatment and the control listings. We re-run all the regression models from our baseline results and find qualitatively unchanged results. Therefore, it is unlikely that systematic differences between treatment and control listings are biasing our estimation results.

As a significant proportion of hosts with listings located in New Orleans did not purchase a license during our observation period, one might also be concerned that our results for all listings in New Orleans might primarily be driven by illegally posted listings. Therefore, we re-run our baseline model, restricting our dataset to listings with a valid license. Here, the coefficients for the interactions of $TREAT\_LICENSE$ remain qualitatively unchanged. However, the interaction of $TREAT\_BAN$ and the months after the policy implementation now become significant, which might be explained by price increases of commercially-licensed listings in the center of the city.

Lastly, to rule out any distortions created by hosts who could have established an Airbnb listing before the policy implementation (our main treatment) because of the announcement of the policy, we re-run our analysis only with listings that were established even before the policy announcement in December 2016. Again, we find qualitatively unchanged results.

6. Discussion and Conclusion

Peer-to-peer rental platforms have been met with increasingly rigorous regulatory intervention from municipal governments aiming to minimize the negative externalities of the peer-to-peer rental market to local communities, as documented in prior literature [2, 3]. Our paper is, to the best of our knowledge, the first to empirically evaluate such a regulatory policy for different host types, which entailed the ban of Airbnb in a certain neighborhood in the center of a city, its legalization in others, and the introduction of mandatory licenses. Our results demonstrate that hosts have increased their prices in response to the announcement and implementation of the policy. We calculate that hosts approximately earn $128 of additional revenue in the first eight months after the policy came into effect. Yet, we discern big differences in the pricing behavior between heterogeneous host types, i.e., commercial and non-commercial hosts. Non-commercial hosts increase their prices mostly irrespective of demand and supply, resulting in either a complete pass-through of the additional licensing costs, or an increase exceeding that cost. By contrast, commercial hosts located outside the city center decrease their prices due to the increase of competition within the city. However, a partial cost pass-through of the additional bring-to-market costs is also observable for commercial hosts in the center of the city.

Theoretically, our results imply that when bring-to-market costs are introduced to a sharing market, the suggested partial cost pass-through [1], which depends on the elasticity of the demand- and supply side, is only observable for commercial hosts located in an area with a substantial decrease in supply. For other regions we even find decreasing pricing responses from commercial hosts. Furthermore, our results suggest that the theoretical model proposed by the literature is not directly applicable to non-commercial hosts. As those hosts rather act as inexperienced microentrepreneurs, they simply pass on all the additional bring-to-market costs to their consumers without considering changes on the demand- and supply side. Hence, our empirical results require an extension of theoretical models in sharing markets in two major ways. First, theory needs to account for heterogeneous types of suppliers with differentiated economic behavior, and second, geographical aspects need explicit and thorough consideration, as pricing behavior is fundamentally affected when supply shifts from one area to another. Practically, our results inform policy makers about the economic effects of a regulatory measure which simultaneously bans short-term rentals from one area and legalizes it in others, requiring suppliers to obtain an annual license. We provide evidence that a licensing system, which introduces additional bring-to-market costs for suppliers, causes the average host to increase their listing prices. However, as non-commercial hosts are seen to pass through all the additional licensing costs to their guests, peer-to-peer renting continues to remain attractive for suppliers. Commercial hosts who operate listings with spatial proximity to the French Quarter also pass through the additional costs to their guests, albeit only partially, implying that the city center in particular remains appealing to commercial suppliers despite the introduction of the policy. As most of the commercial hosts are represented in neighborhoods adjacent to the French Quarter, it seems plausible that the problems associated with home sharing markets will merely shift from one area to another. Taken together, although the policy reduced AirBnb activity in the banned French Quarter and thus may help reduce pressure on the housing market in this area [12], adjacent neighborhoods might now suffer due to the policy. In that sense, anecdotal evidence in New Orleans points towards problems arising in the Garden District, a neighborhood located directly next to the French Quarter. Citizens report that they have lost lots of neighbors due to the proliferation of short-term rentals [20]. As a response, New Orleans city council voted to impose new restrictions on short-term rentals in 2019, including a prohibition of AirBnb activity in the Garden District [19]. However, to avoid another shift of AirBnb supply towards adjacent neighborhoods, our results suggest that policy makers could consider allowing only temporary licenses for owner occupants in all areas of the city.

As with any research, this study also comes with limitations. We only investigate the price effects for

regulations implemented in New Orleans, which arguably limits the transferability of these results to other regions. Nonetheless, we have no reason to believe that the general directions of our results, or the heterogeneous reactions among rental suppliers, should be much different in other cities. That is why our results are at the least suggestive for other regions. Moreover, as some hosts did report their license code inaccurately on the AirBnb website, some licenses could not be mapped to the listings.

Future research could extend our analysis by investigating the price effects of peer rental suppliers in other cities where regulators introduce similar bring-to-market costs. In particular, an analysis of the implementation of heterogeneous bring-to-market costs according to host types is worth further investigation. In that sense, it would be interesting to not only analyze price setting behavior, but also the development of the market share of commercial and non-commercial suppliers. Furthermore, future research could refine our analysis by extending our datasets with hotel sales data, and thus allowing to take a more differentiated view on the competitive environment faced by peer-to-peer rental suppliers. Finally, as our research only analyzes the policy effect on peer-to-peer short term rentals in a one-year period, future research could investigate the long-term effects of such policy measures. In that sense, it would be particularly interesting for scholars, policy-makers and property owners, to further study the effectiveness of policies regulating short-term rentals in curbing the increase of house prices and rental rates in local markets[2].

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