MEASURING THE POTENTIAL IMPACT OF AIRBNB ACTIVITY ON ELLIS ACT EVICTION RATES IN LOS ANGELES

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ABSTRACT

Ellis Act Evictions, evictions of rent-controlled units presuming the entire property is removed from the rental market, are rising in Los Angeles. This paper examines the potential impact of short-term rental services, such as Airbnb, on Ellis Act evictions in Los Angeles, under the hypothesis that Airbnb's higher revenue potential may incentivize converting rental units into units used solely for profit under the Airbnb model. Working within this hypothetical framework, increased Airbnb activity would lead to higher rates of no-fault evictions. Airbnb data was acquired from *Inside Airbnb* and combined with Ellis Act data acquired through requests to various LA-area cities; American Communities Survey data served as a control. Using a robust OLS regression, I find a strong positive correlation between Ellis Act Evictions and Airbnb listings within zip code level analysis. I conclude that the impact of Airbnb on Los Angeles neighborhoods remains an emerging field of study, and that further research is needed to understand it.

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Introduction and Background

The United States suffers from an affordable housing crisis. According to the *National Low Income Housing Coalition*, statewide minimum wage does not cover two-bedroom unit housing costs within all 50 US states (Aurand, 2016). Adjusted for inflation, current housing prices are nearing those during the peak prior to the 2008 housing crash, according to the *National Association of Realtors* (Coldwell Banker, 2015).

In California, this issue becomes particularly acute due to it requiring 114 hours of minimum wage work per week to afford a two-bedroom unit, on average (Aurand, 2016). Frequently topping lists of cities with the highest costs of living are Los Angeles and San Francisco the two metropolitan areas within the state of California (Ray, 2014). In a national analysis of the most expensive housing markets for four-bedroom homes, half of the top 100 markets were in California (Coldwell Banker, 2015).

The forces behind these changes are numerous and complex. Lack of urban housing supply is a major factor. The various iterations of private and public efforts to revitalize previously dangerous or neglected neighborhoods contributes to the process of gentrification. Investment leads to interest from potential residents, increasing demand. Gentrification's "collective displacement" of the neighborhood's native residents lends itself to increased tourism through the ideal of newfound safety and niche businesses (Gant, 2016). Race and wealth add further complexities, seeing as lower income people of color are those that are displaced, replaced by affluent white households (Lee, 2015).

Los Angeles in particular has an expensive housing market. The median renting household in Los Angeles spends 47% of its income on housing (Ray, 2014). Property values in Los Angeles rose 6.13% throughout 2015, the highest rate in 5 years. Meanwhile, rent control

restricts increases to less than 3% a year (Favot, 2015). Property evictions of all types within Los Angeles continue to rise following increases over the last 3 years (Favot, 2015). A California law, the Ellis Act, permits the eviction of rent controlled tenants in cases where the entire property is removed from the rental market (Poston & Khouri, 2016). The law passed in 1985 to permit landlords the ability to go out of business, after the California Supreme Court ruled that landlords could not, if it meant evicting tenants(Gullickson, 2005).

The law now serves to aid in the conversion to a private home or condominiums, or general rezoning. These types of evictions have been steadily increasing in Los Angeles since 2012, as shown by Figure 1. These rent-control removals are not evenly distributed across Los Angeles, but happen both in less affuluent neighborhoods (Ventura) and in "up-and-coming" neighborhoods (Sawtelle), as shown by Figure 2.

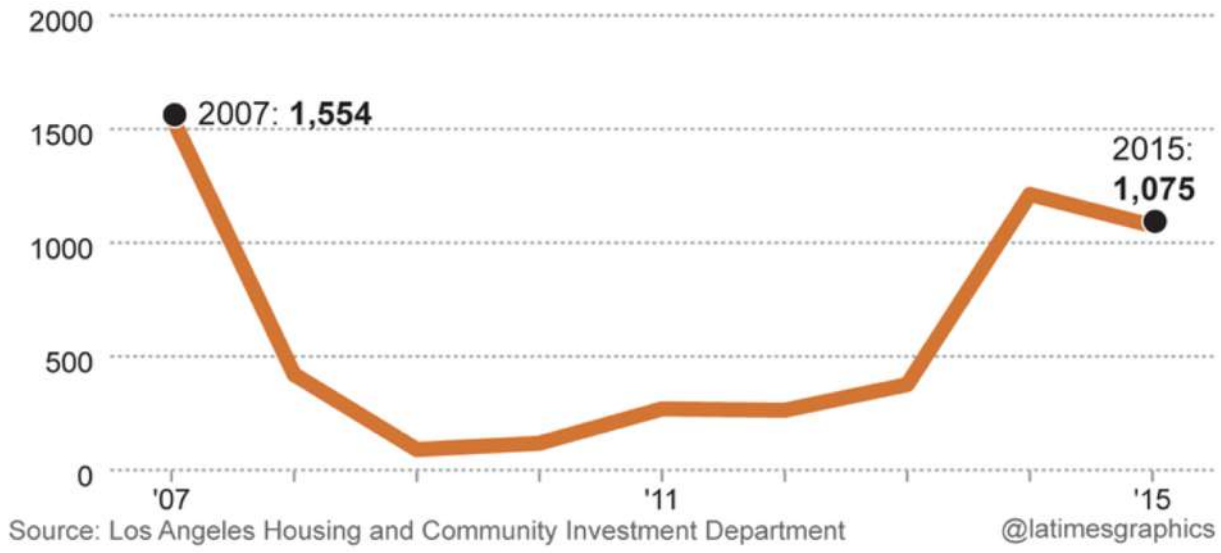


Figure 1: Ellis Act Evictions in Los Angeles since 2007

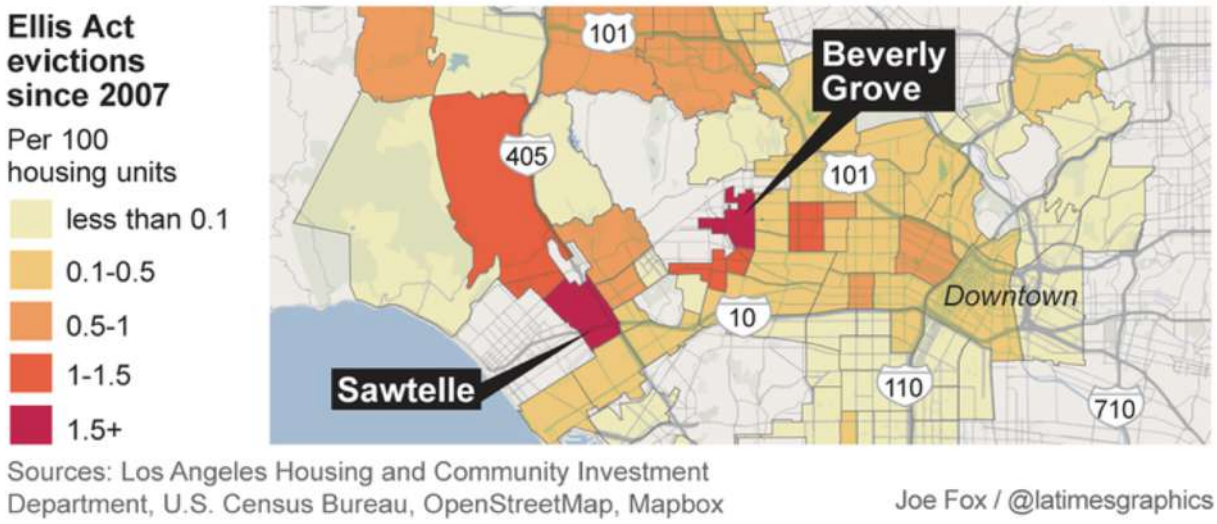


Figure 2: Map of Ellis Act Evictions in Los Angeles since 2007

Affordable housing activists posit that Airbnb could be partly responsible for the rise in Ellis Act evictions in Los Angeles. The corporation was founded in 2008 in San Francisco, and has grown to have an estimated value of $30 billion (Newcomer, 2016). The start-up's business model is simple: download an app on a smartphone and either put up any part of a property ranging from an entire house to a shared room in an apartment for short-term rental. The service began as a social and community-oriented experiment, but a minority of users transformed it into hotel-like business, putting up multiple properties for rental. These owners skirt by hotel regulations and account for most profits earned by Airbnb users (Stuhlberg, 2016).

In fact, Airbnb usage has grown fast enough with few regulations, that policymakers and local activists are concerned about the way the service will change their neighborhoods. The argument is that, the more property is used exclusively for Airbnb, the more housing is taken off the market (Meni, 2017). If more housing is taken off the market than is added, which is usually implied by the difficulty of swift housing development in urban centers, the remaining properties will therefore become more expensive. Despite the lack of research on the topic beyond the above Supply and Demand argument, some municipalities have already acted, such as the city of

Barcelona, which has cracked down on Airbnb with new fines and regulations (O'Sullivan, 2015). In 2014, for example, Airbnb listings in New York state were deemed "mostly illegal" (Streitfeld, 2014) .

With every other impact Airbnb potentially has on the housing market, the service may also be having an effect on Ellis Act evictions: reports exist of some property owners simply turning properties into Airbnb businesses post-Ellis Act eviction, as the monthly earnings from short-term stays outweigh the costs associated with long-term rentals (Poston, 2016). If it were to be proven that Airbnb is a factor in these Ellis Act evictions, on the rise in Los Angeles, it would be evidence that the short-term rental market could be incentivizing condominium construction and reducing the market of affordable housing. This study aims to find potential evidence for or against this claim.

There is an emerging body of literature investigating the relationship between Airbnb and a variety of housing related outcomes, such as average rent, tourism, rates of hotel usage, and more. These studies vary widely in their methods and represent a new field of study within housing policy and urban planning. Analysts are divided on whether Airbnb has any effect, let alone a negative one, on the housing market. I will contribute to this new body of work by exploring whether an increase in the demand for Airbnb is associated with the number of evictions in Los Angeles. The choice of looking at evictions stems from the anecdotal story that Airbnb's profitability is motivating full conversions from apartments to condominiums.

This study will use a robust standard regression model to compare rates of Ellis Act Evictions and Airbnb listings, standardized based on the number of housing units per zip code. The model includes multiple control variables, such as income, unemployment, race, and other standard economic and demographic variables, as well as median Airbnb monthly income and

home value growth rates. In the interest of replicability, the data come from *Inside Airbnb,* since it is publically available. All economic and demographic data comes from the *American Communities Survey* (2011-2015 estimates), with all eviction data coming from local data.

Finding a correlation between the rate of evictions and demand for Airbnb rentals is an important step in the emerging body of research on Airbnb's effects on the housing market. The relationship I find is likely a small part of a larger story of the current housing crisis, but must be researched further nonetheless. This research is not only directly relevant to housing policy in Los Angeles, but is valid for the state of California and indirectly relevant to other states with similar laws regarding rent-control loopholes, such as the "hardship petition", which allows landlords in Washington DC to evict rent-control tenants if their own income is too low (District of Columbia, 2017).

The rest of the paper is organized as follows: The Literature Review provides a detailed picture of the existing literature involving Airbnb. The Analytic Framework will outline the framework of the study. The Data and Methods section outlines the methodology and data while the Results section provides an overview of descriptive statistics and regression results. Finally, the Discussion section provides a discussion of the results, research suggestions, and concluding remarks.

Literature Review

This paper contributes to the emerging body of research that has examined the relationship between Airbnb and a variety of indicators within urban centers. The possible impact of my hypothesized relationship would be important, as it would imply the need to

regulate Airbnb usage to prevent any negative effect on residents. However, the sparse body of research provides little evidence of Airbnb having any effects on local neighborhoods.

There is an existing body of literature investigating the relationship between Airbnb and a variety of housing-related outcomes, such as average rent, tourism, rates of hotel usage, and more. These studies vary widely in their methods and represent a new field of study within housing policy and urban planning. Unfortunately, as a recent phenomenon, there is a dearth of literature on the subject. Included with work that is topically relevant is work that is relevant to Airbnb's effects on the tourism industry, due to valuable insights in terms of methodology.

FiveThirtyEight (Stulberg, 2016) conducted a study correlating rents in urban centers in the United States with demand for Airbnb, which was calculated using combined revenue per neighborhood. The analysis concluded that Airbnb is not driving up rent, but acknowledged the eventual possibility. The methodological details and the data used are not publically available, as the author used *Airdna*, a paid data service for Airbnb researchers. The idea of calculating demand for Airbnb listings through revenue presents an interesting alternative to most other studies, which rely on the raw number of listings. In fact, following in this study's stead, I calculated average income per Airbnb listing per zip code using the guidelines in the article and at *Inside Airbnb*.

Dayne Lee's analysis in the *Harvard Law & Policy Review* (Lee, 2015) used a series of non-regression methods to determine correlation between rent increase and Airbnb listings in Los Angeles, and claims a rent increase is associated with Airbnb. Lee's paper employed a per-neighborhood analysis of Los Angeles' housing market and the effect Airbnb could have on it. Essentially, Lee's logic is that constraints in new housing and recently emptied properties do not match the increasing demand for Airbnb listings, therefore leading to demand outpacing supply,

increasing rent. While the analysis does not have the rigor of an econometric analysis, it still serves as an important reference in research on the subject. Most importantly, the paper provides an articulate theory on Airbnb's role in the housing market.

The Quattrone et al (2016) analysis of Airbnb listings in London uses a multivariate OLS regression comparing demand for Airbnb (dependent variable) to various demographic and economic indicators. . The major finding of this analysis was the stark difference in the categories of Airbnb listing per neighborhood. Highly educated and low-income areas (university student neighborhoods) provide more sharing listings, while suburbs outside of the city center tend to have more expensive, commercial listings. These are the differences that matter in analyzing potential effects on housing markets, as any market distortion would come from the 'upper class' of property owners. The authors also recognize the value of *Inside Airbnb* for study of this issue, given that they plan to use it for future research in the United States.

Next is the conflict between long-term residents of tourist neighborhoods and Airbnb (Gant, 2016). Gant describes long-term residents as "a barrier to capital accumulation." The author then describes the endgame of Airbnb in tourist areas as "collective displacement" or the wholesale replacement of residents by tourists. The study, using spatial modeling analysis from *Inside Airbnb* and census data, found that a startling 16.8% of properties were taken out of housing stock in Barcelona's center. The author speculates that this would lead to a spike in rent, but does not find a significant correlation between the two.

The following studies provide insights into the methodologies possible when analyzing Airbnb data. Guttentag's research shows that Airbnb does not significantly disrupt nearby hotel businesses, as both business models seem to appeal to different travelers with different expectations, i.e. a kitchen vs food service (Guttentag, 2015). The paper provides valuable

information on Airbnb's growth while laying the groundwork for more research on the differences in attitude between Airbnb and hotel customers. This is relevant to trying to understand why Airbnb listings are more common in some neighborhoods over others in ways that do not match up with hotel use, especially Airbnb usage in residential neighborhoods. One example of this is Venice, which has an unusually high concentration of Airbnb listings, according to my analysis.

The other paper relating to Barcelona (Gutierrez, 2016) focuses on the hotel relationship between the density of Airbnb listings and hotels. The paper uses *Inside Airbnb*, and provides guidance on how best to use such data for analyses, although revenue is not used here. The paper also defines commercial Airbnb users as those with 5 or more properties, which is different from the definition that *FiveThirtyEight* provides. The bivariate spacial autocorrelation model also uses a normalized distribution and measured listings per 1000 people. This analysis showed the importance of controlling for population when working with Airbnb, despite few other analyses doing so.

The Hooijer paper discusses the correlation between the tourism industry and Airbnb's presence, this time showing a negative relationship between hotel revenue and number of Airbnb listings, after controlling for population and unemployment rate (Hooijer, 2016). The author introduces unemployment rate as a control, which seems to significantly alter the result compared to the other regressions in the paper.

Finally, Zervas et al (2012) use a difference-in-difference model for a spatial analysis comparing hotels and Airbnb listings to demographic and economic data sourced from the U.S. Census Bureau to analyze not just the effect Airbnb has on hotel prices and revenue, but the effect during peak tourist times. The authors analyzed Austin's tourism and Airbnb data during

South by Southwest (SXSW), a major yearly convention. The study finds that hotel prices are not affected the way one would assume by competition from Airbnb. Rather, the main impact of Airbnb is that hotels no longer have the flexibility or market power to significantly increase prices during tourist seasons. This has significant implications on the timing of any study involving Airbnb accommodation. One must incorporate, or at least think about, tourism spikes during the time data were collected. Another issue is the "stale listing problem," meaning the difficulty in differentiating between active and inactive listings.

Overall, these papers not only provide similar theories of Airbnb effects, they also provide results that suggest a clear path forward: a more complete econometric analysis of Airbnb demand and the housing market. Crucially, even the papers that concentrate more on tourism and the hotel industry than residents and gentrification provide valuable insights into the use of Airbnb data along with census data. In many cases, the exact same data source, *Inside Airbnb,* was used.

Conceptual Framework

Building on prior literature, I develop a model for the process of gentrification, Airbnb's role in it, and how a higher rate of evictions occurs.

Gentrification

In the following subsection, I will briefly summarize a simple and generally accepted model of gentrification. This is because the process produces little consensus among researchers. As stated in *The Gentrification Reader* (Lees, Slater, & Wyly, 2010, p. 85), "academics, policy makers, developers, and community activists dispute [Gentrification's] impacts and desirability".

Running counter to the urbanization that took place in the 19th century, the early 20th century saw the upper and middle classes move to suburbs (Laska & Spain, 1980), leaving many city centers without economic prospects (Gant, 2016). The return on investment (ROI) in these areas became too low to justify development. Beginning in the late 1970's, the process began to reverse itself, with the wealthy choosing to move back to the city (Laska & Spain, 1980). In addition, lower supply of urban property as well as speculation on the housing market led to a sustained increase in the value of these areas, until the ROI of redeveloping a low-income neighborhood justified the high costs of development. In many cases, these costs were subsidized by local or state governments with interests in 'modernizing' the area (Gant, 2016). Development leads to large scale redeveloping of small businesses and low-income housing into artisanal or chain businesses and upscale apartment buildings, displacing former residents. This development mostly comes from outside buyers or government intervention, although local property owners contribute as well. This a process known as gentrification: "the revival of deteriorated urban neighborhoods by the purchase of property by the upper and middle class" (Dictionary.com, n.d.), thus causing the "collective displacement" of low-income residents (Gant, 2016). Residents of these neighborhoods usually leave the city, as prices correct to the point of no longer being affordable for low income families. Overall, market forces are responsible for gentrification, along with lax zoning or property rights laws and government partnerships with private interests (Lee, 2015).

Airbnb's Role in the Model

Airbnb's contribution to this framework is mixed, according to the small body of research available. The model in Fig. 3 shows Airbnb, with blue arrows showing two theoretical effects:

1. reducing supply of property available for residential use, thereby driving up property values, and thus, rents;

2. increasing the ROI on using condominiums for Airbnb compared to selling condominiums or renting them out as apartments

While the logic for the first effect lacks empirically confirmation, it is grounded the fundamentals of supply and demand. The logic of the second effect is that landlords will realize that turning low income rentals into condominiums will have a large ROI because of upward property value trends. Essentially, the opportunity cost of remaining in the low-income rental business will increase. Condominiums can be more profitable than rentals on their own, especially when property values are increasing; however, condominiums that remain unsold, and are instead used as Airbnb 'business' properties (used exclusively to be rented on a short-term basis), are much more profitable on a regular basis, selling for up to hundreds of dollars a night (Stuhlberg, 2016). It is therefore potentially very profitable to remove one's rental properties from the market to turn them into condominiums. Conveniently, doing so in California triggers the Ellis Act (Lee, 2015), which allows for eviction of rent-control renters only when taking a property off the market.

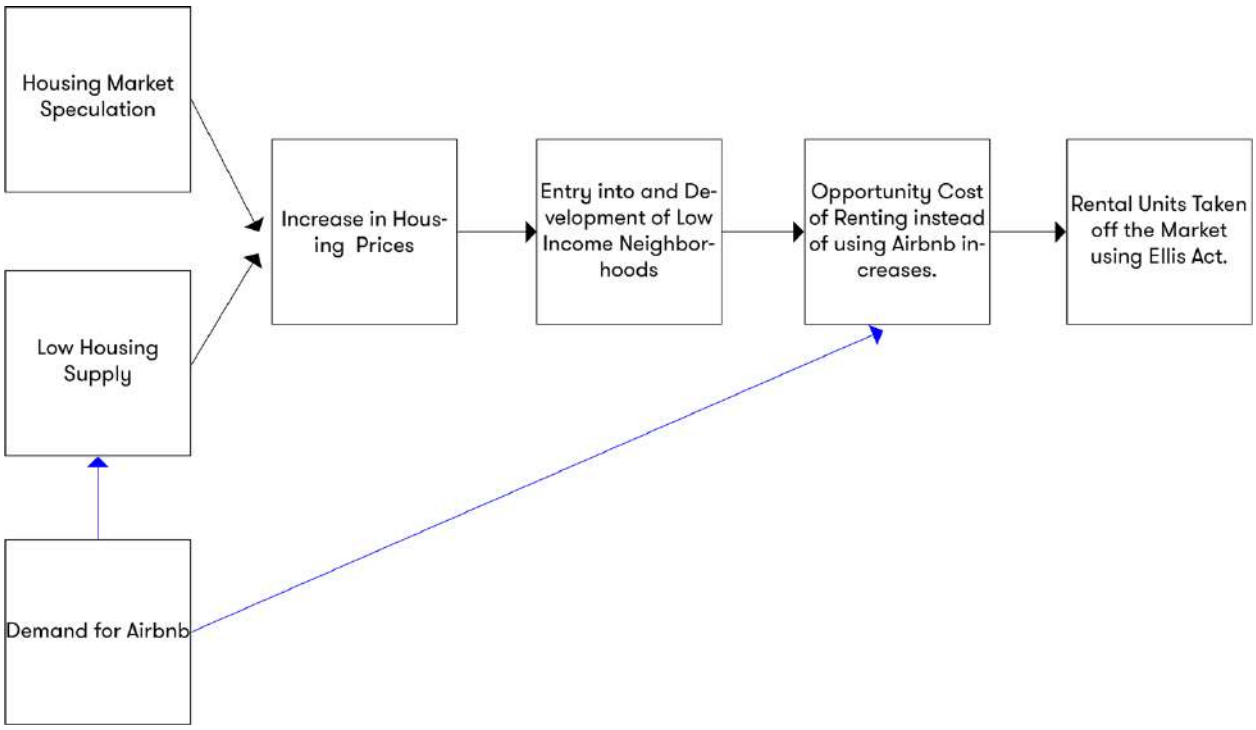


Figure 3: Conceptual Model[1]

Evictions

The model will take demand for Airbnb, outlined above, and relate it to Ellis Act evictions, which serves as the dependent variable. The hypothesized causal effect of this relationship predicts that rent-control removals will be more common in areas with high demand for Airbnb rentals. This model is restricted to using zip codes in which Ellis Act data is available, without knowing any details about individual evictions. The low number of Ellis Act evictions in general leads to my standardizing Ellis Act evictions on a per 10000 housing unit basis.[2]

Hypothesis

Based on this framework, and findings from empirical research on Airbnb and gentrification, this study offers the following research hypothesis: The demand for short-term

[1] Blue arrows indicated hypothetical effects.
[2] The LA Times data in Figures 1 and 2 standardize per 100 housing units as they use multiple years of data instead of just 2016.

rentals in each area will increase the number of no-fault evictions in that area, due to the lucrative nature of short-term rentals of condominiums compared to low-income rentals.

Data and Methods

The estimate of evictions compared to number of Airbnb listings in each area builds on the methodology of the London analysis (Quatrone et al, 2016), with several notable differences. First, this study's dataset is composed of any zip codes from LA County in which Ellis Act data was available, i.e. Los Angeles and Santa Monica, roughly. The control variables, coming from the 2011-2015 estimates of the *American Communities Survey*, include population, unemployment rate, and cost of living; they are in this model since they have been shown to have significant effects in similar studies (Gant, 2016). Some additional controls were coded from *Inside Airbnb* and the *Zillow Home Value Index* (ZHVI). For more information on how these different sources of data were standardized to one dataset, see Appendix A.

Dependent Variable

The dependent variables in this study is the number of Ellis Act evictions per 10,000 housing units per zip code. Evictions data was gathered from the cities of Los Angeles and Santa Monica. This dataset was acquired by requesting the information from government bodies directly. All Ellis Act data spans the entirety of the calendar year 2016.

Independent Variable

The independent variable in this study will measure the number of Airbnb rentals per 1000 housing units per zip code[3]. The variable is like those in other studies, such as the Quatrone et al (2016) study and the Guttentag paper (2015), with the main difference being standardizing based on housing units instead of using the raw number of Airbnb listings.

The Airbnb data comes from *Inside Airbnb*, a free resource that lists rentals per city over time, along with information about these listings. *Inside Airbnb* automatically gathers listings data over a three-month period and exports the data to standard CSV format. This paper's dataset uses the three latest sets of data, spanning from January to August of 2016.

The relevant information is the number of listings, the neighborhood and zip code, the price per night for each rental, how many nights the rental was used, and how often the rental was listed. This information allows one, through simple multiplication, to give a minimum estimate of revenue for each listing, like the method used in Stuhlberg (2016). In the interest of replicability, I coded this variable and ran an alternative model in Appendix B.

Controls

The data used as a control are from the *American Communities Survey*, using 5-year estimates of local data to control for population, unemployment[4] rate and other variables. The first two variables were shown to significantly alter the results of multiple studies, most notably

[3] I divided each variable by a different number to make sure the variables were legible. Percentage rate for Airbnb or a per thousand rate for Ellis Act Evictions would have led to mostly fractional values.

[4] Unemployment and poverty are both calculated using the ACS and are therefore not the same as statistics put out by other parts of the United States government. The variation of these values between zip codes should be close to that of the 'official' unemployment and poverty rates.

the Hoojier study (2016). I added the other controls both to make sure these potential effects are not hidden in the dependent and independent variables, but to answer the question of their effects on the housing market. Race variables are included to see if there is a significant racial tint to the potential correlation between Airbnb and Ellis Act evictions, as is the case put forward by affordable housing activists. Considering the unique characteristics of Los Angeles, the effect of the Hispanic population is especially relevant to this research.

Sample

Combined, I have a dataset with a sample of 126 zip codes in the Los Angeles area this number drops with more variables, due to some Zillow and ACS values being missing). The slight differences in time should not affect the integrity of the data, as the ACS estimates from 2011-2015 are mostly used as controls. The more relevant data, Airbnb, and Ellis Act data, are all 2016 data. In fact, this time mismatch may reflect that housing decisions made in 2016 would have been made based on conditions inherited from 2015.

Analytic Strategy

The descriptive statistics for the variables in the dataset, as shown in Table 1. The descriptive statistics include Mean, Standard Deviation, Minimum and Maximum. Some data visualizations will also be shown to help understand the nature of the dataset.

This study will use a robust OLS regression model to compare number of evictions to demand for Airbnb rentals. The regression is robust to counter the heteroskedasticity in the Airbnb/Ellis Act eviction correlation: both variables show high variance with higher values. The Gant (2016) and Quatrone et al (2016) papers both employ OLS regressions, and the data

available lends itself to few other econometric methods. Three models will be estimated. The first model simply regresses Ellis Act evictions on Airbnb listings. The second model adds population and unemployment rate as controls. The third model includes the other controls that may be relevant to the research question. The simplicity of the model allows for straightforward interpretation: the b1 coefficient represents the relationship between evictions per area and demand for Airbnb in the same area. All three models are shown in Table 2, with their equations shown immediately below:

Model 1: $Yellis = \beta 0 + \beta 1.airbnb$

Model 2: $Yellis = \beta 0 + \beta 1.airbnb + \beta 2.population + \beta 3.unemployment$

Model 3: $Yellis = \beta 0 + \beta 1.airbnb + \beta 2.population + \beta 3.unemployment + \beta n.controls$

Results

Table 1 presents descriptive characteristics of the zip codes in and surrounding Los Angeles. These statistics outline the diversity of the Los Angeles area, with median ages ranging from 23 to 59, and with population per zip code ranging from 2,330 to 104,058. More unique to Los Angeles, there are zip codes in which nearly half the population does not speak English fluently, and some in which 96% of the population is Hispanic; other areas are almost completely white. Some zip codes had their home values grow by only 15% in five years, while others grew 80%. The standard deviations show huge disparities between neighborhoods within Los Angeles. A cursory glance at the data shows that zip codes in gentrifying neighborhoods as well as tourist destinations have more Airbnb listings and more Ellis Act evictions, as shown in Figures 4-7.

Specific zip codes are highlighted for their characteristics. For example, 90291, or Venice, CA, has the highest number of Airbnb listings, at 6,141 listings, and a very high rate of Ellis Act evictions, 17. The other area to note is Beverly Grove (90046 and 90048), with a combined total of 27 Ellis Act evictions and 6,135 Airbnb listings. The zip code with the largest number of Ellis Act evictions (23) is 91601, or the North Hollywood Arts District. The area has been developing rapidly and is seen as "up and coming," with 944 Airbnb listings (Laden, 2014). Other gentrifying neighborhoods, like Downtown and Mid-Wilshire are also experiencing a high number of Airbnb listings and Ellis Act evictions.

One interesting result I found is that Airbnb listings are not uniformly more profitable than ordinary rentals. Using the estimate of average Airbnb income per zip code created using *Inside Airbnb*'s guidelines and the average rent per zip code, I created a variable that shows the extent to which Airbnb is more profitable than renting one's property. I found that many parts of Los Angeles are less profitable with Airbnb, some parts of the valley netting one only 0.15 times the income of a normal rental per month. Alternatively, areas that experience high home value growth rates and high Ellis Act eviction rates were more profitable for Airbnb users, with parts of Downtown being up to 4.85 times more profitable for Airbnb users than for normal landlords, showing a clear incentive to make the switch. The map on the following page, Figure 4, shows where Airbnb profitability is at its highest and lowest within Los Angeles. Figures 5, 6 and 7 show how Home Value Growth, Airbnb Listings, and Ellis Act evictions are distributed among the zip codes included in my analysis.

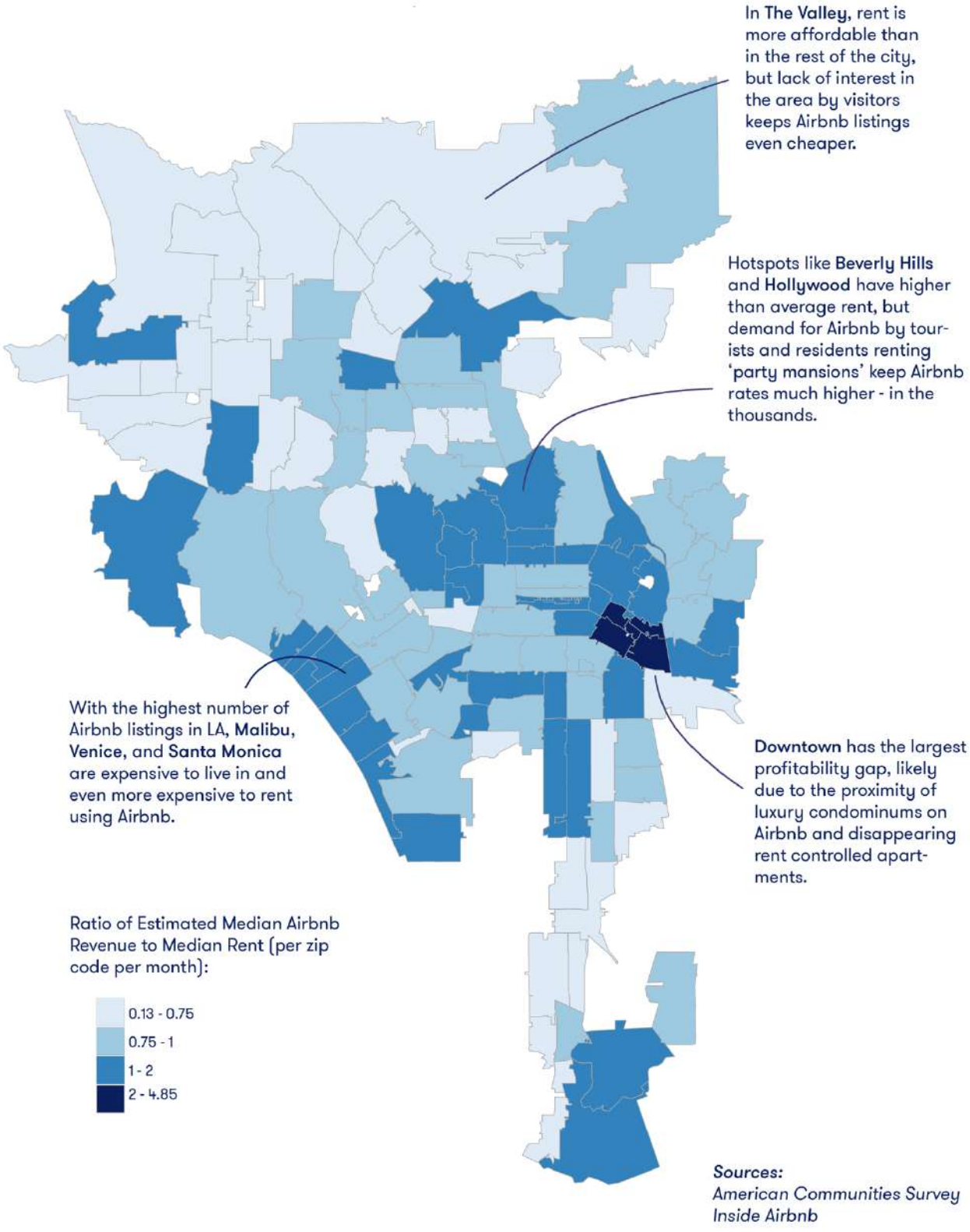


Figure 4: The Profitability Gap

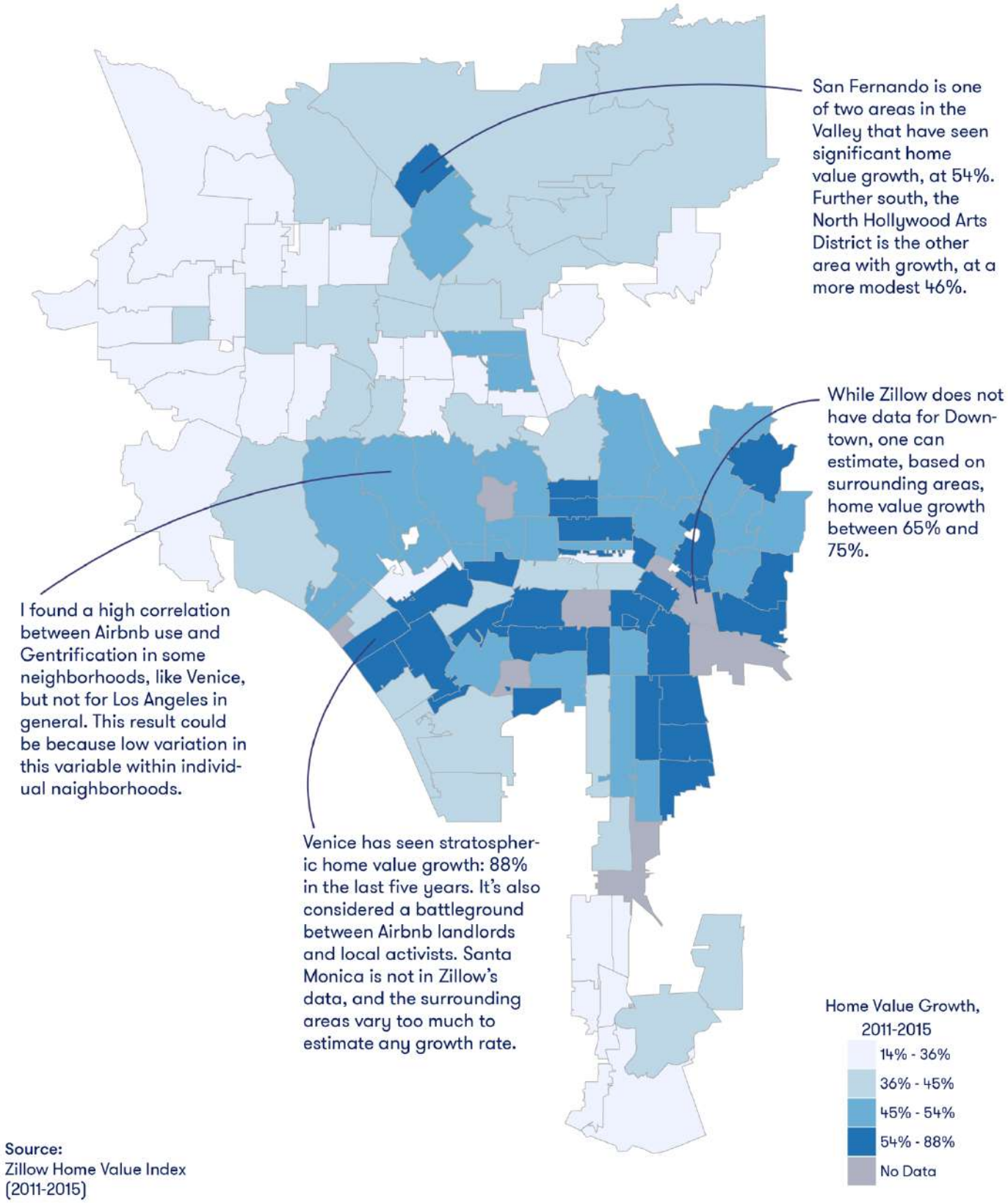


Figure 5: Home Value Growth in Los Angeles since 2011

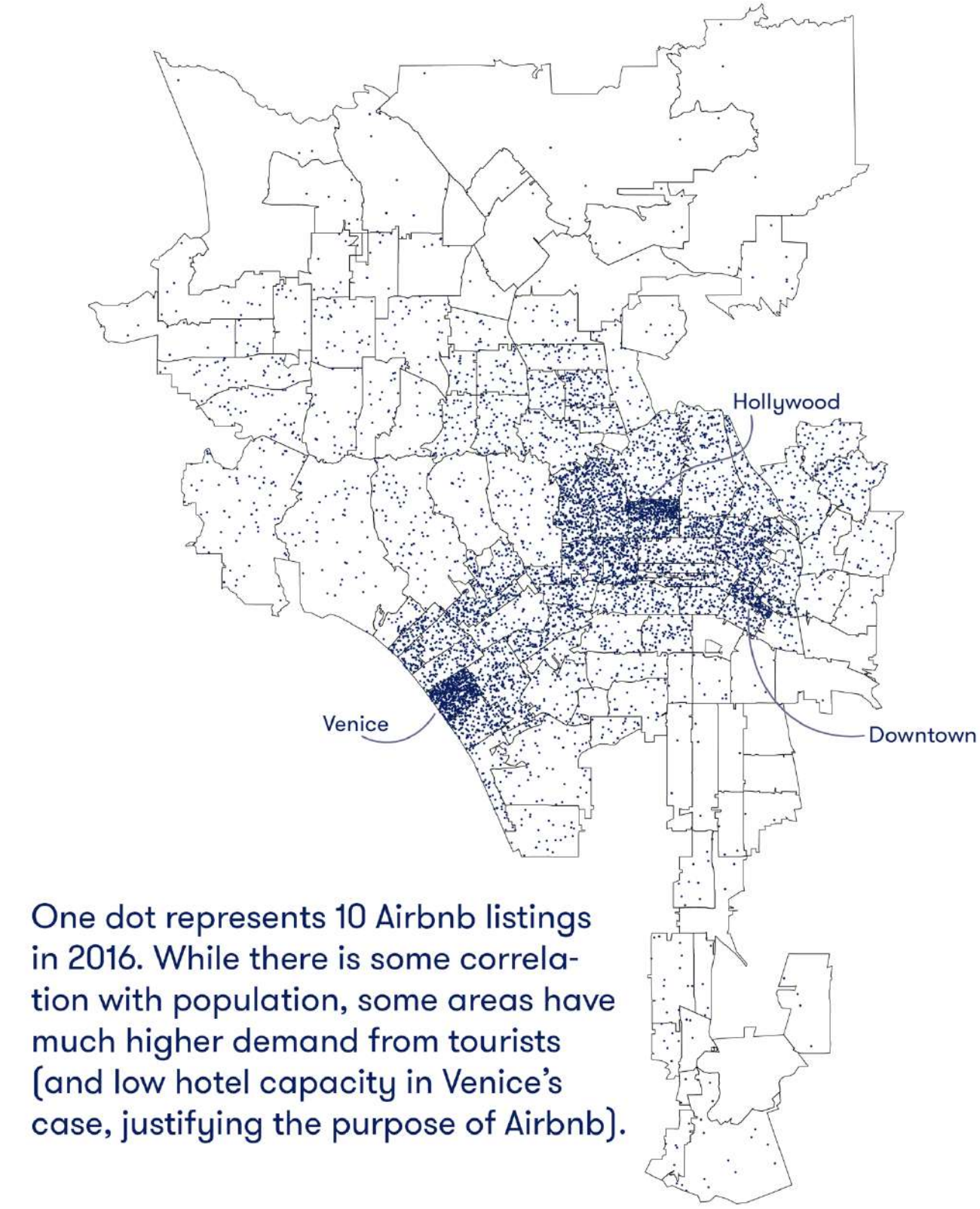
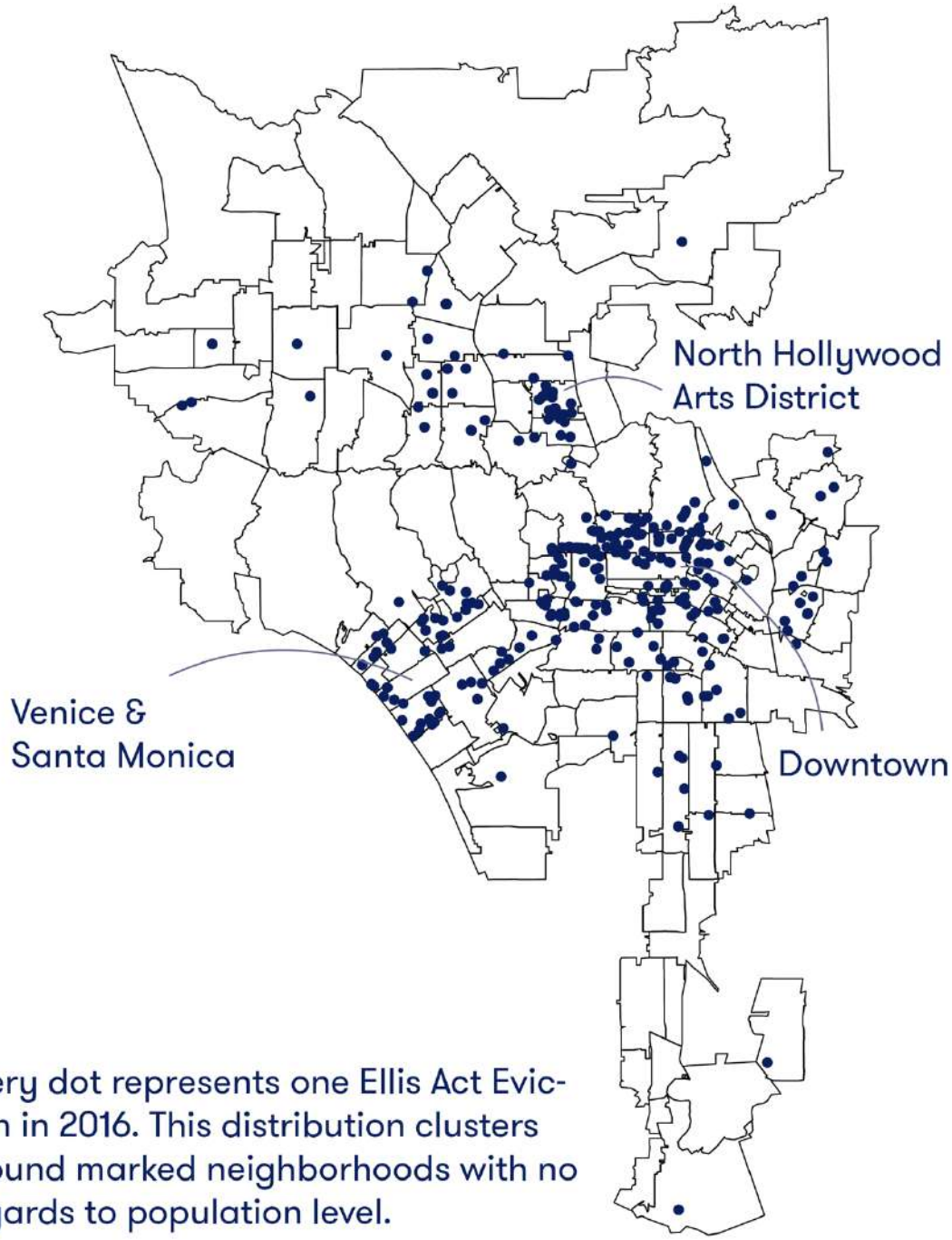


Figure 6: Airbnb Use in Los Angeles in 2016



Source: *Los Angeles & Santa Monica Clerks' Offices*

Figure 7: Map of Individual Ellis Act Evictions in Los Angeles in 2016

Table 1: Descriptive Statistics

Variable	N	Mean	St. Dev.	Min	Max
Population	126	36,726.23	20,405.72	2,330	104,058
Home Value Growth from 2011-15, (%)	117	0.453	0.129	0.143	0.879
Ellis Act Evictions, 2016 (/10000 Housing Units)	126	1.734	2.756	0.000	14.011
Airbnb Listings (/1000 Housing Units)	126	43.508	54.498	0.141	395.352
Number of Properties	126	13,693.91	6,261.21	855	31,322
Median Estimated Airbnb Revenue ($)	126	763.25	391.16	127.65	2,290.20
Median Rent ($)	126	1,357.18	404.74	427	2,564
Profitability of Airbnb over Rental Ratio (x times Median Rent)	126	0.606	0.402	0.191	4.8
Unemployment Proxy (%)	126	6.649	1.718	2.300	11.100
Median Household Income ($)	126	60,379.52	28,480.86	12,813	166,021
Poverty Rate (%)	126	19.344	11.425	4.000	58.800
Population that graduated from High School (%)	126	79.562	16.570	30.200	99.000
Population born outside the United States (%)	126	49.330	15.864	9.300	86.300
Empty Property (%)	126	6.956	3.174	2.200	26.400
Median Number of Rooms per Property	126	4.283	1.087	1.300	7.100
Median Value of Owner Occupied Properties ($)	124	578,006.50	288,198.10	190,800	1,694,400
Median Age	126	37.138	5.704	23.000	59.200
Black (%)	126	9.573	13.874	0.000	76.700
Asian (%)	126	12.390	10.514	0.200	72.600
Pacific Islander (%)	126	0.250	0.513	0.000	4.000
Native American (%)	126	0.540	0.602	0.000	5.500
Other Race (%)	126	17.302	15.333	0.000	56.800
Hispanic (%)	126	38.813	26.024	0.700	96.900
Number of Foreclosures	126	55.619	55.095	0	251
Population that speaks Spanish at home, and little English (%)	126	15.582	13.715	0.000	46.000
Number of Rental Properties	126	7,801.06	4,815.07	329	22,259
Homes Occupied by Renters (%)	126	60.166	20.136	16.500	96.500

Table 2 depicts the robust OLS regression results from all three models. These models, even Model 3, with all control variables (excluding variables that would cause multicollinearity, such as the White population) included in the dataset, show a highly significant relationship between number of Airbnb listings and number of Ellis Act evictions per zip code. Controlling for population and unemployment rate has surprisingly little effect on the Airbnb coefficient, reducing its correlation by a negligible amount. Only with several more controls, race and other economic and housing factors, do we see a reduction in the estimated coefficient. Through all three models, the main finding remains consistent. While Ellis Act Evictions are relatively rare, the relationship with Airbnb is strong, regardless of the large number of Airbnb listings it takes to impute even one such eviction.

In regressing on Ellis Act evictions, there are noticeable patterns. While unemployment is not significant once other controls are added in, the value of rental properties has a positive correlation with Ellis Act evictions. Just as with the main independent variable, none of the significant controls have sizeable correlations, each counting as only a fraction of one Ellis Act eviction.

Model 3 drops several zip codes due to the limitations of ZHVI, which does not cover every zip code in my analysis. The loss of zip codes seems dispersed, but notable absences include parts of Downtown, considered a battleground for Airbnb users and anti-eviction activists. The absence of these observations does not seem to impact the analysis in Model 3, based on an additional regression I ran without the ZHVI variable.

Table 2: Regression Results

	Dependent variable:		
	Ellis Act Evictions, 2016 (/10000 Housing Units)		
	(1)	(2)	(3)
Airbnb Listings (/1000 Housing Units)	0.026*** (0.002)	0.028*** (0.002)	0.019*** (0.004)
Population		0.00002*** (0.00001)	-0.00004** (0.00002)
Unemployment (ACS est. %)		0.130* (0.067)	0.158 (0.112)
Home Value Growth (2011-2015, %)			-1.891 (1.478)
Empty Property (%)			-0.103 (0.064)
Median Value of Owner Occupied Properties ($)			0.00000 (0.00000)
Median Rent ($)			0.0003 (0.001)
Number of Foreclosures			0.005 (0.004)
Median Number of Rooms per Property			0.081 (0.450)
Homes Occupied by Renters (%)			0.003 (0.027)
Median Value of Properties Occupied by Renters ($)			0.0003*** (0.0001)
Poverty Rate (ACS est. %)			0.011 (0.039)
Born outside the United States (%)			0.008 (0.025)
Graduated High School (%)			-0.024 (0.040)
Median Age			0.009 (0.058)
Hispanic (%)			0.002 (0.025)
Black (%)			-0.022 (0.021)
Asian (%)			0.005 (0.015)
Native American (%)			-0.235 (0.235)
Pacific Islander (%)			0.133 (0.267)
Other Race (%)			-0.002 (0.019)
Constant	0.293* (0.166)	-1.526*** (0.467)	0.125 (7.943)
Observations	126	126	115
Residual Std. Error	1.103 (df= 124)	0.997 (df= 122)	0.923 (df= 93)

*$p<0.1$; **$p<0.05$; ***$p<0.01$

Discussion

Summary and Interpretation

The results suggest that Airbnb is significantly and positively correlated to the number Ellis Act evictions in each zip code in Los Angeles. If such a relationship could be replicated with further and more complete research, the restrictions being placed on 'commercial' Airbnb use in Los Angeles and other urban centers could be justified. However, there is still very little research on this subject. In fact, few statistical analyses have shown relationships between Airbnb and other housing related indicators, leaving those advocating for restrictions against Airbnb operating without much evidence, though the same could be said of their opponents. In fact, after experiencing the difficulty of acquiring Ellis Act data for one metropolitan area, it seems unlikely that activists on either side have the facts necessary to discuss the factors behind of Ellis Act evictions.

Another explanatory strength is in the robust r^2 value of each model. While one can explain the high value (0.5818) for Model 3 with the high number of variables, Models 1 (0.3315) and 2 (0.334) have high values with few variables. My hypothesis states that Airbnb would have a small but significant impact on Ellis Act evictions, so I doubt that Airbnb could truly explain one third, let alone nearly two thirds, of variation within Ellis Act evictions. I theorize that both the dependent and independent variables capture much more than simply the number of listings or rent-control removals. The information within these variables could be related to both variables having some link to the same phenomenon, gentrification, which my home value growth variable could not effectively proxy.

A more accurate way to determine which neighborhoods are attractive to middle and upper class buyers and businesses is needed. Growth in educational attainment has been one method of

measuring this, but more granular detail is needed, such as a way of measuring growth of niche small businesses, or of major public/private partnership developments. There is much more than home value growth to explain which neighborhoods are counted as "up-and-coming" and therefore have higher rates of both Airbnb listings and Ellis Act evictions, standardized by number of housing units and controlled for population, among other variables.

If further research replicates the results of this model, the restrictions needed would include better oversight of landlord activities after they remove their properties from the rental market, and classification of Airbnb activity as a new type of rental, so that they fall more clearly under rent control laws. Enforcement may be difficult, but it would start with a review of any Ellis Act eviction resulting in reclassification to a condominium or personal use property after the fact.

With only a few hundred evictions per year, this oversight would not likely pose a significant drain on city resources. Cities like Santa Monica, with only 60 evictions in 2016, would find enforcement manageable. Most restrictions being implemented are restricting Airbnb usage based on the amount of properties rented, but my analysis shows that another potential avenue of regulation: through keeping track of where Airbnb properties come from, and who may have been vacated for that short-term rental to take place.

Caveats

While the models above show a correlation between Ellis Act evictions and Airbnb listings per zip code, there are several caveats to this study. The most important one is that, despite almost half of the variation of Ellis Act evictions being explained, according to the robust R^2 of the third model, there are still unobserved characteristics that may be upwardly biasing results for the main independent variable, as there are many aspects to gentrification that are not captured in this dataset. For example, while the ZHVI seemed to be a potential proxy for

gentrification, it was not significant in any model and could not capture the complexities of what Gant (2016) called "collective displacement."

The lack of data historical also prevented a more comprehensive look at Airbnb's influence on the housing market. One could, with enough time-data, code a repeated cross-sections dataset to explore alternative ways to answer the research question, such as a fixed effects model, or a difference-in-difference model, with Airbnb activity coded to be the "treatment." The availability of data was severely restricted by time: Airbnb data ended at August 2016, while the available Ellis Act data was available for the entirety of 2016.

The most important caveat involves Ellis Act data, which is collected locally. Petitioning the state of California or Los Angeles County provided no data, as there is no multi-city collection of Ellis Act data. Consequently, much of my time gathering data meant sending CPRA (California Public Records Act) requests to cities like Inglewood and Burbank, usually with staffs too small to handle such requests. Only Los Angeles and Santa Monica responded within the legally mandated 10-day window. Some cities, such as Culver City, do not even collect Ellis Act data. For future research of this kind to be more comprehensive, I recommend statewide collection of Ellis Act data.

Conclusion

This paper is a first step in what will hopefully be a well-researched topic. Of course, future researchers on this topic need better access to data than what I could find. Hopefully such data can be better aggregated by public officials so that future research on this topic can have a larger sample size, which posed a significant constraint on my analysis.

Of course, Airbnb is still be one minor part of the larger narrative of gentrification that must be the subject of further research, including the social effect of neighborhoods inhabited by

tourists and travelers. As previously mentioned, the potential economic effects of Airbnb would be on the largest part of most monthly costs for low-income families: rent. It is therefore clear that housing policy, and therefore Airbnb's effect on it, plays a major role in poverty reduction through the working class' access to affordable housing. In addition, where one lives has countless collateral effects on one's life, such as job opportunities, education, and health (Lee, 2015). We therefore should not simply accept that lower income Angelinos are leaving the city without further research into how Airbnb may play a role this demographic shift.

While the Ellis Act is only a partial loophole under most circumstances, this thesis shows that there is a chance that Airbnb may be widening that loophole. With an exodus of the less wealthy out of gentrifying neighborhoods towards the outskirts of Los Angeles underway (Sindinski, 2017), and considering the possibility that Airbnb may be exacerbating this exodus, policy researchers must examine housing policy with renewed focus and with short-term rentals in mind.

Appendix A: Creating the Dataset

The data needed to conduct this study comes from a wide range of sources, and needed to be combined into one comprehensive dataset. I started using the ACS datasets as the basis for my working dataset, choosing relevant economic and demographic controls from the 5-year estimate, 2011-2015. The ACS datasets I pulled variables from were separated by Zip Code Tabulation Area (ZCTA), which is almost identically congruent to Zip Codes, besides slight variation by individual properties. Using a ZCTA dataset with Zip Code data should not present any problems. To this basis, I add two variables that were coded manually.

The first is the number of Airbnb listings per 1000 housing units per zip code. To acquire this data, I loaded *Inside Airbnb* datasets for Los Angeles from 2016 into a statistical analysis program, calculated how many listings there were per zip code, and entered that information into the ACS dataset. I used a similar method for the Ellis Act data, after acquiring it through a public data request form from the Los Angeles Housing Board.

Finally, I used Zillow's proprietary but publically available index of property value growth. I isolated the zip codes used in the main dataset, chose the years 2011 and 2015 and calculated the growth rate of the index. This variable should give a rough look at which zip codes are experiencing the fastest rates of gentrification. I chose January 2011 and December 2015 as start and endpoints for this variable to match the ACS data by time. Other controls include my estimate, using *Inside Airbnb*'s standards, of median Airbnb revenue per zip code, as well as a ratio of this monthly revenue over median rent, allowing one to see how much more one could make on Airbnb than through the rental market, per zip code. See Figure 4 for more details on this ratio.

Appendix B: Additional Models

To confirm the above results, I created additional models redefining my independent and dependent variables, shown in Table 3. First, I corrected for the large number of observations that had no Ellis Act evictions in 2016. I converted Model 3 into a Tobit model, which censored the dependent variable to drop any observation with 0 Ellis Act Evictions. The results remained significant, although with a small coefficient and much smaller sample size. The next models use several independent values I coded from *Inside Airbnb*, the ZHVI, and the ACS instead of the Airbnb listings per 1,000 housing units variable, all based on Model 2 (since I included Home Value Growth variable in Model 3). The 'Gentrification Model', which uses home value growth, is significant and positive. The coefficient on the Home Value Growth variable is around 1 Ellis Act eviction per 10,000 housing units for each 25% increase in home value over 5 years. The model using Estimated Airbnb Revenue is also significant and positive, albeit very small in magnitude. The last model is based on the profitability gap from Figure 4, and does not hold significant results. These additional results reinforce the correlations between Airbnb, housing value growth (to some extent), and Ellis Act evictions shown in Models 1-3.

Table 3: Additional Model Regression Results

	Tobit Model	Gentrification Model	Revenue Model	Profitability Model
VARIABLES	**Ellis Act Evictions, 2016 (/10000 Housing Units) (Censored at 0)**	**Ellis Act Evictions, 2016 (/10000 Housing Units)**	**Ellis Act Evictions, 2016 (/10000 Housing Units)**	**Ellis Act Evictions, 2016 (/10000 Housing Units)**
Airbnb Listings (/1000 Housing Units)	0.0324*** (0.00811)			
Population	-4.17e-05 (5.37e-05)	-5.26e-06 (1.05e-05)	1.22e-05 (8.84e-06)	2.60e-06 (9.38e-06)
Unemployment (ACS est. %)	0.0788 (0.248)	0.298* (0.162)	0.342** (0.152)	0.282* (0.148)
Home Value Growth (2011-2015, %)	-1.291 (3.182)	4.274* (2.308)		
Empty Property (%)	-0.385** (0.183)			
Median Value of Owner Occupied Properties ($)	2.02e-06 (2.11e-06)			
Median Rent ($)	-0.00359 (0.00238)			
Number of Foreclosures	0.0110 (0.00993)			
Median Number of Rooms per Property	0.319 (1.062)			
Homes Occupied by Renters (%)	0.103 (0.0642)			
Median Value of Properties Occupied by Renters ($)	0.000221 (0.000202)			
Poverty Rate (ACS est. %)	-0.0814 (0.0974)			
Population born outside the United States (%)	-0.0503 (0.0591)			
Population that graduated from High School (%)	-0.0132 (0.0869)			
Median Age	-0.301* (0.152)			

Table 3 (cont.)

	Tobit Model	Gentrification Model	Revenue Model	Profitability Model
Hispanic (%)	-0.0312 (0.0561)			
Black (%)	-0.0205 (0.0457)			
Asian (%)	-0.0386 (0.0367)			
Native American (%)	-0.710 (0.670)			
Pacific Islander (%)	-1.156 (1.391)			
Other Race (%)	0.0369 (0.0408)			
Median Estimated Airbnb Revenue ($)			0.00134*** (0.000484)	
Profitability of Airbnb over Rental Ratio (x times Median Rent)				0.495 (0.481)
Constant	14.92 (18.51)	-2.009* (1.120)	-2.692** (1.086)	-0.717 (0.866)
Observations	66 (49 censored)	117	124	124
R-squared		0.088	0.124	0.055
Sigma	2.391*** (0.215)			

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