Front Matter: CASA0013: Foundations of Spatial Data Science

Visualize the distribution of Airbnb listings in London and explore the impact of Airbnb on the London housing market

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Executive summary

The rapid expansion of Airbnb in recent years has led to an increase in the number of listings and transactions, with more homeowners willing to rent their homes for short periods through Airbnb and the potential for abuse of a large number of listings. This study explores the distribution of Airbnb listings in London and whether it is exacerbating the pressure on the housing market (house prices, rents) to support the Mayor of London in his decision making, given the tight supply in the London housing market and rising rents and house prices over the years.

This study applies London housing situation data from the Office for National Statistics (ONS) and Airbnb listings data from Inside Airbnb to define possible abuses. By linking the data to a map to view the distribution of Airbnb listings and misuse, and by using linear regression to try to build a model to explore whether and how the number of Airbnb listings and possible misuse affects house prices and rents.

The analysis revealed that Airbnb listings have a downtown concentration effect, a tourist attraction concentration effect, and a large number of possible misuse cases. The model indicates that the number of Airbnb listings and abuse has a positive impact on house price and rent growth, with house prices rising by around £2,205 and rents rising by around £2.80 for each additional unit in Airbnb's listings, and house prices rising by around £13,320 and rents rising by £1.40 for each additional unit in Airbnb's Misiuse. This exacerbates the housing pressure on Londoners, especially inner Londoners. Finally this study attempts to give several potentially actionable recommendations to improve the situation.

1 Background
1.1 Airbnb Background

Airbnb is one of the most famous short term travel rental platforms that uses the internet to bring together people looking for short term accommodation and housing providers (McAfee, 2005). to get in touch with housing providers (McAfee & Brynjolfsson, 2017; Parker, van Alstyne & Choudary, 2016). This platform is revolutionizing the traditional housing and travel market, and in London, airbnb entered the market in 2008 and began to explode in 2014

(Rowland Manthorpe, 2018). Due to its convenience and real-time nature, more customers are choosing to use airbnb, which attracts more accommodation providers to join, as well as specialized providers with a large number of listings. One of the biggest problems with such services to date is the lack of collective regulation (Stone, 2017). In this paper, we explore Airbnb supply and gauge its possible impact on the housing market in London, the world's largest city.

1.2 The London housing market

The London housing market has experienced extreme turbulence over the past few hundred years (Anon, 2016; Watt & Minton, 2016), and studies by several scholars have identified the potential impact that the rapid rise of airbnb could have on the housing market (Barron, Kung & Proserpio, 2018; Gutiérrez et al., 2017a, 2017b; Horn & Merante, 2017; Sheppard & Udell, 2016). London is a city with a large and unequal foreign population, with rapidly growing rents, very high house prices, a disparate income distribution, and significant social class divisions. Those who owned property earlier benefited from the rapid rise in house prices, and a large number of new Londoners, those with lower incomes, had no choice but to rent due to high house prices, which also raised demand for the rental market and affected rents (Davidson & Wyly, 2012; Hamnett, 2003; Zervas, 2017).The impact of Airbnb's rapid growth on the housing market has attracted more attention, with some researchers arguing that Airbnb is invading the housing market and hotels (Barron, Kung & Proserpio, 2018; Gutiérrez et al., 2017a, 2017b; Horn & Merante, 2017; Rev. & 2016, n.d.; Sheppard & Udell, 2016), others have found no significant negative impact of Airbnb in reducing permanent housing and converting it to short-term accommodation (Snelling & Colebrook, 2016). Because Airbnb varies greatly across regions and is highly dependent on socioeconomic factors such as the city's own housing market (Quattrone et al., 2016), the impact of Airbnb is very much in need of analysis in a regional context.

The UK government introduced regulations in 2015 restricting the use of vacation rentals to no more than 90 days per year (HM Government United Kingdom, 2015), and this study aims to explore the impact of Airbnb on the local housing market: house prices and rents by exploring the availability and potential misuse of Airbnb in London. It provides a basis for adaptive updates to policy regulations and enforcement.

2 Airbnb and the London Housing Market Analysis

2.1 Data sources

The data consists mainly of geographic data, Airbnb data and London housing market data.

a. Geographic data from The Open Geography portal from the Office for National Statistics (ONS) (https://geoportal.statistics.gov.uk) contains London boundary data at the Borough and Middle Layer Super Output Areas levels. Layer Super Output Areas level boundary data.

b. Airbnb data from Inside Airbnb (http://insideairbnb.com) 2021. Listings are properties advertised on the Airbnb platform (including entire properties, private rooms, or shared rooms).

c. London housing market data from the Office for National Statistics (ONS) (https://www.ons.gov.uk).   Includes house price data for 2014 to 2021: Median house prices by middle layer super output area, and 2021 rental data: Private rental market summary statistics in England.

2.2 Supply and abuse of Airbnb in London

Figure 1 maps each listing to the map by linking Inside Airbnb's data to the map to get a scatter plot of the distribution. It can be seen that the more central the location the more Airbnb listings are available and the more listings are likely to misuse.

Based on Section 44 of the Deregulation Act implemented in London, we define potential misuse using the following criteria.

a.London 2020 has an overall occupancy rate of approximately 50% (InsideAirbnb, 2018), with more than 180 days of entire listings available in a year cumulatively. These listings have a high likelihood of being booked for more than 90 days per year (which violates the 90-day limit for renting properties as vacation rentals in London).

b. Airbnb abuse is defined as the cumulative availability of an entire listing for more than 180 days in a year where the host has multiple (two or more) listings.

Figure1 Scatterplot of Airbnb's listings in London (all listings, listings >180 days per year, misuse listings)

From Figure 2 shows Airbnb's share of total housing supply, which grew from 0.75% (25,000 units) in 2015 to 2.38% (80,000 units) in 2019. This growth is continuing. Figure 2 also shows the potential abuse of Airbnb from 2015 to 2019(Shabrina, Arcaute & Batty, 2021). Figure 3 shows the distribution of all listings and possible misuse by aggregating the data within different London boroughs, and Figure 4 shows these distributions in a similar way in the middle layer super output area, a smaller formation area. They all exhibit central aggregation

and are more concentrated on the north bank of the Thames, which may be due to the fact that Airbnb listings possess characteristics that are dependent on tourist centers.
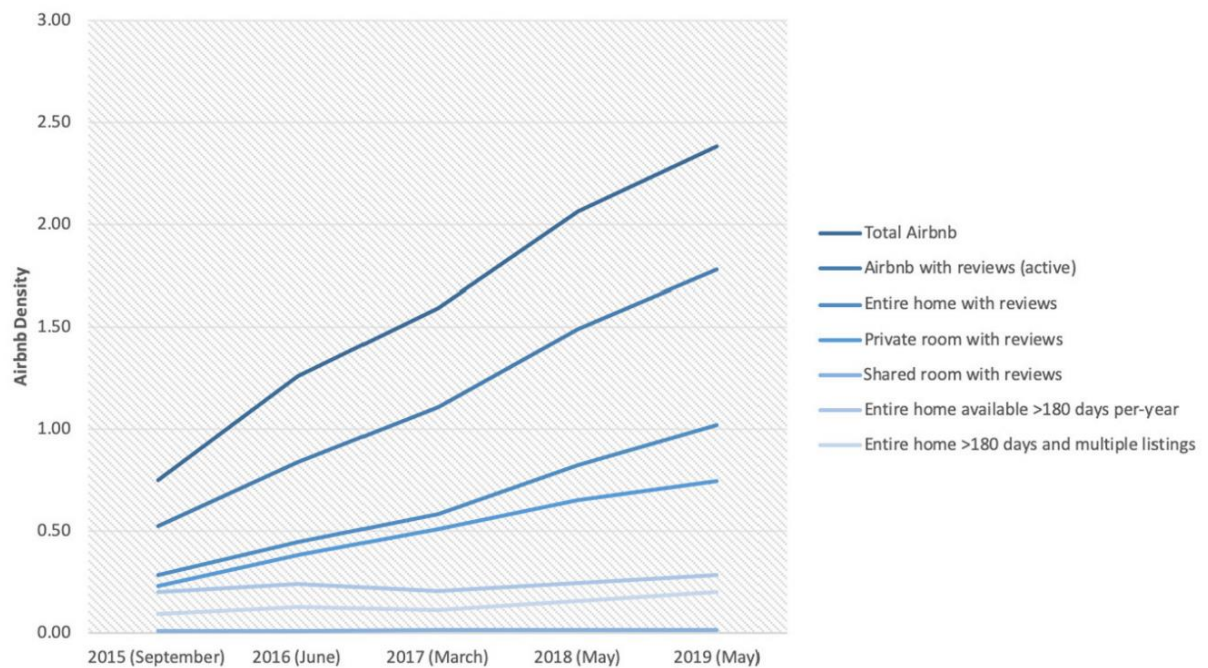

Figure2 Percentage of Airbnb supply from 2015 to 2019 and potential abuse based on the number of days the property is offered and whether the host has multiple listings. (Shabrina, Arcaute & Batty, 2021)
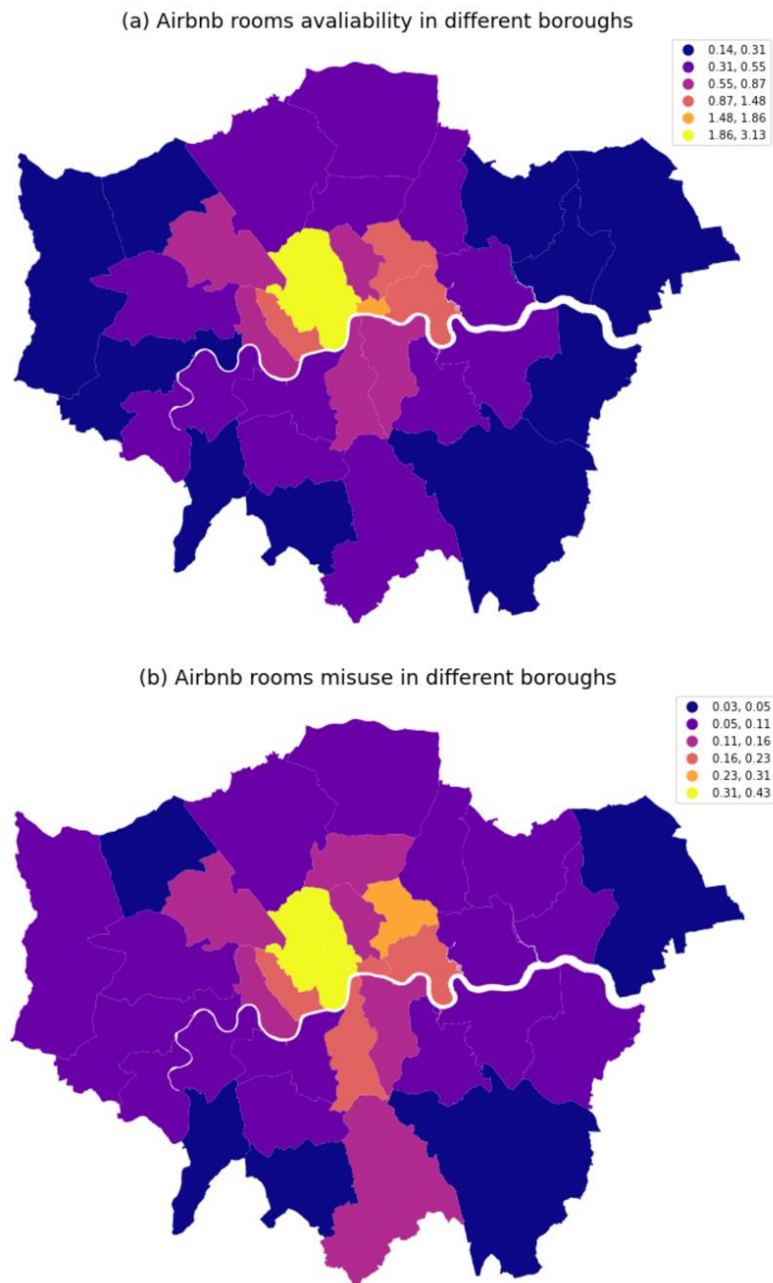
(a) Airbnb rooms avaliability in different boroughs

| 0.14, 0.31 |
| 0.31, 0.55 |
| 0.55, 0.87 |
| 0.87, 1.48 |
| 1.48, 1.86 |
| 1.86, 3.13 |

(b) Airbnb rooms misuse in different boroughs

| 0.03, 0.05 |
| 0.05, 0.11 |
| 0.11, 0.16 |
| 0.16, 0.23 |
| 0.23, 0.31 |
| 0.31, 0.43 |

Figure3 Distribution of Airbnb listings in London in different boroughs (all listings and misuse of listings)

(a) Airbnb avaliable rooms map in different MSOA
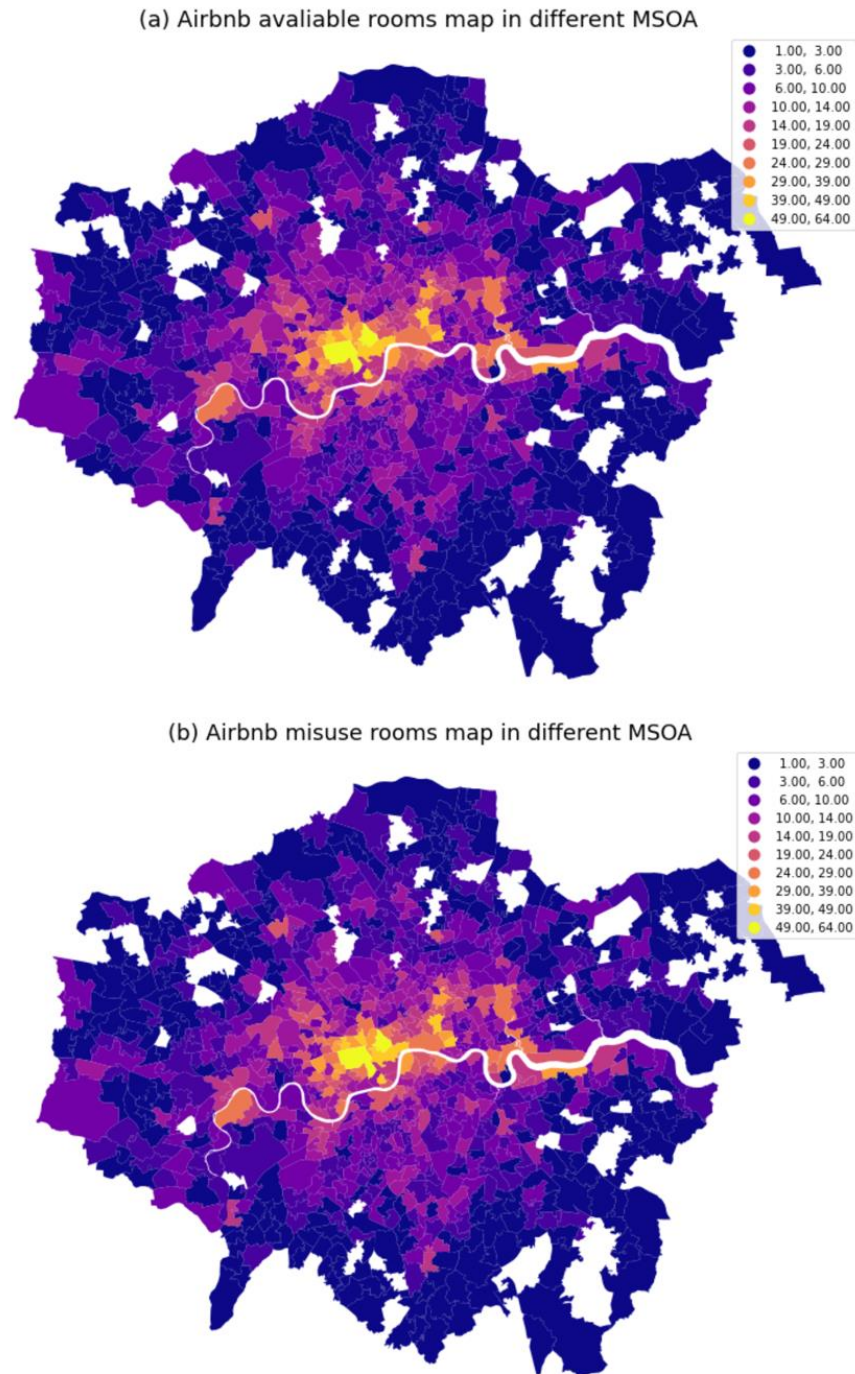

(b) Airbnb misuse rooms map in different MSOA

Figure4 Distribution of Airbnb listings in London across MSOA (all listings and misuse of listings)

2.3 The impact of Airbnb on the London housing market

According to the Valuation Office, there are approximately 3.4 million homes in London, and compared to this number, the homes posted through the platform represent a small percentage of the overall housing supply. This number may not seem very significant. But by comparing Figures 3 and 4 we can see that this is due to the concentration of Airbnb in the city centers on the north bank of the Thames, which leads to the possibility that these areas are under greater rental conversion pressure from Airbnb converting long term rentals to short term rentals, with City of Wsetminster bearing far more of the conversion pressure than other areas. Figure 3

shows that in areas with high Airbnb supply, such as Kensington & Cheksea, City of Westminster, City of London, Tower Hamlets, they also have more potential for abuse.

The median house price in London in 2021 and the median rent in the private rental market in 2021 were selected to form the linked map in Figure 5. Here, the median house price and rental averages are more likely to be influenced by larger value properties, so the median is more representative of the majority of housing stock than the average, and is more representative of how much Londoners spend on buying or renting in general.
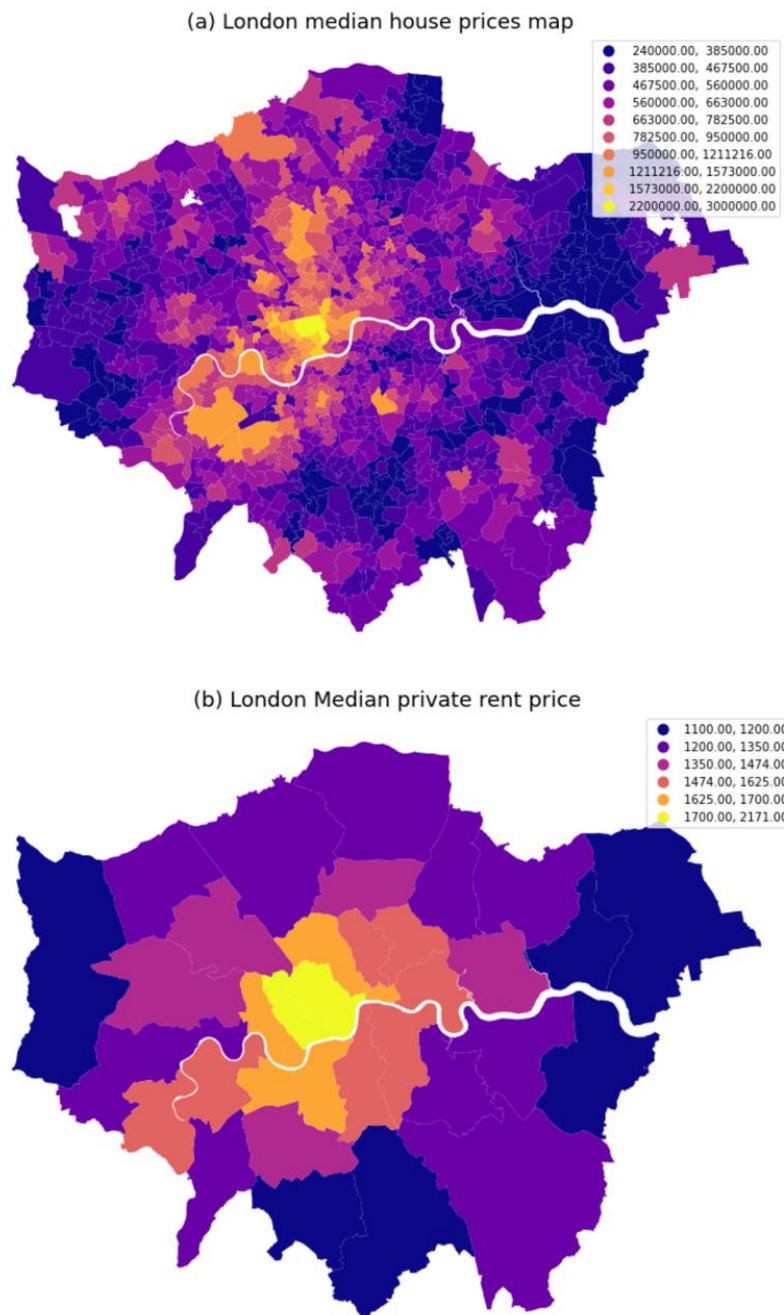

Figure5 London housing market distribution (house prices in different MSOAs and monthly rents in different boroughs)

2.3.2 Modeling

From the previous analysis it can be seen that London house prices and rental prices and Airbnb

listings and possible misuse show a positive correlation. After verifying the positive-terms distribution of these sets of data, we decided to try to explore exactly how Airbnb's listing supply affects London house prices and rents through a linear regression model. Since there is a multivariate covariance between all listings and misuse, the two variables cannot be modeled here and can only be modeled separately.

2.3.2.1 How Airbnb impact London houses prices?

The results of the 2 regression models are presented in Table 1, for model 1 we see that the model explains 22.8% of the cases. There is a statistical relationship between our response variable and the explanatory variables at the 0.05 level of significance. This indicates that there is a positive relationship between the number of Airbnb listings and house prices and that for every unit increase in Airbnb listings, house prices increase by approximately £2205; for model two we see that the model explains 17.1% of the cases. At the 0.05 significance level, there is a statistical relationship between our response variable and the explanatory variables. This indicates that there is a positive relationship between the number of Airbnb listings and Airbnb abuse, and that for every unit increase in Airbnb's Misiuse, the house price rises by approximately £13,320.

Model id	Dependent variable	Independent variable	Coefficients	R-squared	Adj. R-squared	P values	standard errors
1	London median houses prices	Number of airbnb roomlistings by MSOA	2205.4553	0.228	0.227	0.000	8686.286
2		Number of airbnb misuse by MSOA	1.332e+04	0.171	0.170	0.000	976.515

Table 1 Summary of the model of the impact of Airbnb's supply on London house prices

2.3.2.2 How Airbnb impact London private rental prices?

The results of the 2 regression models are presented in Table 1 and for model 3 we see that the model explains 41% of the cases. There is a statistical relationship between our response variable and the explanatory variables at the 0.05 level of significance. This indicates that there is a positive relationship between the number of Airbnb abuses and the price of rent, and that for each additional unit in Airbnb's listings, the rent increases by approximately £2.80; for model two we see that the model explains 61% of the cases. At the 0.05 significance level, there is a statistical relationship between our response variable and the explanatory variables. This indicates that there is a positive relationship between the number of Airbnb listings and Airbnb abuse, and that rents increase by about £1.40 for each additional unit in Airbnb's Misiuse.

Model id	Dependent variable	Independent variable	Coefficients	R-squared	Adj. R-squared	P values	standard errors
3	London median private rental prices	Number of Airbnb roomlistings by borough	2.8181	0.410	0.409	0.000	0.113
4		Number of Airbnb misuse by	1.4019	0.611	0.599	0.000	0.201

		borough					

Table 2 Summary of models of the impact of Airbnb's supply on London rents

Several models passed the residual diagnosis separately.

3 Conclusion

3.1Key findings

In London, the number of Airbnb listings and Misuse were positively associated with median house prices and private rental rents, with each additional unit of Airbnb listings increasing house prices by approximately £2205 and rents by approximately £2.80, and each additional unit of Airbnb Misuse increasing house prices by approximately £13,320 and rents by £1.40. And according to Airbnb's distribution map in London, Airbnb's push for house price and rent growth may be stronger due to the large number of listings and abuse of Airbnb in Inner London, especially the City of Westminster. This may mean that more people have to live further away from the city center, bearing more commuting time and costs.

3.2Limitation

1. In exploring the impact of Airbnb on the private rental market in London, no msoa-level data were found available, only borough-level data, which may lead to a small amount of data and affect the interpretability of the modeling.

The proportion of Airbnb listings to local private housing in London is more representative of the distribution of airbnb listings in a region, but since data on the number of private housing in London at the MSOA and borough levels are not available at this time, the number of listings rather than the proportion is used in the analysis.

3.3Recommendations

1. Stricter restrictions on Airbnb in different regions. There is a need to limit the expansion of Airbnb and the growth of listings, especially in Inner London, with more attention to the City of Westminster.

2. Enforcement of the 2015 Act limiting the number of days a private home can be rented may not be perfect, and to date there is still a lot of abuse of Airbnb London, with a possible abuse rate of over 40%. More stringent enforcement measures and monitoring tools are needed.

3. Introduce policies or regulations to reduce or curb house price and rent increases due to Airbnb. Possible measures include reducing the number of days a private landlord is legally required to rent or reducing the number of permits issued for long term short term rentals.

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