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Taming Airbnb: Toward guiding principles for local regulation of urban vacation rentals based on empirical results from five US cities

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Abstract

Urban vacation rentals, a phenomenon that has grown explosively very recently, bring benefits to cities but also impose quality of life and housing market impacts on neighborhoods. As a consequence, cities are beginning to grapple with creating regulatory regimes for managing this new land use and its encroachments on residential areas. This article uses webscraped data from Airbnb, the industry leader, to analyze the geographical patterns and concentrations of these impacts in five US cities: Austin, Boston, Chicago, San Francisco, and Washington, DC. It uses the findings to put forth four general principles for cities seeking to manage impacts imposed by Airbnb and its competitors. These are that webscraping is an imperfect but relatively cheap and effective means of gathering locally specific data; that "spiky" usage patterns dictate a microgeographic approach to regulation; that meaningful regulation necessitates dedicated enforcement, likely paid for with permit fees; and that it is desirable to distinguish between "mom-and-pop" hosts and those operating at a commercial scale.

Keywords

Urban vacation rentals; Sharing economy; Housing affordability; Urban tourism; Webscraped data; Local government; Land use regulation

Urban vacation rentals, or the renting out of part or all of a residential dwelling to out-of-town visitors, have risen from obscurity to a global industry in just a few years. This practice is nothing new—for decades people have rented out their homes using technologies ranging from simple notices placed on grocery store bulletin boards to recent ones such as Craigslist, an online bazaar that is popular throughout the United States. However, the much more recent rise of sophisticated, purpose-built online platforms run by profit-motivated entities such as Airbnb and Homeaway has enabled urban vacation rentals to grow explosively. The market leader, Airbnb, was recently reported to have an estimated valuation of $24 billion (US), a figure that exceeds the market capitalization of major global publicly traded hotel

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.landusepol.2017.09.025.

chains such as Marriott International (Winkler and MacMillan, 2015). While this upstart industry's rise has been heralded by many, its effects on everyday living environments and housing markets in the United States and around the world are only beginning to come into view.

One of our most detailed glimpses of these effects comes from the New York State's Office of the Attorney General, which subpoenaed internal records from Airbnb for New York City as part of a legal action it pursued against the company (2014). It found that the overwhelming majority, or 72%, of the more than 35,000 unique units used for urban vacation rentals violated New York City law in doing so. It found that a small subset (6%) of people posting listings on the site operated at a commercial scale with three or more listings apiece but garnered a greatly disproportionate share of revenue (37% of the total). Indeed, some of the top commercial operators appeared to be operating multimillion-dollar illegal businesses. Listings were disproportionately concentrated in neighborhoods experiencing the most rapid housing cost growth, raising questions about whether they were displacing what would otherwise be permanent housing units and thus exacerbating existing shortages of housing (ibid).

These sorts of effects have, in turn, put considerable pressure on city governments in New York and elsewhere to develop regulatory frameworks to cope with the emergence of a phenomenon that was barely mentioned in public discourse only a few years ago. In this article, our purpose is to put forth basic principles that could help guide these fledgling efforts to regulate urban vacation rentals, informed by our empirical results drawn from five major U.S. cities.

1. Why regulate urban vacation rentals?

The impacts imposed by the operations of Airbnb and its competitors in New York City summarized briefly above are unfolding, to varying degrees, in other cities. It is useful to think of them as falling into two basic categories. While these two types of impacts are related, we view them as sufficiently distinct so as to discuss separately.

1.1. Housing market impacts

There is ongoing debate as to whether urban vacation rentals remove housing that would otherwise be rented on the open market—essentially converting it from residential to commercial use—thus aggravating a pre-existing scarcity of rental housing.[1] To assess whether this process is significant, planners and policymakers need to understand the role played in particular by *whole unit* rentals in urban vacation rental offerings. Whole unit rentals make entire dwellings, rather than mere portions of them (such as spare bedrooms), available to visitors. And whole unit rentals are only likely to have significant housing market effects in cases where they are rented for a significant proportion of the year, as contrasted to those only occasionally rented while their usual occupants temporarily leave. On the other side, proponents of urban vacation rentals argue that Airbnb, Homeaway, and

[1]For a recent overview of this debate in the popular press—one that emphasizes the thin state of knowledge thus far—see Yaffe (2016).

similar platforms make it possible for participating homeowners or renters to earn extra income that helps them to defray the high and increasing costs of housing seen in many city neighborhoods.

1.2. Quality of life impacts

Urban vacation rentals impose a number of quality-of-life impacts on residents of neighborhoods in which they proliferate. When geographically concentrated in excess of a given threshold, urban vacation rentals can introduce increased competition for on-street parking, boorish and noisy behavior at odd hours by out-of-town guests, and other disruptions to a formerly all-residential area. In extreme cases, they could conceivably undermine the entire character of a neighborhood as a residential area mostly inhabited by permanent residents, a process that in another context has been termed *tourism gentrification* (Gotham, 2005).[2]

At the scale of a building in which individual apartments or rooms within such apartments are being rented to guests, neighbors can experience a reduced sense of security as a constantly shifting cast of visitors are granted access to common areas, in addition to noise and other disruptions. Unlike the negative housing market impacts discussed above, these quality of life impacts can be imposed by any type of urban vacation rental, whether whole-unit or otherwise, and whether a given rental is rented occasionally or constantly.

2. Regulating land use and not simply urban form: back to the future

The rise of novel land use regulatory tools such as Form Based Codes in recent years has accompanied a new emphasis on regulating the physical characteristics of urban buildings, all in an effort to create more walkable and human-scaled neighborhoods (Hughen and Read, 2016). Form Based Codes are intended to supplant traditional zoning ordinances that have long made regulating the *uses* within buildings rather than their physical dimensions the highest priority (ibid). The latter—often referred to as “Euclidean zoning” in the United States—arose about a century ago in large part because of concerns about multifamily housing and industrial and commercial uses encroaching into so-called “residential” neighborhoods, or districts exclusively composed of single-family houses (Hirt, 2015).[3] Today, Euclidean zoning is increasingly maligned as outdated (Talen, 2013), not least because its propensity to separate uses into spatially distinct zones runs counter to the current revival of interest in mixing uses within neighborhoods and buildings.

But as cities grapple with the explosive growth of urban vacation rentals, what is old could soon be new again. Regulating urban vacation rentals will necessitate making enforceable distinctions between residential units used as permanent residences for long-term homeowners and renters, and as hotel-like accommodations for transient guests.[4]

[2]This process has occurred all over the world in a wide variety of settings. For an in-depth account of an example unfolding over a quarter century in a rural village in China and its attendant impacts on pre-existing residents, including loss of traditional culture, see Xi et al. (2013).

[3]Euclid is the name of the Cleveland, Ohio suburb whose use-based zoning scheme prompted the lawsuit that led to the landmark U.S. Supreme Court case in 1926, Village of Euclid v. Ambler Realty Co., that permanently established the legal basis for zoning throughout the United States (Hirt, 2015).

Where this becomes tricky is when these two use categories blur together. Under what circumstances is a homeowner—referred to as a *host* in Airbnb argot— who allows a guest to stay in her home engaging in a benign (if profit-motivated) sharing activity that does not fundamentally erode the neighborhood's residential character? Is it when the homeowner is present, or perhaps when she is altogether absent no more than a certain threshold number of days per year, i.e. when the *occupancy* of the unit by guests falls below a certain level? Should urban vacation rentals of an entire dwelling unit be allowed to take place at such a high frequency that a permanent resident cannot realistically reside there, thereby transforming the home's use into that of a de-facto commercial hotel room? Is such activity acceptable in principle but only when a certain maximum percentage of homeowners within a neighborhood engage in it?[5] Resolving these questions will require cities to revive the distinctly old-fashioned practice of regulating uses in order to protect residential neighborhoods from a form of commercial incursion, even if the commercial incursion is brand new and something only made possible by 21st century information technology. In addition, for it to be meaningful, regulation will need to be accompanied by robust enforcement—something that, as we will discuss, can be controversial and logistically intensive.

3. Plan for the article

This article uses an empirical approach to gauge the intensity and spatial pattern of Airbnb usage in five major US cities: Austin, Boston, Chicago, San Francisco, and Washington, DC. To do so, we rely on so-called "webscraped" data taken directly from Airbnb's website, allowing us to identify listings' approximate geographic locations, estimate their usage intensity, and distinguish resident hosts from commercially-oriented ones operating multiple listings. In short, we find a strikingly geographically lopsided pattern to Airbnb usage in the five cities, with intense concentrations of listings in a minority of neighborhoods—particularly those that have plentiful non-driving transportation options and few children—and a dearth in the rest. The rental housing market impacts of Airbnb appear to only be notable at the citywide scale in San Francisco but are likely important within particular neighborhoods in all five cities. We also find that, as in New York City, commercial operators in the five cities appear to account for a disproportionately large share of Airbnb activity. These findings inform four propositions that we suggest for cities contemplating new regulatory and enforcement regimes to manage the effects of urban vacation rentals. These are that they use webscraping as an imperfect but useful and readily available source of data to gain understanding about their own local urban vacation rental market; that their regulations limit the concentration of urban vacation rentals within particular neighborhoods, and that they consider redistributive mechanisms between neighborhoods; that they deploy dedicated staff to enforcement, funded via permit fees; and that their regulations distinguish between commercially-oriented operators and true "mom-and-pop" hosts.

[4]The typical cutoff is 30 days—shorter stays are treated as visits, while longer ones are generally regarded as permanent tenancy, accompanied by its various legal protections.

[5]As one example, when Austin first began regulating urban vacation rentals in 2012, it stipulated that urban vacation rentals in which the owner does not reside can account for no more than 3% of the one- and two-family housing stock in a census tract, a geographic unit that typically contains about 1200 to 8000 people.

4. Learning from legal scholarship on regulating urban vacation rentals: can emerging regulatory frameworks be informed by sound empirics?

An early article noting and anticipating the rise of the *sharing economy* defined shareable goods as those that are (1) *lumpy*, meaning "that they provision functionality in discrete packages rather than in a smooth flow" and (2) of *mid-grained granularity*, meaning that there is "relatively widespread private ownership of these goods and that these privately owned goods will systematically exhibit slack capacity relative to the demand of their owners" (Benkler, 2004). Legal scholars have recently begun to take up the mantle of theorizing the challenge that the sharing economy poses to existing regulatory structures. Davidson and Infranca (2016) note that much of the sharing economy differs from past waves of technological innovation in being a phenomenon that unfolds primarily at the urban scale, and whose regulation is thus above all a challenge for local rather than state or federal governments. Local governments need to walk a fine line between, on the one hand, regulating a new (or newly prominent) activity such as urban vacation rentals sufficiently to manage its impacts on residents, while proceeding with a sufficiently light touch so that they do not either stamp it out altogether or simply drive it underground (Miller, 2016).

To succeed, localities will need regulatory structures that go beyond traditional command-and-control mechanisms, possibly including some that mimic the very structure of the sharing economy itself. For instance, Miller (ibid) proposes a novel system of Transferable Sharing Rights, or tradeable permits for stays of limited duration for urban vacation rentals sold at auction online by local governments. His proposal is inspired by the success in some U.S. cities of Transferable Development Rights for land use entitlements in achieving historic preservation goals.

Getting new regulations right will not be easy. Once the relatively obvious questions are dispensed with—should unreasonable barriers to entry be eliminated? (yes) and do sharing economy companies need to pay taxes? (yes)—the remaining questions will be tricky to resolve and will require democratic deliberation at the local level (Lobel, 2016). But for these debates to be meaningful—for the optimal and locally appropriate mix of regulatory approaches to be discovered in a given jurisdiction—they will have to be informed by facts rather than perceptions (ibid).

At present, research that provides the basic empirical facts called for by Lobel and others in the urban vacation rental market is in its infancy. To our knowledge, only one peer-reviewed study examining the housing market and quality of life impacts of urban vacation rentals in a city—in this case Sydney—has been published to date (Gurran and Phibbs, 2017). It reports uneven impacts from Airbnb by neighborhood, with one Sydney district experiencing the conversion of fully 7% of its housing stock to permanent Airbnb rentals, while many other neighborhoods have very little. The authors conclude that to respond, planners "will need to revise zoning and residential development controls to distinguish between different forms of short-term accommodation listings enabled by Airbnb and to manage their differential impacts on neighborhoods and permanent rental housing" (ibid, p. 81).

Non peer-reviewed studies are only slightly more numerous. An early example examined the impact of urban vacation rentals on the apartment market in New York City and found it to be minimal at the citywide scale. However, this conclusion must be viewed with considerable skepticism given that the study was commissioned by Airbnb (Rosen et al., 2013).

Other non-peer reviewed studies conducted by entities more pre-disposed to take a combative or least neutral stance towards the urban vacation rental economy reach markedly different conclusions. Because its data was obtained under court order, the New York State Attorney General's Office study described earlier provides the most accurate picture of Airbnb's operations in a US city known to date. Other entities, however, have used "webscraping" techniques to extract information from Airbnb's website in an effort to perform similar, if more limited, analyses of the company's activities in other cities. LAANE, a pro-labor organization, analyzed Airbnb's activities in Los Angeles (Samaan, 2015). LAANE also found Airbnb revenues to derive disproportionately from hosts operating multiple listings, and found listings disproportionately concentrated in the LA neighborhoods experiencing the lowest levels of housing vacancy. In the chic beachfront neighborhood of Venice, for example, LAANE estimated that over 12% of all housing units are used for Airbnb-enabled urban vacation rentals.

The San Francisco Budget and Legislative Analyst (2015) analyzed Airbnb listings that, like those in LAANE's study, were obtained via webscraping. Similar to Los Angeles and New York City, San Francisco is experiencing among the tightest urban housing market conditions in the United States at the time of writing. The Budget and Legislative Analyst's report estimated that whole unit Airbnb listings had removed a number of housing units from the market that, while small on the citywide scale (0.4% to 0.8% of the total housing stock) was significant when considered as a fraction of reported vacant units (11% to 23%). As in New York and Los Angeles, compliance with existing regulations on urban vacation rentals, as indicated in San Francisco by the ratio of issued licenses to active listings (under 5%), appeared to be extremely low.

The collective weight of the research reviewed above, from Sydney to New York to Los Angeles to San Francisco, suggests that applying the term "sharing" to the urban vacation rental economy is misleading. Far from solely relying on the sharing of slack capacity lying fallow within lumpy assets—namely extra, unused space within housing units—a substantial share of the business model of Airbnb, and perhaps of some of its competitors, appears to rest on the intensive use of some of the listings as, in effect, temporary or permanent hotels with the erstwhile host absent. While Lobel (2016) has proposed the term "platform economy" instead of "sharing economy" for this very reason, for our investigation of Airbnb's on-the-ground footprint in this paper we use the straightforward phrase *urban vacation rental*.

5. Data source and interpretation

Our study examines Austin, Boston, Chicago, San Francisco, and Washington, DC. We sought to perform a multicity comparison—to our knowledge, the first—within the same

national context to look for common patterns across cities. We selected cities that are well-known travel destinations located throughout the length and breadth of the continental United States.

The data analyzed in this paper was obtained from “scrapes” of Airbnb’s website conducted by New York-based photojournalist and data analyst Murray Cox. Scrapes for two of the five cities had already been made publicly available on Cox’s website, and he conducted the three others at our request. For each city, a database in Microsoft Excel provided dozens of variables’ worth of information for each of thousands of listings per city.

Data for each of the five cities was collected in the late spring or early summer of 2015 (see Table A-1 in the Appendix for the exact dates). In Austin, the time period was selected to avoid the enormous festivals for which the city has become globally recognized in recent years. We must acknowledge that the webscrapes provide only a snapshot of the state of Airbnb usage at effectively one point of time in each of the five cities; this is one of the practical limitations of relying on webscraping.

Using the information in the databases, we estimated several variables for each listing:

- Occupancy rate (the percentage of nights during which a given Airbnb listing has been occupied since its debut on the website).
- Estimated revenue to Airbnb per year (in US dollars).
- Whole unit listings (listings in which the entire dwelling is rented out to visitors).
- Listings held by multiunit hosts (hosts that simultaneously list more than one active listing in the same city).
- High-occupancy whole unit listings (whole unit listings that exceed an occupancy rate of 25%, i.e. that are occupied by guests at least one out of every four days of the year). These listings raise the greatest concern for housing market effects, as they are so intensively occupied by guests that it is unlikely that they can be used as permanent dwellings for residents rather than tourists.

Methodological details regarding these variables can be found in the appendix. Note that for reasons we discuss there, we only report relative variations in the estimated revenue variable rather than absolute dollar amounts.

As a general methodological observation, it is worth remarking that analyzing Airbnb’s behavior from scrapes of its public-facing website at single points in time is not ideal. Using the company’s internal records, as the New York State Office of the Attorney General was able to obtain for New York City under court order, would be preferable. Webscrapes do not allow us, for example, to account for seasonal fluctuations, and (as explained in the technical appendix) only make possible order-of-magnitude estimates of occupancy rates and amount of revenue collected. However, web scrapes are the only possible source of data given Airbnb’s general lack of transparency about its operations.[6] Despite their limitations, web scrapes provide a wealth of valuable information and have served as sources in some of the reports reviewed earlier. We believe that in the near future they will be an important

technique not only for researchers but also for planners seeking to regulate urban vacation rentals, barring any unexpected major increase in transparency by Airbnb or its competitors.

6. Citywide trends

Citywide patterns computed from each of the five databases reveal both commonalities and some important differences between them (Table 1). Three common patterns are as follows:

- Whole unit listings are consistently dominant across all five cities.
- Multiple-unit hosts play an outsized role in all five cities.
- High-occupancy whole unit listings account for a significant share of Airbnb's revenues in all five cities.

In two other indicators, there are substantial differences between the cities:

- Intensity of Airbnb usage varies substantially across the five cities, with San Francisco the leader by far.
- High-occupancy whole unit listings could be plausibly aggravating the citywide rental housing scarcity in San Francisco, but likely not in the four other cities.

All five of these patterns are discussed at greater length below.

6.1. Similarity: whole unit listings are consistently dominant across all five cities

In the five cities, whole unit listings range from 59% to 70% of all listings. Thus, most of the company's activity in the five cities appears to be the short-term rental of entire housing units, i.e. with the "host" not residing in the unit during the short-term rental period. While many of Airbnb's marketing materials emphasize the friendly interactions between hosts and guests—a relationship based on something more personal than a simple monetary transaction—our data suggest that these instances, while they certainly exist, are not the most common.

6.2. Similarity: multiple-unit hosts play an outsized role in all five cities

The share of listings associated with hosts who hold more than one listing ranges from 30% in Austin to 44% in Boston. When measured as a share of total estimated revenue flowing to Airbnb, the share attributable to multi-listing hosts, or hosts for whom the profit motive likely outstrips the desire for forming new friendships by inviting travelers into their own homes, is even higher (from 47% in Austin to fully 59% in Boston).

Most profit-oriented operators, however, appear to be quite small. The average multi-unit host offers between 3.0 listings (Austin, Chicago, and San Francisco) and 3.6 (Boston) listings. However, each of the five cities appears to have at least some hosts operating at much larger scales; we found hosts with as many as 28 simultaneous listings in San Francisco and 140 in Austin.

[6]Early in the project, one of us made contact with an Airbnb official, who promised to ask for approval from higher-ups in the company regarding data access. However, our follow-up inquiries were not answered. We then made the decision to rely on webscraped data.

6.3. Similarity: high-occupancy whole unit listings account for a significant share of airbnb's revenues

Mirroring findings by LAANE (Samaan, 2015) and by the New York State Office of the Attorney General (2014), it appears as though whole units that are rented so frequently (at least 25% of the time) so as to render them unlikely to be usable as permanent dwellings account for a sizable share of Airbnb's revenues. These high-occupancy whole unit listings account for between 16% (Boston) and 32% (Austin and San Francisco) of estimated citywide revenue flowing to Airbnb.

6.4. Difference: Intensity of Airbnb usage varies substantially across the five cities, with San Francisco the leader by far

Measured via listings per 100,000 city residents, the intensity of Airbnb usage in San Francisco is nearly five times that of the city with the lowest level, Chicago. Austin is not too far below San Francisco, while Boston and Washington, DC fall between Austin and Chicago. However, when measured in terms of revenue, San Francisco is far and away the leader among the five cities, with nearly three times as much estimated income flowing to Airbnb from San Francisco as from the second place city, Austin.

It is not difficult to list plausible explanations for the pre-eminence of Airbnb in San Francisco and, to a lesser but still notable extent, Austin. Both are economically booming cities, popular tourist destinations with young adults, and both are well-known for being home to highly-educated, youthful, and tech-savvy populations. This is likely due in no small part to the importance of IT to each city's economy. Other locally specific factors may be influential as well: for instance, San Francisco is Airbnb's headquarters city, and it lacks hotel rooms in the Mission District, which has emerged as one of the most popular destinations in the city, particularly for youthful travelers.

Austin is home to internationally known annual festivals, particularly South by Southwest and the Austin City Limits Festival, that draw visitors from around the globe in large numbers relative to the city's size. Airbnb may thus play an important role in helping Austin absorb brief but intense surges of visits by travelers. This "spiky" visitation pattern may also explain Austin's very low occupancy rate vis-à-vis the other four cities, despite its high numbers of listings.

6.5. High-occupancy whole unit listings could be plausibly aggravating the rental housing scarcity in San Francisco, but perhaps not in the four other cities

Comparing the number of high-occupancy whole unit listings—i.e., those that have the potential to remove entire dwellings from the stock of rental housing—to the vacancy rate for rental housing in each city yields figures that are only large in San Francisco, at 13%. In the second-place cities, Boston and Washington, DC, the comparable ratio is only 3%. These figures should be interpreted with caution, however, since as described earlier the occupancy rates should be seen as lower-bound estimates. The results from San Francisco, however, confirm the San Francisco Budget and Legislative Analyst's findings that Airbnb could be playing a role in aggravating an already severe housing shortage in that city.[7]

6.6. Spatial patterns

The geographical distribution of listings in the five cities reveals three spatial patterns, present to varying degrees: centralization, a paucity in low-income communities of color, and a radial pattern following (some) transit lines (Fig. 1).

6.7. Centralization

Dense concentrations of Airbnb listings appear in close proximity to the central districts of the five cities. In both Austin and San Francisco, listings appear to blanket the residential neighborhoods surrounding those cities' urban cores—in Austin, the city's Central Business District, and in San Francisco, the northeastern and east-central sections of the city, which contain not only the CBD but also the Mission District and most of the iconic tourist destinations. In Boston, listings are intensely concentrated within the tight-knit historic urban fabric of the portions of the city whose streets were laid out in the 17th and 18th centuries.

6.8. Paucity of listings in low-income communities of color

Although like the other three cities Chicago and Washington, DC have near-downtown neighborhoods with intense concentrations of listings, unlike in the other three cities the overall pattern is asymmetrical. In Chicago, neighborhoods radiating from the urban core on the North, Northwest, and Near West and Near South Sides are thick with Airbnb listings, while they diminish rapidly with distance from the CBD to the west and to the south. The one notable exception is the area around the University of Chicago on the city's South Side, which appears to serve as a modest attractor of listings despite its affluent district of Hyde Park being surrounded by high-poverty communities. In Washington, DC, areas lying geographically close to the CBD but across the Anacostia River in the city's southeast quadrant are strikingly devoid of Airbnb listings. All of these areas have predominantly low-income African American populations, and have experienced decades of social ills ranging from housing abandonment to high rates of violent crime and many others. Struggling neighborhoods in the other three cities, such as the Rundberg area in Northeast Austin, Dorchester in Boston, and Bayview-Hunters Point in San Francisco are also devoid of listings, though these areas all lie at least five miles from their cities' respective CBDs.

Our data does not allow us to ascertain the reasons for this pattern—are they a lack of demand from Airbnb guests seeking to stay in low-income communities of color, or a lack of supply stemming from structural factors that inhibit would-be hosts who live in those areas? Or do demand and supply-side factors reinforce each other?[8] The answers to

[7]We are cautious about making such claims. For example, it is possible that landlords who were holding their apartments off the rental market are now renting them out on a short-term basis using Airbnb. This is certainly a possibility in San Francisco, despite the overall strength of the housing market, as a consequence of the city's rent control policies. But the overall point is that whole unit, high occupancy rentals are of a sufficient magnitude—even taking into account the likely undercount—in San Francisco that they could be further aggravating the lack of availability of housing on a citywide basis. More study and possibly economic modeling would be needed to test such a claim. It seems even more likely that particular neighborhoods that are Airbnb hot spots are affected—thus, the housing market effects could be small on a citywide scale but significant in certain neighborhoods popular with visitors in the other four cities we studied other than San Francisco.

[8]As one of the anonymous reviewers noted, reasons for lack of demand of Airbnb guests for accommodations in low-income communities of color could be further divided into fear of crime or racial bias. Edelman and Luca (2015) have provided at least some evidence of the latter, showing that black Airbnb hosts, all else equal, receive fewer bookings and lower revenue than white hosts.

these questions are, for now, not known, but are important. Regardless, however, the spatial pattern is stark.

6.9. Radial patterns following (some) rapid transit lines

In three of the five cities, listings appear to cluster along rapid transit lines. However, in keeping with the pattern described above, only some transit lines—those passing through high-demand neighborhoods—appear to attract Airbnb listings. For example, in Chicago the north branch of the Red Line and the Brown and Blue subway lines passing through the booming Northwest Side of the city appear to be attracting listings, while the Green Line heading west and the south branch of the Red Line, both passing through impoverished areas, are not.

San Francisco provides an exception. Here, listings are so broadly dispersed over the tourist-friendly northeast and east-central sections of the city that clustering along the city's one fully grade-separated rapid transit line that runs from southwest to northeast through the CBD is not apparent. The other exception is Austin, which alone among the five cities studied in this report lacks a well-developed and heavily-used transit system.

6.10. What types of neighborhoods have the most listings?

In order to assess the magnitude and distribution of quality of life impacts of Airbnb activity, we analyzed the neighborhood-level factors that correlate with high concentrations of listings. To do so, we ran an Ordinary Least Squares regression model for each of the five cities. We used as our dependent variables the total Airbnb listings as a proportion of total housing units at the census tract level.[9] We only included listings that lie within census tracts wholly or mostly contained by the five central cities. For census tracts that lie partly within the five cities, we included them only if 50% or more of their land area lies within city limits.

We selected tract-level independent variables for inclusion in the regressions that quantified various aspects of the housing stock, urban form, and sociodemographic characteristics of each census tract in the five cities. All of these data are taken from five-year American Community Survey data (published by the US Census) from 2009 to 2013.

7. Regression results

The regression results (Table 2) show a number of significant correlations.

For the sake of brevity, we will not comment on all of them; however, a number of results are notable:

The nonfamily and mode share variables are each significant in the expected direction in all but one of the five cities. The two variables that have the most consistent correlations are

Meanwhile, public accommodations laws have not caught up to the urban vacation rental market or the sharing economy in general (Leong and Belzer, 2017). This is despite their heavy reliance on user reviews of hosts and guests, whose individualized profiles, through photos and names, can impart their racial or ethnic identities (ibid).

[9]We also ran models using the tract-level concentration of high-occupancy whole unit listings, rather than all listings, as a dependent variable. The results were sufficiently similar that we do not report them here. They can be obtained from the authors by request.

nonfamily household share (positive) and solo automobile work commute share (negative). Taken together with the lack of a consistent association with population density, these results imply that Airbnb listings (or perhaps the hosts themselves) tend to concentrate in modestly-scaled yet lively neighborhoods replete with public transit options, walkable streets, and a lack of children (National Trust for Historic Preservation, 2014). The lack of significance for the mode share variable in the case of San Francisco may be explained by that city's high density even in outlying areas, compact size, and relative difficulty of navigation of the transit system for outsiders except for one heavy rail line.

- *The Hispanic variable coefficient is significant and positive in Austin and Chicago*. Both cities include Latino-identified districts that are either centrally located (East Cesar Chavez and Bouldin Creek in Austin) or well-served by public transit (Pilsen and Logan Square in Chicago).
- *The African American variable coefficient is significant and negative in Boston and Chicago*. Both cities have large African American populations and long histories of redlining, disinvestment and other systemic processes of racialized enclave formation. These processes, of course, have long existed in Austin and San Francisco as well, but both cities began with much lower African American populations than the other three and have experienced rapid decreases in this group in recent decades (Tang and Ren, 2014). The reason for the lack of significance in this variable in Washington, DC is less clear. One possibility is that Washington, DC has numerous majority African American neighborhoods that lie along the gentrification frontier, whereas such neighborhoods in Boston and Chicago are more isolated and fewer of them have experienced gentrification. In any case, the inconsistent results in the African American and Hispanic coefficients suggest that racialized patterns of urban vacation rentals depend on a given city's history of racial segregation and internal housing market dynamics.
- *Housing stock vacancy is positively associated with listings in Austin and negatively in Chicago*. The latter relationship is reasonable; Chicago's high-vacancy districts on the West and South Sides are a world away from the neighborhoods that are prized by visitors. Austin is experiencing tight housing market conditions, and therefore somewhat higher vacancy rates are almost certainly not indicative, on their own, of the sorts of social ills that would deter Airbnb visitors.

8. Four guiding principles for regulating urban vacation rentals

The three types of analysis summarized above show that while there are certainly differences among the five cities, there are also some commonalities. Admittedly our results are from only a small subset of US cities, and without question studies of urban vacation rentals in a wider variety would be beneficial. We nonetheless now present a set of four preliminary guiding principles for planners and policymakers from large US cities—and perhaps cities in other countries as well—-contemplating introducing new regulations and enforcement

mechanisms to ensure that the benefits of urban vacation rentals are not swamped by their negative impacts.

Guiding principle #1: Webscraping is an imperfect and (hopefully) temporary but nevertheless useful source of data on urban vacation rentals for city governments when alternatives are lacking.

As more studies, including this one, relying on webscraping to garner data about urban vacation rentals accumulate, cities would do well to commission studies using similar techniques for themselves. These can be used to help them tailor regulatory efforts to their unique circumstances and build public support for them. Hopefully, webscraping will recede in importance as a means of information gathering once local governments establish robust regulatory systems that mandate data sharing from the major urban vacation rental platforms, as recommended by Miller (2016).

Guiding principle #2: Regulations limiting concentrations of urban vacation rentals within particular neighborhoods, and possibly redistributive mechanisms, are worth considering.

The intense geographic concentration of Airbnb listings seen in all five cities in our study confirms Davidson and Infranca's (2016) prediction that "in most cities, only a small number of vibrant neighborhoods, already attractive to tourists, are likely to see a significant volume of transient visitors" (p. 259). Regulations that limit concentrations of urban vacation rentals within particular microgeographies, such as census tracts, will likely be attractive for many cities for managing quality of life impacts. Such rules could help limit undue concentrations in areas where urban vacation rentals tend to cluster, and perhaps help push some of them to other areas that could benefit from more of them. Beyond differentially managing urban vacation rentals across neighborhoods, cities may elect to go further and heed Davidson and Infranca's (2016) recommendation that they use redistributive mechanisms. As a matter of basic justice, this would ensure that neighborhoods with few urban vacation rentals, particularly low-income ones, see some of the benefits of the agglomerative economies that concentrate in a few favored areas.

Guiding principle #3: Meaningful enforcement of regulations on urban vacation rentals likely requires dedicated staff, who can be funded via permit fees.

Our literature review, as well as our anecdotal familiarity with the case of Austin via media reports and professional contacts, make it clear that for regulatory efforts to be meaningful, dedicated enforcement staff specifically devoted to urban vacation rentals are needed. Otherwise the new rules, however thoughtfully conceived, are hollow. Code enforcement staff are generally overwhelmed in US cities Wegmann and Bell (2017), and it is not realistic to expect them to adequately enforce a new set of rules that are inevitably treated as a lower priority than enforcement cases involving matters of fundamental health and safety. We believe that the appropriate approach in many cases is to require would-be hosts to register for a permit, which could be used to assess compliance on the platform's website, and to then use the resulting fee revenues to fund code compliance personnel exclusively tasked with urban vacation rentals.

Guiding principle #4: Distinguish between “mom-and-pop” and commercial operators.

While some cities may choose to tolerate commercially-oriented, multiunit hosts, others may not, not least because of competition with hotels and motels. Regulatory mechanisms may therefore be designed to either eliminate or severely restrict multiunit hosts, as Miller (2016) recommends (and notes has recently been achieved in Portland and San Francisco), while giving more lenient treatment to true “mom-and-pop” hosts. The latter category would be defined as hosts who are present in their housing unit during the guests’ stay (i.e., true “home sharing”), and also possibly include those who only rent their entire dwelling to guests for up to a certain number of total nights within a certain time period (for example, up to 30 nights within a given calendar year). In this way, cities could steer the urban vacation rental market away from direct (possibly unfair) competition with the formal hospitality sector, and towards the provision of a genuine “home sharing” experience, including extended stays in a neighborhood setting, unavailable in conventional hotels and motels. This could help reposition urban vacation rentals as a laudable 21st century revival of the once widespread 19th century American practice of lodging and boarding in private residences, which largely vanished by the second half of the 20th century (Jefferson-Jones, 2015).

Clearly our article, building on prior studies such as those of Gurran and Phibbs (2017), is but a first step in developing a body of knowledge concerning the housing market and quality of life impacts of urban vacation rentals on cities. Nevertheless, the patterns that have emerged as common between the five US cities we analyzed begin to suggest the outline of a comprehensive strategy that many locales can use to appropriately manage the sudden spike in urban vacation rentals seen worldwide. On its own, data gathering is not enough, and nor is regulation, particularly when they are not backed by meaningful enforcement. However, if these elements are combined together into a thoughtful and comprehensively integrated strategy, we believe that the potential exists for cities to harness the potential of urban vacation rentals while minimizing their downsides.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

Benkler Y, 2004. Sharing nicely: on shareable goods and the emergence of sharing as a modality of economic production. Yale Law J. 273–358.

Davidson NM, Infranca JJ, 2016. The sharing economy as an urban phenomenon. Yale Law Policy Rev. 34 (2), 215–279.

Edelman B, Luca M, 2015. Digital Discrimination: The Case of Airbnb.com. Harvard Business School Working Paper Series. Harvard University, Cambridge, MA.

Gotham KF, 2005. Tourism gentrification: the case of new orleans' vieux carre (French quarter). Urban Stud. 42 (7), 1099–1121.

Gurran N, Phibbs P, 2017. When tourists move in: how should urban planners respond to Airbnb? J. Am. Plann. Assoc. 83 (1), 80–92.

Hirt S, 2015. The rules of residential segregation: US housing taxonomies and their precedents. Plann. Perspect. 30 (3), 367–395.

Hughen WK, Read DC, 2016. Analyzing form-based zoning's potential to stimulate mixed-use development in different economic environments. Land Use Policy 61, 1–11.

Jefferson-Jones J, 2015. Airbnb and the housing segment of the modern sharing economy: are short-term rental restrictions an unconstitutional taking? Hastings Constitutional Law Q. 42 (3), 557–576.

Leong N, Belzer A, 2017. The new public accommodations. Georgetown Law J. 105 (5), 1271–1322.

Lobel O, 2016. The law of the platform. Minnesota Law Rev. 101 (1), 87–166.

Miller SR, 2016. First principles for regulating the sharing economy. Harv. J. Legislation 53, 147–202.

National Trust for Historic Preservation, 2014. Older, Smaller, Better: Measuring How the Character of Buildings and Blocks Influences Urban Vitality. Preservation Green Lab (May). http://www.preservationnation.org/information-center/sustainable-communities/green-lab/oldersmallerbetter/.

New York State Office of the Attorney General, 2014. Airbnb in the City. Research Department and Internet Bureau. (October). http://www.ag.ny.gov/pdfs/Airbnbreport.pdf.

Rosen KT, Sakamoto R, Bank D, 2013. Short-term Rentals and the Impact on the Apartment Market. Rosen Consulting Group (October). http://publicpolicy.airbnb.com/wp-content/uploads/2014/04/Short-TermRentalsandImpactonApartmentMarketNY1.pdf.

Samaan R, 2015. Airbnb, Rising Rent, and the Housing Crisis in Los Angeles. Los Angeles Alliance For a New Economy (LAANE) (March). www.laane.org/airbnb-report.

San Francisco Budget and Legislative Analyst, 2015. Policy Analysis Report Re: Analysis of the Impact of Short-term Rentals on Housing. Memo to San Francisco Supervisor David Campos. (May 13).

Talen E, 2013. Zoning for and against sprawl: the case for form-based codes. J. Urban Des. 18 (2), 175–200.

Tang E, Ren C, 2014. Outlier: the Case of Austin's Declining African American Population. The Institute for Urban Policy Research and Analysis, the University of Texas at Austin (May 8 Issue Brief #1).

Wegmann J, Bell JP, 2017. The invisibility of code enforcement in planning praxis: the case of informal housing in southern California. Focus 3 (1), 20–29.

Winkler R, MacMillan D, 2015. The Secret Math of Airbnb's $24 Billion Valuation: Home-rental Site's Revenue Projected to Top More than $900 Million. Wall Street Journal (June 17).

Xi J, Zhao M, Ge Q, Kong Q, 2013. Changes in land use of a village driven by over 25 years of tourism: the case of Gougezhuang village, China. Land Use Policy 40, 119–130.

Yaffe G, 2016. Activists Say Airbnb Drives up Rents. But Is That Actually True? L.A. Needs to Find Out. Los Angeles Times (op-ed) (May 13).

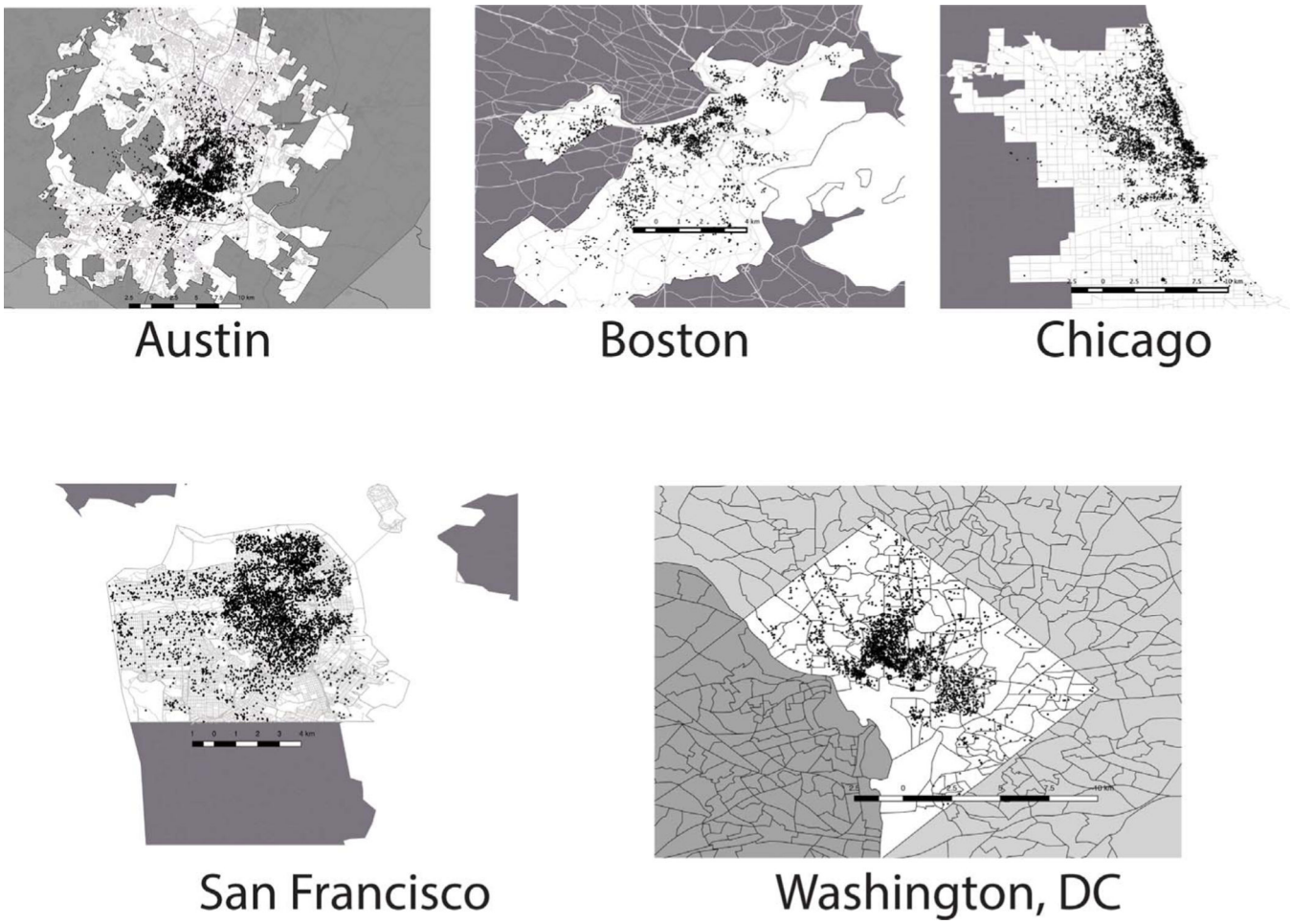

Fig. 1.

The spatial distribution of all Airbnb listings in the five cities studied. Each dot represents one listing.

Table 1

Selected citywide comparisons computed from the databases obtained by scraping Airbnb data foreach of the five cities.

	Austin	Boston	Chicago	SF	Wash., DC
Total listings[a]	5155	1984	3762	5384	3052
Listings per 100,000 residents (2014 ACS)	565	302	138	632	463
Whole unit listings as share of total	70%	59%	59%	60%	67%
High-occupancy whole unit listings [b]	189	135	28	760	285
As share of citywide for-rent vacancies, 2014 [c]	1.6%	3.0%	0.1%	13.3%	3.0%
Share held by hosts with more than one listing	30%	44%	38%	34%	39%
Average listings per host with more than one listing	3.0	3.6	3.0	3.0	3.5
Maximum listings held by one host	140	81	39	28	80
Occupancy rate for the average listing	5%	12%	9%	18%	12%
Total estimated relative Airbnb revenue from listings (Chicago = 1.0)	5.8 x	2.2 x	1.0x	15.6 x	3.8 x
Share from high-occupancy “Entire home/apt” listings	32%	16%	19%	32%	19%
Share from hosts with more than one listing	47%	59%	49%	47%	51%

“Vacancy Status By Type,” downloaded from www.socialexplorer.com on Oct 3, 2015.

[a]Excludes listings identified as “Bed & Breakfast” units.

[b]“High occupancy” is defined as 25% or greater occupancy. “Occupancy” is defined in the text.

[c]American Community Survey 1-Year Estimate, 2014, Table SE:T96.

Table 2

Results from the combined model (data from all five cities combined together, with the dependent and all independent variables standardized by individual city).

Dependent variable: Total Airbnb listings as percent of housing units in tract (up to 100)									
Tract-level independent variable	Austin		Boston		Chicago		SF		Wash., DC	
(Intercept)	3.07		6.055		3.181	.	−49.302		0.530	
Pop density (in 1000 s per sq mile)	−0.077		−0.003		−0.002	***	−0.073		0.015	**
Percent Hispanic (up to 100)	0.029	**	−0.006	.	0.004	***	0.016		0.004	
Percent non-Hispanic African American (up to 100)	0.001		−0.006	**	−0.003	***	−0.157		−0.003	
Percent of housing units in structure with 3 units or more (up to 100)	−0.044	***	0.003		0.002	*	−0.103	*	−0.017	***
Median year structure built	0.000		−0.003		−0.002	.	0.029		0.000	
Median gross rent (in 100 s of 2013 dollars)	−0.074		0.033	**	0.034	***	−0.740	**	0.017	
Percent of workers who drive to work alone (up to 100)	−0.061	**	−0.016	***	−0.007	***	0.078		−0.028	***
Percent foreign born (up to 100)	−0.057	*	−0.006		−0.009	***	−0.072		−0.006	
Percent nonfamily households (up to 100)	0.088	***	−0.001		0.008	***	0.295	***	0.028	***
Percent of housing stock that is vacant (up to 100)	0.114	**	0.001		−0.004	*	−0.197		−0.002	
n (number of census tracts)	*164*		*170*		*803*		*195*		*176*	
Adjusted r-squared	*0.40*		*0.48*		*0.47*		*0.12*		*0.60*	
Mean listings per 100 housing units in tract	*1.68*		*0.67*		*0.29*		*2.15*		*1.01*	
Max listings per 100 housing units in tract	*11.30*		*2.86*		*2.95*		*142.86*		*3.80*	
Total listings represented	*5010*		*1944*		*3793*		*5407*		*3090*	

Signif. codes: 0

‘***’ 0.001

‘**’ 0.01

‘*’ 0.05

‘.’ 0.1

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