

Airbnb and the Rent Gap: Gentrification Through the Sharing Economy

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Abstract: *Airbnb and other short-term rental services are a topic of increasing interest and concern for urban researchers, policymakers and activists, because of the fear that short-term rentals are facilitating gentrification. This article presents a framework for analyzing the relationship between short-term rentals and gentrification, an exploratory case study of New York City, and an agenda for future research. We argue that Airbnb has introduced a new potential revenue flow into housing markets which is systematic but geographically uneven, creating a new form of rent gap in culturally desirable and internationally recognizable neighbourhoods. This rent gap can emerge quickly—in advance of any declining property income— and requires minimal new capital to be exploited by a range of different housing actors, from developers to landlords, tenants and homeowners. Performing spatial analysis on three years of Airbnb activity in New York City, we measure new capital flows into the short-term rental market, identify neighbourhoods whose housing markets have already been significantly impacted by short-term, identify neighbourhoods which are increasingly under threat of Airbnb-induced gentrification, and measure the amount of rental housing lost to Airbnb. Finally, we conclude by offering a research agenda on gentrification and the sharing economy:*

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New York's short-term rental showdown

In October 2013, New York State's Attorney General issued a subpoena to the short-term rental service Airbnb, demanding that the firm hand over its records on hosts operating in the state, so that a law passed a few years earlier regulating home sharing in New York City could be properly enforced. The company refused and filed a motion in court to have the subpoena thrown out. What followed was a seven-month legal standoff culminating at the State Supreme Court. In May 2014 the court overturned the Attorney General's subpoena as being overly broad, but the next day the Attorney General filed a new, narrower subpoena. A week later, the two parties announced a settlement, which included Airbnb handing over the requested information.

Over the next several years, the public relations battle heated up. At the end of 2015, Airbnb undertook a data transparency exercise, voluntarily sharing a one-day snapshot of data from New York City with lawmakers. But independent analysts demonstrated that the company had carried out an unprecedented purge of listings just days beforehand, raising persuasive doubts about the data's representativeness and accuracy (Cox and Slee 2016). In 2016 a white paper found that Airbnb hosts are prone to reject African-American guests even if it means a loss in possible income (Edelman et al. 2017), fueling a flurry of media scrutiny as well as a vague commitment to change from the company's new "director of diversity" (Benner 2016b). In April, Airbnb (2016) released a report "Airbnb and Economic Opportunity in New York City's Predominantly Black Neighborhoods", which used testimony from families saving for college and African-American business owners to make the case that Airbnb helps middle-class African-American families make ends meet in New York. Their report boasted that usage had risen more than 50% faster in Black neighbourhoods than in the city as a whole. Critics of the company were quick to point out that the most obvious interpretation of this fact is that Airbnb is helping to gentrify these neighbourhoods by taking affordable long-term rental units off the market. In particular, an independent study of New York City's predominantly Black neighborhoods found that white hosts consistently earned a dramatically larger share of revenue on Airbnb than their share of the population (Cox 2017).

And by the end of 2016 the company found itself in another legal standoff with the State government. That October, New York Governor Cuomo signed a bill into law which made it illegal simply to advertise a rental of less than thirty days in New York

City; the previous law had required the Mayor's Office to investigate whether a transaction had actually occurred. Airbnb promptly challenged the new law in court. But, two months later, in what was seen as a shocking about-face, the company dropped the lawsuit under the condition that hosts—rather than Airbnb itself—face the up-to-\$7,500 fines (Benner 2016a). This capitulation capped a month in which Airbnb decided to call truces with some of the city governments which had been most hostile to it, agreeing to cooperate with regulatory efforts in the US and Europe. The company's retreat started in its hometown of San Francisco, when a federal judge dismissed their request for an injunction against new legislation that vowed to fine Airbnb \$1,000 per day per illegal listing in the city (Said 2016). For the first time Airbnb agreed to directly police its hosts by limiting listings to one per host and eventually blocking the rental of a unit for more than 90 days; the company also promised to release user information to authorities.

As this brief timeline of Airbnb in New York suggests, cities and communities around the world are increasingly grappling with the impact of short-term rentals on their housing markets, and the question of whether and how to regulate the matter. Cities across North America and Europe have seen legislative showdowns fuelled by housing activism. Barcelona's leftist mayor Ada Colau swept to office in 2015 with a platform that explicitly linked Airbnb with housing stress. Berlin has cracked down on short-term rentals in hopes of keeping housing affordable. Pricier capitals London and Amsterdam have limited rentals to 90 nights and 60 nights per year, respectively. And even while New York City and San Francisco dominate the US discourse, a range of mid-size cities across the country have challenged the company's business practices, while others have reached amicable arrangements.

Yet, despite the enormous and growing policy and public interest in the impact of short-term rentals on housing affordability, there has so far been little scholarly investigation of this problem. In this article we address this deficit by presenting a framework for analyzing Airbnb and gentrification, an exploratory case study of New York City, and an agenda for future research. We argue that Airbnb has introduced a new potential revenue flow into housing markets which is systematic but geographically uneven, creating a new form of rent gap in culturally desirable and internationally recognizable. This rent gap can emerge quickly—in advance of any declining property income—and requires minimal new capital to be exploited by a range of different housing actors, from developers to landlords, tenants and homeowners. Performing spatial analysis on three years of Airbnb activity in New York

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Airbnb, the sharing economy, and housing affordability

Alongside the ride sharing company Uber, Airbnb is one of the two leading lights of the so-called “sharing economy”, a contentious concept built on the peer-to-peer exchange of goods and services enabled by recent advances in information technology. The sharing economy has its free-market triumphalist advocates (e.g. Hopkins 2016), as well as liberal-progressive defenders who view it as an opportunity for destabilizing market-oriented consumerism and individual ownership (e.g. Sundararajan 2016). An emerging line of radical critique, meanwhile, conceptualizes it as a new kind of deregulatory right-wing populism (Morozov 2016; Slee 2016).

Airbnb is a short-term housing rental service whose platform connects travelers with hosts. Its customers interact with the service much as they would interact with a hotel – making bookings for accommodation – but it is the hosts who list and charge for occupancy of their sofa, spare room, or entire unit, while Airbnb takes a commission of 8% to 18% per booking. The company launched in 2008 and enjoyed early successes during the Democratic National Convention in Denver, Colorado and the annual South by Southwest music festival in Austin, Texas that year. It now counts villas, castles, and luxury penthouses among its listings. At the close of 2017, the company boasted over four million listings around the world and was valued at \$31 billion – more than the Hilton and Marriot international hotel chains.

Airbnb has effectively created a new category of rental housing – short-term rentals – which occupies a lacuna between traditional residential rental housing and hotel accommodation. Airbnb is by no means the sole provider of short-term rentals but it is by all accounts the dominant force; its closest competitor, Austin-based HomeAway, lists about half as many units worldwide. Nonetheless, Airbnb’s impact on cities and housing markets is not well understood, since the company takes great pains to cloud its operations from scrutiny. Airbnb’s business model has been particularly controversial because it so clearly flouts existing housing and land-use regulations in

many or even most of the cities in which it operates, and does so in a fashion which appears to undermine policies aimed at protecting the supply of affordable housing. Airbnb and its advocates insist that these regulations must be updated to accommodate the new possibilities presented by the sharing economy. Opponents argue that Airbnb aims to avoid the regulation and taxation imposed on other businesses and threatens affordable housing in cities.

The company's practices have inspired a curious oppositional coalition of tenant associations, community groups, municipal governments, and hotels. Municipalities and affordable housing advocates share concerns about the effect of short-term rentals on the housing market, particularly in cities and neighbourhoods where demand is putting upward pressure on rents. Airbnb and related platforms have made it easier and more lucrative for landlords and property managers to offer units as year-round short-term rentals than as long-term residential rentals. Accordingly, legislators and activists in cities from Boston to Berlin have begun to target short-term rentals as a housing affordability problem. "Cities are struggling to address urgent shortages of affordable housing and there is evidence that commercial interests in the [short-term rental] industry are removing residential units from housing markets and thereby contributing to even higher rents," read a letter to the US Federal Trade Commission signed by urban lawmakers from across the United States (Partnership for Working Families 2016). Several cities worldwide (most notably Berlin and Barcelona) have pursued near-total bans on the service, while 2016 saw a flurry of short-term rental legislation in cities across North America. In many municipalities, short-term rentals were already illegal according to pre-existing law, and new legislation has been used to increasing municipal monitoring and enforcement capacities. Several cities, such as Philadelphia and San Jose, have legalized short-term rentals but attempted to tax them, while others such as Phoenix have adopted an entirely *laissez-faire* posture.

In general, municipalities recognize the huge amount of untaxed income enabled by Airbnb and argue that the service or users should pay their share. The New York Attorney General, for instance, estimates from subpoenaed data that the city should have received over \$33 million in hotel room occupancy taxes alone from Airbnb between 2010 and 2014. Additionally, the anonymity provided by Airbnb means it is unlikely that hosts paid the necessary taxes at any level. Finally, municipal regulators have displayed reticence to confront small-time users – those who may occasionally rent out a spare room to supplement their incomes – instead focusing on

so-called “commercial users”. Commercial users rent out multiple units on a full-time basis, and their share of the overall short-term rental market has been rising steadily, to approximately one third of overall Airbnb revenues in 2016 by one estimate (Stulberg 2016).

Alongside a small but growing number of researchers, community groups and housing advocates in cities across the world have begun to sound the alarm about the impact Airbnb is having on affordable housing in their communities, highlighting above all issues of racialized gentrification and displacement (see, e.g., BJH Advisors 2016; Lee 2016; Samaan 2015; New York Communities for Change 2015; Wachsmuth et al. 2017; Wachsmuth et al. 2018; Wieditz 2017). In a 2015 white paper, the Los Angeles Alliance for a New Economy (LAANE) estimated that homesharing platforms took 11 units off the local rental market each day, accounting for a significant portion of new housing built since 2010 that was intended to slow rent increases. They found that professional landlords accounted for most of the profit of Airbnb and their competitors. From 2014 to 2015, the number of total listings skyrocketed while the presence of leasing companies increased from 6% to 9% of users, accounting for up to 37% of all revenue. Meanwhile, the share of hosts renting out a spare room decreased from 52% to just 36%, taking in only 16% of all income. LAANE argues that short-term rentals have offset municipal efforts to increase housing stock; in popular neighbourhoods, the number of full-time short-term rental units is up to four times higher than the number of new units built since 2010. The study found that rents were rising much faster than average in popular Airbnb neighbourhoods, for which the platform has written travel guides on its website (Samaan 2015).

A study by New York Communities for Change and Real Affordability for All found that Airbnb took approximately 20% of vacancies off the market in certain Manhattan and Brooklyn zip codes, and up to 28% in the East Village neighbourhood, even though it is technically illegal to rent an entire unit for less than 30 days. Overall, they estimated that the 20 neighbourhoods most popular on Airbnb have lost 10% of rental units (NYCC and RAFA 2015). These neighbourhoods are also featured in Airbnb’s neighbourhood guides. The company dismissed the report as “lies, fuzzy math and faulty stats” (Fermino 2015) a curious inversion of the many critiques lodged against Airbnb’s own dubious claims of providing for the local economy.

Quality of life is also a concern for residents who have seen their neighbourhoods transformed into de facto hotel districts (Cócola Gant 2016). In the fall of 2016, residents of New Orleans, still recovering from Hurricane Katrina, held a

jazz funeral at city hall (with coffins reading “RIP real neighbors” and “RIP affordable housing”) to mourn neighbourhoods lost to Airbnb tourism in a protest (Litten 2016). Meanwhile, hotel associations complain that short-term rentals effectively function as hotels but have an unfair advantage because they don’t pay taxes and don’t comply with safety and zoning regulations. Hotels also fear – plausibly, it turns out (Zervas et al. 2016) – that this grey-market enterprise will take away from their business.

The short-term rent gap: Gentrification without redevelopment

These debates and controversies in cities around the world provide significant circumstantial evidence that short-term rentals are implicated in gentrification. Accordingly, we now proceed to demonstrate that there is fire to go with this smoke. Our argument is that Airbnb and other facilitators of short-term rental housing are indeed systematically driving gentrification and displacement. Airbnb 1) simultaneously opens and provides a means for closing new technology-driven rent gaps, but it does so 2) by raising potential rentier income without any need for redevelopment, 3) in a geographically uneven fashion, concentrating in neighbourhoods with extralocal tourist appeal which do not necessarily overlap with areas gentrifying due to more traditional state or market factors.

Because Airbnb is, first of all, a mechanism for producing new revenue flows through land ownership, our theoretical point of entry is the *rent gap*. Neil Smith (1979) first proposed the rent gap model to offer a structural explanation for gentrification in American inner-city contexts such as New York City and Philadelphia. At its core, the rent gap model describes a situation where the actual economic returns to properties tend to decline or stagnate while potential economic returns tend to increase. In neighbourhoods where this “gap” between actual and potential returns systematically increases, the result will be a correspondingly increasing incentive for real estate capital to direct new housing investment flows. As these investment flows drive up housing prices, attract more affluent newcomers, and displace existing poorer residents, the result is gentrification.

Smith developed this model in an American urban setting featuring a host of specific cultural, social, and political-economic features, but the core of the rent gap model is relatively independent of these features. It simply states that where actual rents and potential rents diverge, a structural incentive for capital reinvestment begins to assert itself, and this incentive can be seen at work in cities around the world (Slater

2015; Lees et al. 2016). And as research on rural (Ghose 2004) and wilderness gentrification (Darling 2005) demonstrates, these conditions can exist in even non-city spaces, with much the same result. Smith mainly discusses the case where the divergence between actual rent and potential rent occurs because of devalourization and neighbourhood decline the common empirical picture of pre-gentrified neighbourhoods. But he also allows for the possibility that rent gaps could emerge in previously stable neighbourhoods, thanks to sudden shocks which drive up potential rents:

But it is also possible to conceive of a situation in which, rather than the capitalized ground rent being pushed down through devalorization, the potential ground rent is suddenly pushed higher, opening up a rent gap in a different manner. This might be the case, for example, when there is rapid and sustained inflation, or where strict regulation of a land market keeps potential ground rent low, but is then repealed. (Smith 1996: 68)

Indeed, Hackworth (2002: 828) (following Hammel 1999) has argued that rent gaps are increasingly likely to form through rising potential ground rent rather than decreases in actual ground rent, “because the surrounding core of reinvestment has lifted the economic potential of all centrally located parcels”.¹

The fact that short-term rentals have produced effectively out of thin air a new potential revenue stream in housing markets suggests the possibility that Airbnb is systematically creating rent gaps in cities around the world. This is our argument: across certain neighbourhood types (primarily still-gentrifying areas and now-affluent, formerly gentrifying areas), the new, technologically-enabled possibility of short-term rentals systematically raises potential ground rents and thus creates rent gaps even where there has been little or no devalourization of existing housing. For dedicated entrepreneurs, monthly income from short-term rental properties can substantially exceed what could be realized through conventional long-term residential leases, particularly in cities with strong rent control regimes. And for “amateur” homeowners or tenants, the prospect of monetizing a spare room or staying with friends for an occasional weekend while their residence is rented similarly increases the overall rent achieved through the property. Airbnb is in effect shifting the “highest and best use” of residential housing in neighbourhoods with sufficient extra-local tourist interest, and the result is a rent gap.

¹ Our thanks to Benjamin Theresa for drawing our attention to this point.

This argument builds in important respects on the concept of “transnational gentrification” proposed by Sigler and Wachsmuth (2016). Relying on a case study of the redevelopment of a historic neighbourhood in Panama City, they argue:

[In Panama City], localised disinvestment presents an opportunity for reinvestment capital not because of the neighbourhood’s changing relationship with metropolitan growth dynamics, but because of the neighbourhood’s changing relationship with a transnational middle class, for whom globalisation has rendered a physically distant locale increasingly accessible both logistically and imaginatively as a lifestyle destination. (Sigler and Wachsmuth 2016: 708)

The standard model of the rent gap and gentrification in general is a metropolitan scaled process where a neighbourhood declines but metropolitan growth sets the stage for reinvestment (Hammel 1999). Transnational gentrification, by contrast, occurs where rent gaps are *globally* scaled, and can create significant crisis for local residents who are forced to pay housing prices being set by global rather than local demand. Airbnb is an instance of this phenomenon; the service offers the opportunity for local capital to take advantage of extra-local demand.

So what kind of rent gap does Airbnb produce? It is in part technological; the potential economic returns to the very same apartment may be higher now than they were a few years ago, for no other reason than the availability of a website which allows short-term visitors to stay there. At the small scale, leaving for the weekend didn’t formerly create a feasible opportunity for tenants to rent out their apartment. And at the large scale, even if there had been sufficient flows of tourism to keep an apartment continuously occupied with short-term visitors, what landlord could have handled the necessary logistics to find these tourists, collect payment, and manage the schedule? While a small number of cities have historically received gigantic inflows of tourists at specific times of year (e.g. Edinburgh, Scotland, which hosts the Fringe Festival each August), and hence saw the development of a dedicated short-term rental sector even prior to the growth of web-based tourism, these cities are the minority. Airbnb’s technology platform creates new potential housing revenue flows in a far larger cohort of cities because it solves many of the logistical problems associated with short-term rentals in a general fashion.

Airbnb’s rent gap is thus technological, but it is also culturally mediated. Anyone can list their apartment on the service, but real economic activity only exists in areas where there is strong extra-local tourism demand. Some of these locations will be in pre-existing hotel districts and central business districts, but others will be in

areas which do not have large hotel presences but nevertheless have cultural cachet such as Williamsburg in New York, the Mission District in San Francisco, and inner East London.

While Airbnb opens up new technology- and culture-driven rent gaps by introducing the possibility of short-term rentals into formerly long-term housing units, it also offers the means of closing those same gaps. Contrast this with, for example, a major rezoning which raises potential ground rents in an area. The municipality takes the action which helps produce a rent gap, but other actors are necessary for realizing the higher rents—banks, developers, and the like. With Airbnb, the very same factor which creates the possibility of higher returns to housing also creates the means of achieving those returns. This decreases the turnaround time necessary to close the rent gap. Clark (1995: 1496), for example, illustrates the lifecycle of a property's rent gap using a 30- or 60-year time horizon, over which time actual rents fall and fall, before beginning to rise as speculation on the property's redevelopment prospects increases. He concludes that "The force of the rent gap is already history during the years just prior to redevelopment." By contrast, the rent gap which short-term rentals produce is literally a short-term rent gap. For properties which have a new highest and best use thanks to the emergence of Airbnb over the last few years, there was no sustained period of speculation and gradually increasing actual rents, but rather an exogenous shock to potential rent.

Moreover, little or no new investment is necessary to capitalize on an Airbnb rent gap. Again, a comparison with received wisdom on gentrification is instructive here, since nearly every analysis of gentrification concerns cases where the "gap" itself needs to get large enough to justify the high cost of new construction or major renovations. In Smith's (1979: 545) original analysis of the rent gap, he explained that:

Gentrification occurs when the gap is wide enough that developers can purchase shells cheaply, can pay the builders' costs and profit for rehabilitation, can pay interest on mortgage and construction loans, and can then sell the end product for a sale price that leaves a satisfactory return to the developer.

Not a single one of these steps is necessary for converting an existing residential unit to a short-term rental. While serious Airbnb entrepreneurs may well refurbish their units to increase their success with the service, *the only necessary step for converting a long-term rental to a short-term rental is to remove the existing tenant*. This means that relatively small rent gaps can motivate conversion to short-term rentals; no new mortgages need to be taken out, or contractors hired. In other words, Airbnb enables

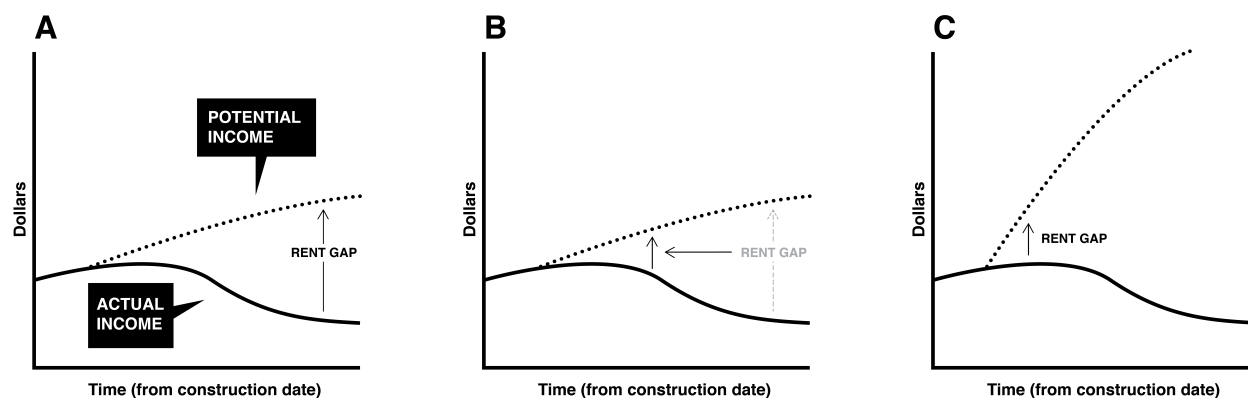


Figure 1. Variations of the rent gap: A) In Smith’s (1979) original analysis, a gap can open between gradually declining actual ground rent and the potential ground rent were the property to be redeveloped or put to the “highest and best use”. When this rent gap becomes big enough, redevelopment and gentrification may follow. B) The minimal capital needed to take advantage of an Airbnb rent gap means that the gap can become large enough to motivate landowner action much sooner than with a traditional disinvestment-driven rent gap. This causes the point at which a rent gap becomes effective to shift to the left (i.e. sooner in time) on the figure. C) Airbnb can cause potential income to rise sharply, creating a rent gap well in advance of any declining property income.

gentrification without redevelopment. Figure 1 schematically illustrates the distinctive rent gap dynamics which short-term rentals generate.

There are two other immediate implications of the short-term nature of Airbnb’s rent gaps. The first is that owners of rental units in areas where there is strong tourist demand for short-term rentals face strong economic incentives to evict existing tenants, or to not find new tenants when previous ones depart, in order to quickly and cheaply realize the higher possible rents. The second is that the growth in short-term rentals is very likely to be coming at the expense of long-term rental housing, as the latter gets converted to the former to take advantage of new rent gaps. Either in the short-term with actual evictions, or over a slightly longer timescale as long-term rental housing is “organically” converted to short-term rentals, the result will be the displacement of an existing, lower-income population and the arrival of higher-income newcomers. This outcome differs from a conventional gentrification scenario because the newcomers are temporary visitors rather than permanent residents. But, unlike a situation where the housing is demolished and replaced with hotels—a situation of housing converted to tourism accommodation which would not usually be described as gentrification—the housing being used as short-term rentals

remains potentially in circulation, if higher-income tenants or owner-occupiers are able to outbid Airbnb tourists.²

By creating higher potential returns to property through the possibility of short-term rentals, Airbnb produces rent gaps, and thereby should be expected to drive gentrification and displacement. But the “opportunity” Airbnb offers to landlords and tenants is highly uneven, because it directly depends on the magnitude of tourist demand for short-term accommodation. Accordingly, we should not expect Airbnb’s rent gaps, and the resulting gentrification and displacement, to be equitably distributed across urban space.

As a first approximation, Airbnb demand is likely to be particularly concentrated in the following two neighbourhood types: 1) areas near the central business district which have historically featured high rates of hotels, hostels, B&Bs and other forms of short-term tourist accommodation i.e. areas with strong pre-existing tourist demand; and 2) residential areas with strong cultural cachet, good public transit, and leisure amenities i.e. gentrifying or recently gentrified areas, which haven’t historically hosted tourists in large numbers. Conversely, Airbnb demand is likely to be weak in poor and racialized neighbourhoods lacking (white, middle-class) tourist-friendly cultural amenities, as well as more suburban areas with poorer public transit connectivity to the central city.

From a gentrification-theoretical perspective, therefore, we should expect Airbnb-induced gentrification pressures to overlap incompletely with other drivers of gentrification. Short-term rentals may exacerbate housing pressures in already wealthy areas experiencing so-called “super-gentrification” (Lees 2003) as well as in areas undergoing more traditional 2nd- or 3rd-wave (Hackworth and Smith 2001) gentrification processes, particularly in their more advanced stages. Meanwhile, in poor neighbourhoods which are experiencing gentrification pressures but which are not (yet) understood as desirable destinations for extra-local visitors, short-term rentals may not be a significant exacerbator of these pressures.

Is Airbnb gentrifying New York?

To substantiate this theoretical argument, we now turn to a case study of Airbnb’s activities in New York City over the last several years. We measure and

² Our thanks to an anonymous reviewer for raising this issue.

describe Airbnb's impact on ground rent flows throughout the city and document the emergence of new Airbnb-driven rent gaps in specific neighbourhoods. Data on all 188,000 Airbnb listings which were active in the New York metropolitan region between September 2014 and August 2017 was obtained from the consulting firm Airdna. The data includes canonical information about listing type (private room or whole house), asking prices, and other per-listing variables, along with daily per-listing occupancy and revenue estimates. The primary study focus is New York City proper during the year September 2016 to August 2017; 67,100 Airbnb listings received at least one reservation in this geography and time period. To compensate for uncertainty in the per-listing occupancy and revenue estimates, and to facilitate comparison with five-year estimates from the 2015 American Community Survey data concerning housing and demographic characteristics, listing data is aggregated at the census-tract scale using a novel method for overcoming the random spatial obfuscation which Airbnb applies to listing locations. Full methodological details are available in the attached appendix.

An overview of Airbnb's activity in New York City

Short-term rentals are not a new phenomenon in New York City; the State's Multiple Dwelling Law, which regulates and generally prohibits them, in fact dates back to 1929. But contemporary policy and community attention to short-term rentals emerged in the early 2000s, when legislators and community organizations in Manhattan began to receive increasing numbers of complaints about apartment buildings being converted to short-term rentals. Complaints were most common on the West Side, which already hosted the city's largest concentration of single-room-occupancy housing. Residents had begun to notice tourists or frequent visitors to neighbouring units, and registered complaints about safety and quality of life, as well as fears of being evicted as their buildings transformed into de-facto hotels. In response, a group of legislators and civil society actors formed an Illegal Hotel Working Group in 2005. An investigation by the group identified hundreds of illegal hotel conversions and documented the impacts of these conversions both on individual tenants (harassment, security concerns and loss of quality of life) and on the city as a whole (loss of housing supply and municipal revenue, and damage to legitimate hotels) (Illegal Hotel Working Group 2008).

In retrospect, these illegal hotels were a precursor to the "sharing economy" version of short-term rentals, of which Airbnb is now by far the dominant player.

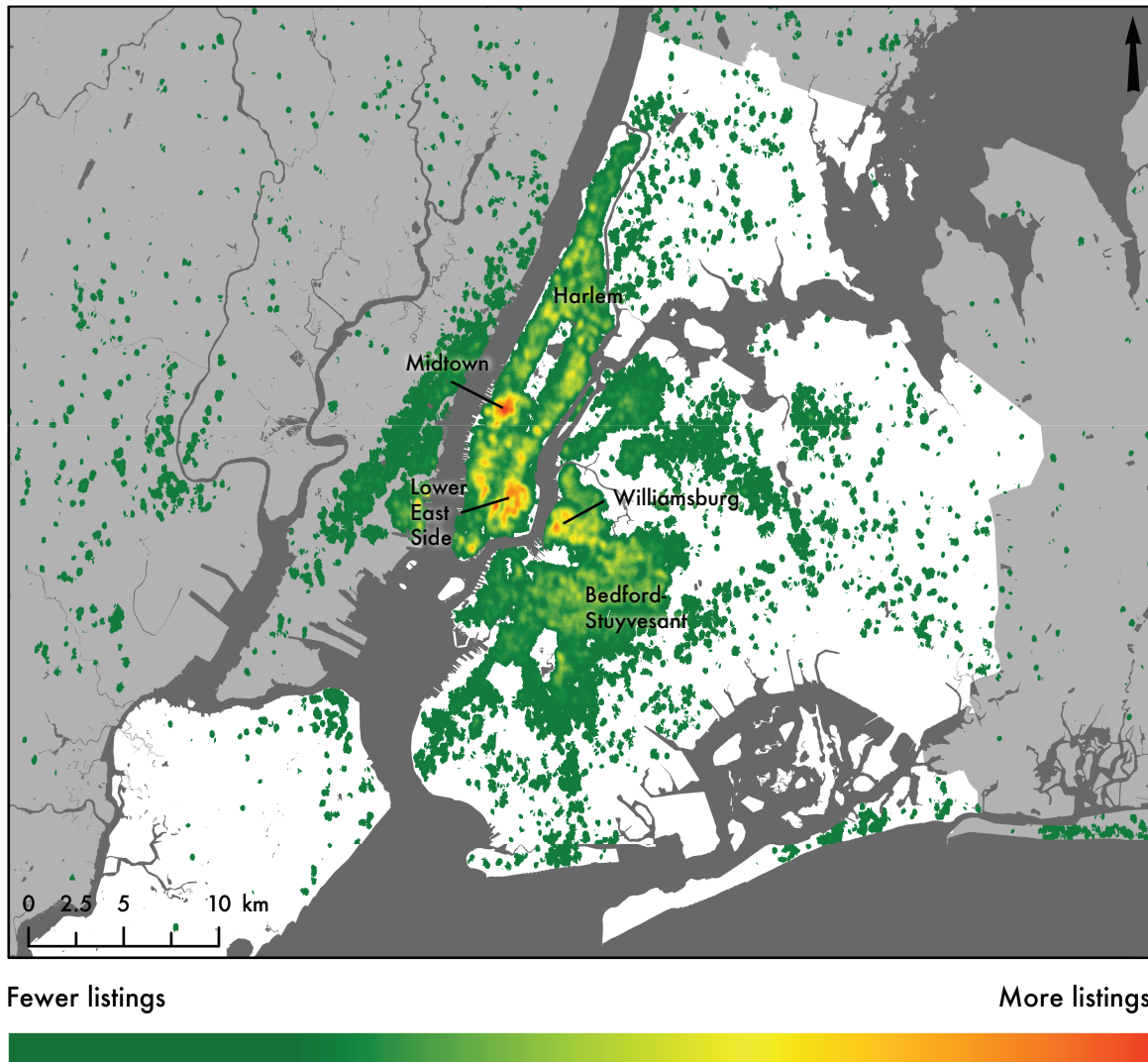


Figure 2. Density map of active Airbnb listings in the New York region (September 2016 – August 2017), with important New York City neighbourhoods indicated

Indeed, the scale of Airbnb’s activities renders earlier concerns in New York about illegal hotels almost quaint by comparison. While in the mid-2000s the Illegal Hotel Working Group (2008) identified 224 illegal hotel conversions in New York City, over the one-year period from September 2016 to August 2017 there were 67,100 active Airbnb listings in New York City. New York City is Airbnb’s third largest market worldwide (after London and Paris), generating more than \$650 million in host revenue over the year. Figure 2 shows the total distribution of active listings across the entire region in this period, revealing hotspots in Midtown Manhattan (near the

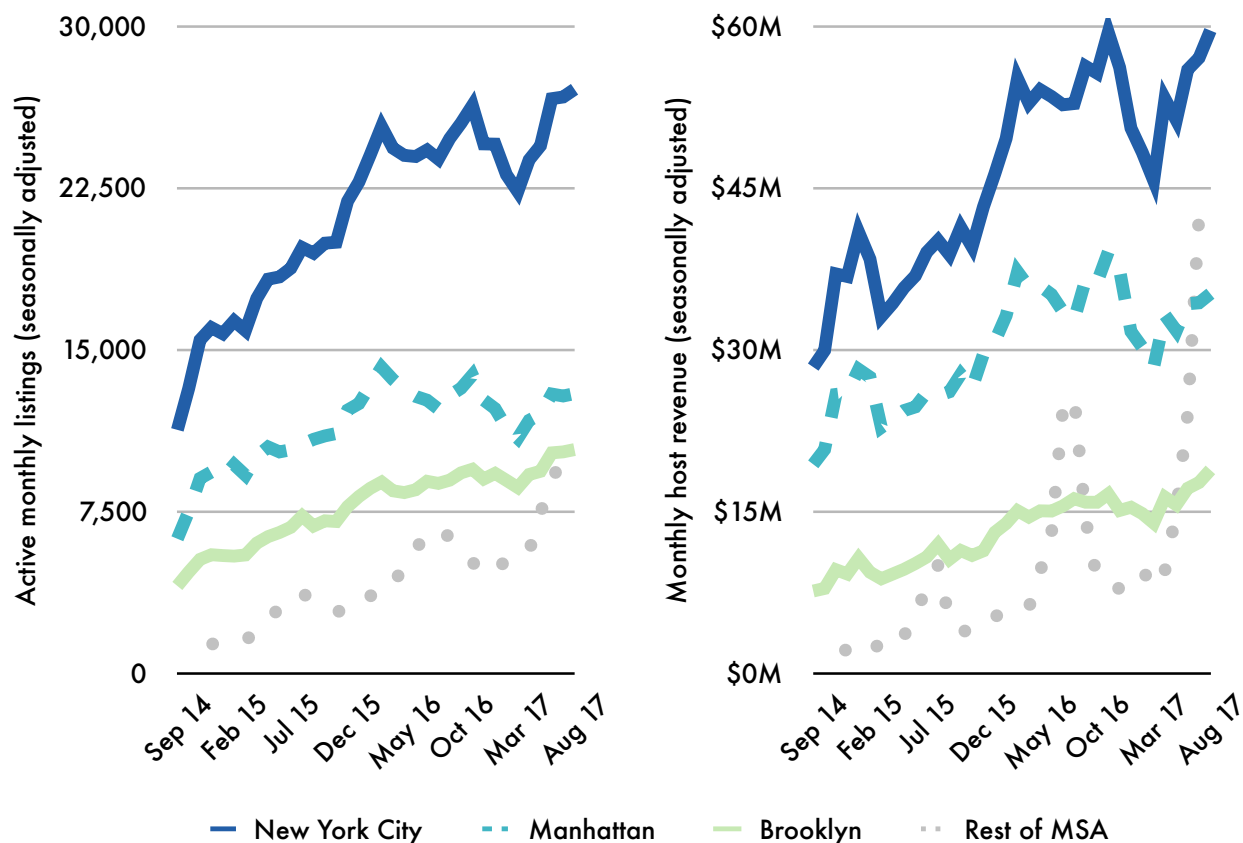


Figure 3. Seasonally adjusted revenue-earning listings (left) and monthly host revenue (right) in the New York region (September 2014 – August 2017)

existing Manhattan hotel district, an area with a long history of illegal hotels), the Lower East Side, and Williamsburg and Bushwick in Brooklyn.

As Figure 3 demonstrates, Airbnb’s growth in New York City has slowed down considerably over the September 2016 – August 2017 period in comparison with the previous two years. On an annual basis, the number of active listings (i.e. listings which received at least one reservation during the month) increased 4.5% from 64,200 to 67,100, while host revenue increased 14% from \$576 million to \$657 million. Entire-home listings make up just over half (51%) of all active New York City listings, but earn a disproportionate 75% of all platform revenue. Slightly over one quarter (28%) of revenue is earned by hosts with multiple entire-home listings or three or more private-room listings, who cannot be solely renting their primary residence and are therefore necessarily commercial operators rather than “home sharers” per se. However, both the share of entire-home listings and the share of commercial operators have declined somewhat in the last year, following a settlement with New York State’s attorney

general in 2016 in which Airbnb agreed to start enforcing a one-host, one-home policy in New York City. The company claims to have removed 4,800 entire-home listings operated by hosts with multiple such listings since November 2015 (Airbnb 2018).

Airbnb's two rent gaps: open and closed

The theoretical core of the rent gap model is simple—where potential ground rent sufficiently exceeds actual (or capitalized) ground rent, redevelopment and hence gentrification will tend to occur. But operationalizing this model is difficult. Indeed, arguably only Clark's (1988) painstaking examination of 120 years of land redevelopment in Malmö, Sweden has fully succeeded in doing so. The core of the problem is that “potential ground rent” and “capitalized ground rent” are abstract rather than concrete concepts, and hence are not available for direct observation or measurement (Clark 1995). By contrast, the two most readily observable concepts—contract rent and land price—do not necessarily capture the key theoretical proposition of land rent—that it is the economic surplus accruing to a landowner.

We now proceed to provide two major empirical indicators with respect to the distribution and intensity of Airbnb-induced rent gaps in New York City: 1) the proportion of total residential contract rent generated from Airbnb, and 2) the proportion of neighborhood median long-term contract rent earned on average by hosts of frequently rented entire-home listings on Airbnb. Neither of these indicators is claimed to directly measure potential or capitalized ground rent, or the difference between the two which is the rent gap. Instead, they are used as proxies for these abstract concepts, and there are compelling theoretical reasons to believe they will adequately describe the existence and relative size of rent gaps. Both of these indicators are measured at the neighborhood (i.e. census tract) scale, in accordance with Hammel's (1999) arguments about land rent and scale. (Hammel argues that capitalized ground rent is determined at the neighborhood scale, and that potential ground rent is determined at the metropolitan scale, but with a parcel's location within that scale—i.e. its neighborhood—being decisive.)

While gentrification researchers generally expect rent gaps to be filled through new capital investment—renovations and redevelopments—in the case of Airbnb this often won't be necessary. Property owners can simply supply furniture and switch their units from residential leases to short-term rentals. If there has been an Airbnb-induced rent gap, we should not expect to see large new capital investments; instead we should expect to see existing rental housing revenue flows diverted into Airbnb,

	Airbnb share of residential rents (2015)	Airbnb share of residential rents (2016)	Airbnb share of residential rents (2017)	Airbnb share of residential rent increase (2015-2016)	Airbnb share of residential rent increase (2016-2017)
<i>New York City</i>	1.2%	1.6%	1.8%	20.2%	9.2%
<i>Manhattan</i>	2.4%	3.1%	3.3%	46.5%	8.2%
<i>Brooklyn</i>	1.1%	1.5%	1.8%	13.1%	6.9%

Figure 4. Airbnb's share of total annual residential rents in New York City, Manhattan and Brooklyn, alongside its share of the annual growth in residential rents (September 2014 – August 2017)

and new revenue flows created. At an aggregate level, this has indeed occurred over the September 2014 to August 2017 study period, as Figure 4 demonstrates. In the last year, Airbnb accounted for almost 2% of all residential rent payments in New York. More dramatically, between 2015 and 2016 (the last year of very rapid Airbnb growth in New York), Airbnb accounted for more than 20% of all growth in residential rent flows a number which rises to nearly 50% in Manhattan.

These rent flows can be decomposed by neighbourhood, and the result – the proportion of total residential contract rent generated from Airbnb – is a post-hoc measurement of neighborhoods where Airbnb drove up potential ground rent, and where short-term rentals proliferated as a result. Put differently, these are areas where an Airbnb rent gap opened up and was filled through new short-term rental activity. The reasoning here is as follows. On urban land zoned for residential uses, there are effectively only two sources of rentier income: rent from long-term tenants and rent from short-term tenants. The latter did not exist at any meaningful scale as recently as five years ago. Neighborhoods with large proportions of total rent now being earned through Airbnb are neighborhoods where, over the last several years, one or both of two things occurred with frequency: residential landlords converted existing long-term rental units to dedicated short-term rentals, or short-term rentals were introduced to supplement the existing tenure arrangement in a unit. The second possibility is self-evidently an increase in the total land rent (since new economic surplus is being generated), while the first possibility will generally represent the same, since landlords are presumably only converting existing long-term rentals to short-term rentals in situations where they stand to realize an economic return to doing so.

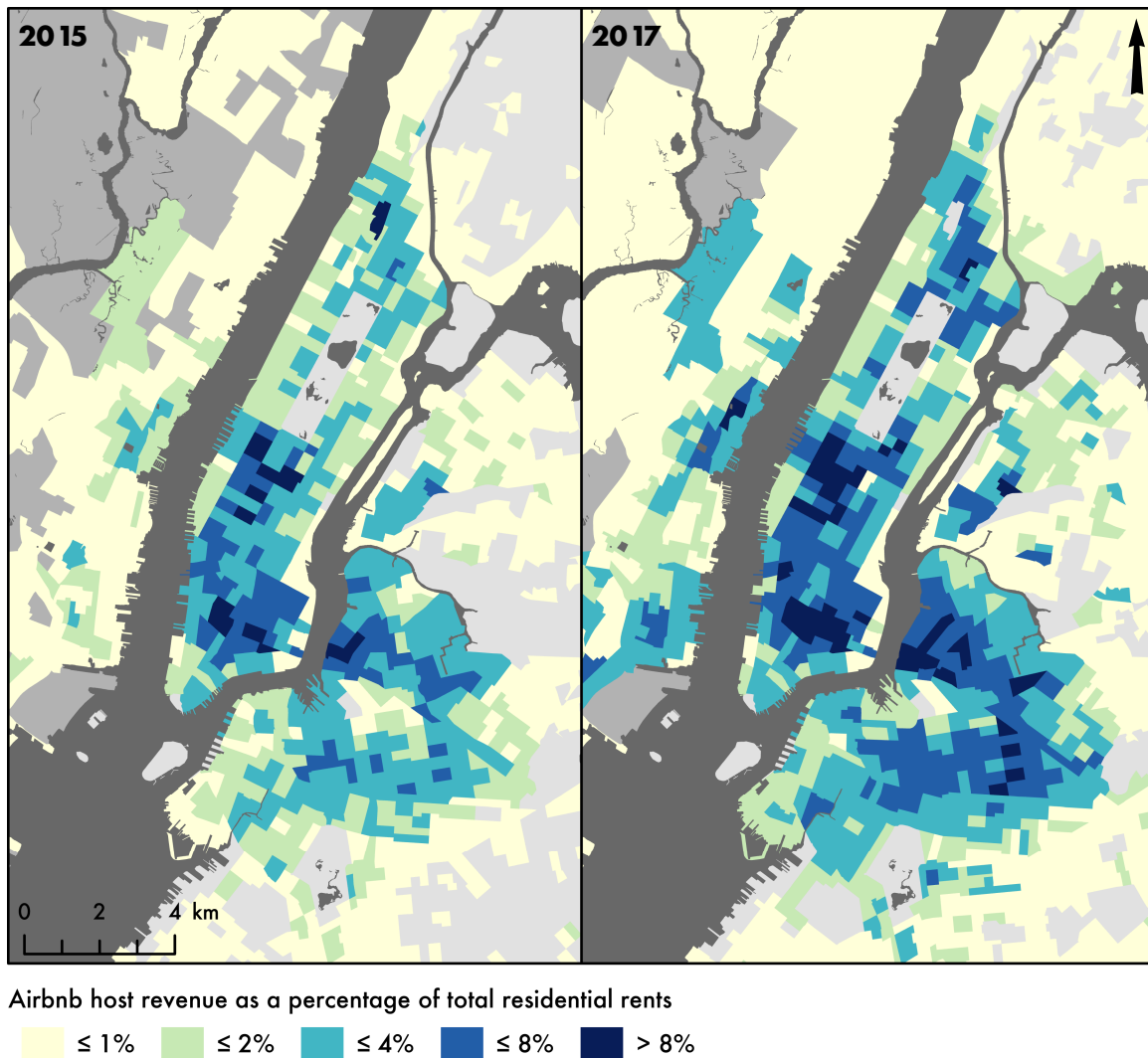


Figure 5. The rent gap which has already been closed, shown by the percentage of residential rent payments which now flow through Airbnb in 2015 and 2017

As a consequence, the share of a neighborhood's total residential rental revenue which now flows through Airbnb should be a reliable guide to the size of rent gap which had emerged thanks to the advent of a new rentier economic opportunity, and which has already been filled.

Figure 5 displays this indicator—the proportion of total residential contract rent generated from Airbnb—spatially for the first and third years of the study period. It demonstrates, first of all, that Airbnb as a new revenue stream from housing has consistently been most consequential in Times Square, the Lower East Side, and Williamsburg. These are the areas where Airbnb created a rent gap, and where

landlords have shifted housing supply into short-term rentals to capitalize on that rent gap. Importantly, these three neighbourhoods are all “post-gentrified”, in the sense that they saw massive increases in rents and massive displacement over the last several decades, and now have been to a greater or lesser extent transformed into wealthy neighbourhoods. Airbnb has had its biggest impact to date, in other words, not at the gentrification “frontier” (Smith 1996), but in areas that have already been pervasively restructured by capital. It is further intensifying gentrification and displacement dynamics where these dynamics have already been acute. Figure 5 further demonstrates, however, that Airbnb’s impact has been growing rapidly in several more peripheral areas of the city. Harlem in North Manhattan and Bedford-Stuyvesant in Central Brooklyn have both seen Airbnb’s share of total residential rents increase dramatically over the last two years.

A complementary picture of Airbnb’s impact emerges through examining how much landlords can earn on the service relative to prevailing rents in their neighbourhoods. We capture this by measuring the proportion of neighborhood median long-term contract rent earned on average by frequently rented entire-home listings on Airbnb. These are areas where individual landlords are making the most money on Airbnb relative to what they could have been making with traditional long-term rentals. This indicator is a prospective measurement of neighborhoods where Airbnb has driven up potential ground rent in a manner which has not (yet) been addressed through new short-term rental activities. The logic of this indicator is that, on a neighborhood scale, if operators of high-intensity short-term rentals are earning substantially more income than traditional long-term rental landlords, the latter will face economic incentives to convert from long-term rentals to short-term rentals. In any individual case there will be some friction to be overcome in this conversion (existing tenants need to be removed, the landlord needs to arrange for key management and cleaning, and so on), so we shouldn’t expect an inflection point wherever short-term rents exceed long-term rents. But, in line with the rent gap model, the larger the divergence between these two income sources, the larger the gap between the actual ground rent earned by traditional landlords and the potential ground rent were they to convert to the “highest and best use” of short-term rentals.

When this rent gap becomes large enough, we should expect to see short-term rental conversions occur.³

Figure 6 displays this indicator spatially and reveals a different geography from Figure 5. While the Lower East Side remains a hotspot on this map, with average full-time Airbnb revenues in the range of 200-300% of median rents, the other major areas of Airbnb activity—Williamsburg and Midtown Manhattan—have significantly receded in importance. The two previously second-tier neighbourhoods of Harlem in North Manhattan and Bedford-Stuyvesant in Brooklyn have advanced in importance. These are areas where there is not yet a lot of Airbnb activity in absolute terms, but where the landlords who are using Airbnb are making a lot more money than they would have in the long-term rental market. These are the neighbourhoods at greatest risk for Airbnb-induced gentrification in the near future. And whereas current Airbnb impacts were concentrated in already-gentrified areas, these at-risk neighbourhoods are all still very clearly at the gentrification frontier.

Comparing these two patterns—the percentage of housing revenue that now flows through Airbnb, and the percentage of the median rent which an average full-time Airbnb property earns—allows us to see where Airbnb has already had a major impact on neighbourhood change and where it is likely to have an impact in the future. The first pattern indicates where Airbnb has opened and closed a rent gap. The

³The major assumption of this indicator is that the extent to which contract rents map onto actual ground rent is agnostic to long-term or short-term rentals. This will be true if the ownership costs for long-term and short-term rentals are reasonably similar. Since ground rent in general is the economic surplus accruing to land ownership, a contract rent of X monotonically implies a higher actual land rent than a contract rent of Y if $X > Y$ and the ownership costs are the same. If, by contrast, the higher contract rent can only be achieved through correspondingly higher investments by the rentier, then this monotonic relationship between contract rent and actual ground rent will not hold. In general, this problem is why contract rent is an unreliable guide to actual ground rents, and hence to the existence of rent gaps: if major reinvestments are needed to achieve higher contract rents, the actual economic return to the rentier may not be any higher under a new, higher-earning land use. However, as previously discussed, short-term rentals have a key characteristic which answers this problem, which is that major investments are not required to convert long-term rental properties to short-term rentals; it is effectively just a change in tenant, with some additional furniture needing to be purchased. The costs of maintaining short-term tenants may well be slightly higher than long-term ones, particularly because of the need to clean the apartment frequently, but Airbnb hosts charge dedicated cleaning fees which should mitigate this cost. In sum, we feel confident assuming that variations in contract rent between long-term and short-term rentals adequately reflect underlying variations between actual ground rent for long-term rentals and these properties' potential ground rent as short-term rentals, as indicated by the contract rent generated by other nearby short-term rentals.

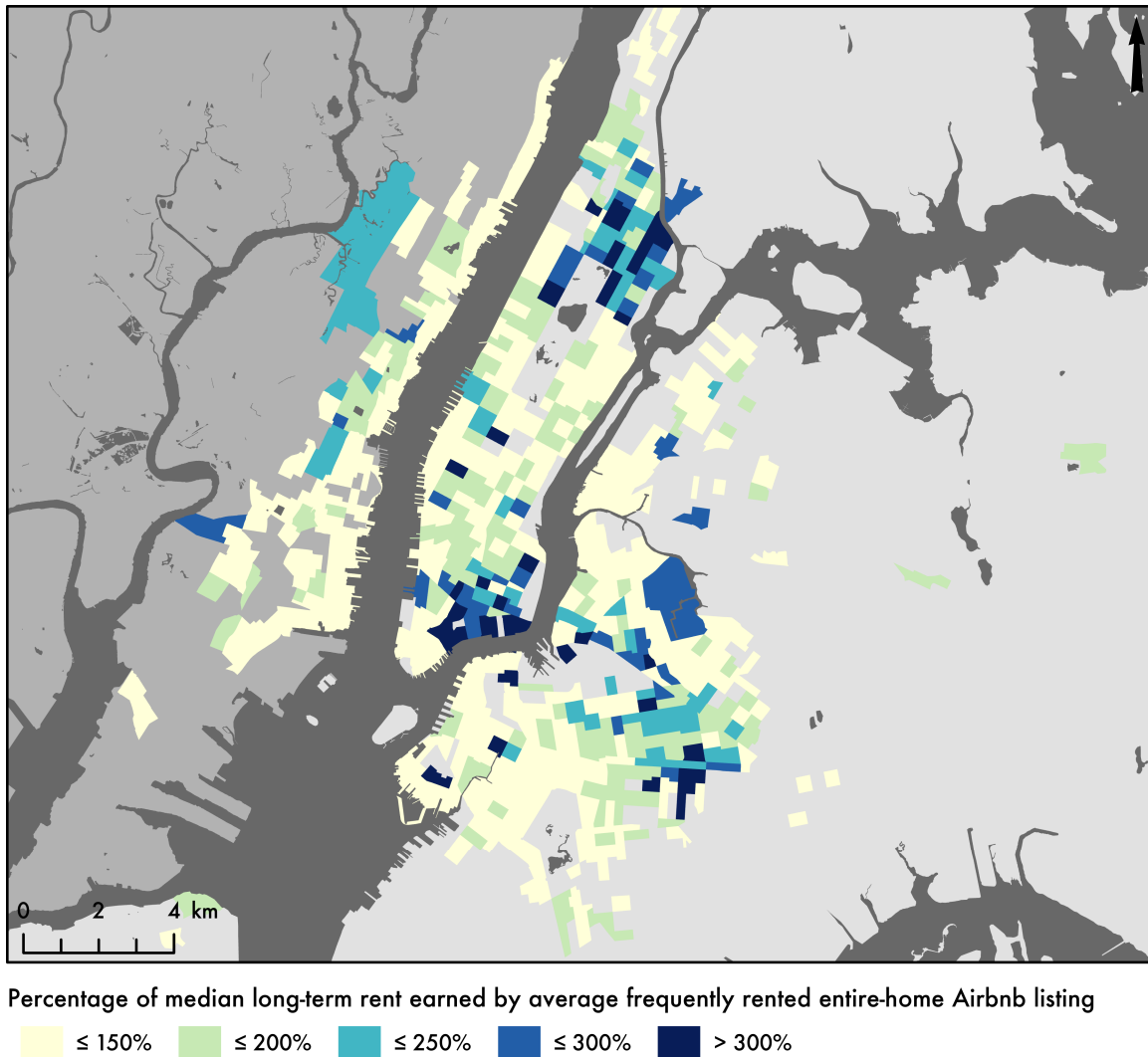


Figure 6. The rent gap which is still open, shown by the profitability of an average frequently rented entire-home Airbnb listing compared to the median 12-month rent in the neighbourhood

second pattern indicates where there is still money to be made for landlords by converting long-term rental housing to short-term rentals – where Airbnb has opened a rent gap which hasn't been closed. A third pattern – where the first two intersect – indicates where rent gaps are closing but not yet closed, where new Airbnb revenue has been considerable but landlords continue to face incentives to introduce new short-term rentals.

These three patterns are synthesized in the first panel of Figure 7, which presents a vulnerability index for Airbnb-induced gentrification in New York. First, shown in blue, are the areas which have had their housing supply heavily impacted by

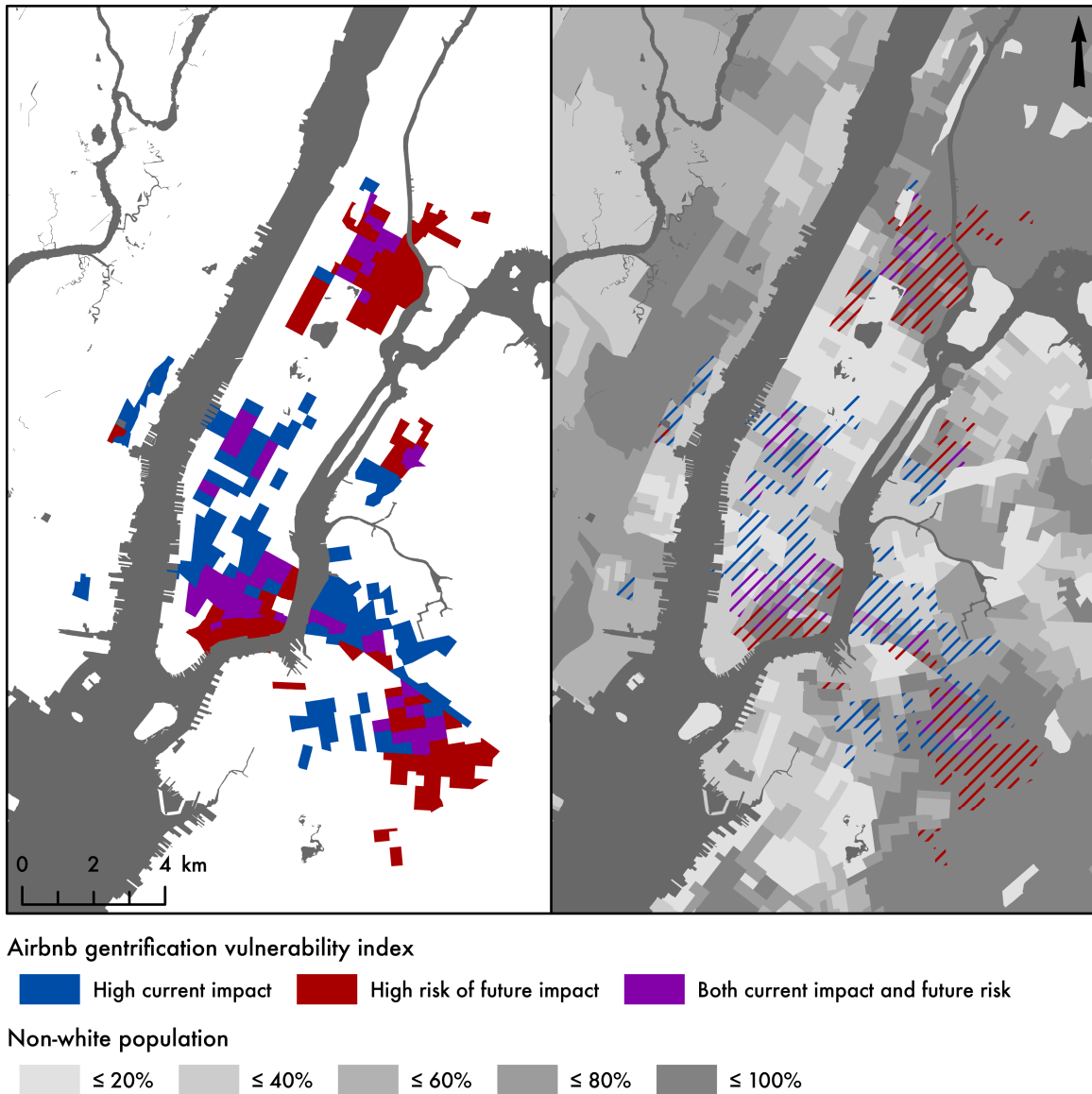


Figure 7. An Airbnb gentrification vulnerability index (left) identifying neighbourhoods with closed rent gaps (“high current impact”), open rent gaps (“high risk of future impact”), and partially closed rent gaps (“both current impact and future risk”). The index’s juxtaposition with race (right) indicates that the likely next frontiers of Airbnb-induced gentrification in New York are racialized (and particularly African-American) neighbourhoods.

Airbnb, but which may be close to reaching an equilibrium (a closed rent gap). Large areas of Midtown Manhattan, Lower Manhattan and Williamsburg fit this profile. Second, shown in red, are the areas which haven’t yet been seriously impacted by Airbnb, but are in real danger of it in the near future, because of how much more money landlords in these areas are making by using Airbnb (an open rent gap).

Harlem in Manhattan and Bedford-Stuyvesant in Brooklyn fit this profile. Last, shown in purple, are the areas which have already been heavily impacted by Airbnb, but where there appears to be more impact still to come (a not-yet closed rent gap). The Lower East Side and parts of Harlem and Brooklyn fit this profile.

The second panel of Figure 7 demonstrates the strong overlap between the patterns of Airbnb-induced gentrification and racial segregation. Airbnb has had its greatest impact so far in largely non-Hispanic white neighbourhoods, while the areas it is increasingly threatening are largely African American and Hispanic neighbourhoods. Households in areas suffering high current impact of Airbnb in New York are only 34% non-white, while households in areas at high risk of future impact are on average 71% non-white. (Across New York City 61% of households are non-white a figure which drops to 52% region-wide.) Given emerging research demonstrating the prevalence of racial discrimination on Airbnb (Cox 2017; Edelman et al. 2017), the pattern identified here implies the impending arrival of a new intensification of racialized gentrification in New York.

The consequences of Airbnb's rent gaps for New York households

The preceding section demonstrated the opening and closing of Airbnb-induced rent gaps in New York City. But the question of the consequences of these rent gaps is still to be answered; as Slater (2015: 12) remarks, “a challenge for students of rent gap theory is...to illustrate specifically how the opening and closing of rent gaps leads to the agony of people losing their homes.” In the case of short-term rentals, the mechanism is unfortunately straightforward. Beyond the neighbourhood quality-of-life issues researchers have already documented (Cócola Gant 2016), Airbnb's impact on housing availability and affordability can be documented in two interrelated ways: through a reduction of housing stock available for long-term residents, and through increased rents and housing prices.

The growth of Airbnb in a housing market does not necessarily lead to a reduction in housing units for long-term residents. If Airbnb hosts are exclusively casual, part-time users of the platform, who rent their primary residence while they are out of town or rent a spare room that would not have otherwise housed a tenant, then even a large short-term rental sector would be compatible with no long-term housing loss. It is hard to imagine how this situation could emerge organically, but strong state regulation of the short-term rental industry could in theory achieve such a result. If, on the other hand, Airbnb usage is concentrated in units which are

dedicated to short-term rentals throughout the year, then the opening and closing of Airbnb-induced rent gaps is coming at the expense of local residents, for whom housing options have been reduced.

In a pioneering discussion of gentrification and displacement, Marcuse (1985) introduced a distinction between “direct displacement” and “exclusionary displacement”. The former is the scenario most commonly associated with gentrification-induced displacement: landlords evicting tenants in order to raise rents or redevelop. But gentrification can also cause displacement through the indirect mechanism of rendering unobtainable what would have otherwise been viable, affordable housing for a family — as Marcuse (1985: 206) puts it, “a household excluded from living where it would otherwise have lived”.

The data suggest that both forms of displacement are occurring in New York City as a result of the growth of Airbnb. In 2017 there were 12,200 whole-unit listings rented 60 days or more and available 120 days or more (hereafter “frequently rented”), and 5,700 whole-unit listings rented 120 days or more and available 240 days or more (hereafter “very frequently rented”). These figures can be taken, respectively, as high-end and low-end estimates for housing units removed from the long-term rental market, since apartments offered for rent on Airbnb at least a third of the year are unlikely to have a full-time tenant, and apartments offered for rent two thirds of the year almost certainly do not. If we compare this number with the amount of normal housing in the region, we can estimate what portion of each neighbourhood’s housing stock has been lost to Airbnb. As the first panel of Figure 8 indicates, many census tracts appear to have seen three percent or more of their long-term rental housing converted into Airbnb hotels. (A further 10,000 private rooms were rented 60 days or more and available 120 or more, and many of these will have displaced long-term renters as well, but we have excluded these from the analysis to err on the conservative side.) There is no way to estimate how many tenants were forcibly evicted or harassed out of their apartments to free up units for Airbnb (direct displacement), and how many units were simply converted to short-term rentals after they “naturally” became vacant (exclusionary displacement). But in either case, the result has been a large and concentrated loss of rental housing in the city. To put the numbers in perspective, the city-wide rental vacancy rate was 2.7% in 2015 (US Department of Housing and Urban Development 2016). A roughly equivalent percentage of rental housing in Lower Manhattan and Williamsburg has been converted, or is at risk of being converted, into full-time Airbnb use. The second panel of Figure 8 provides the

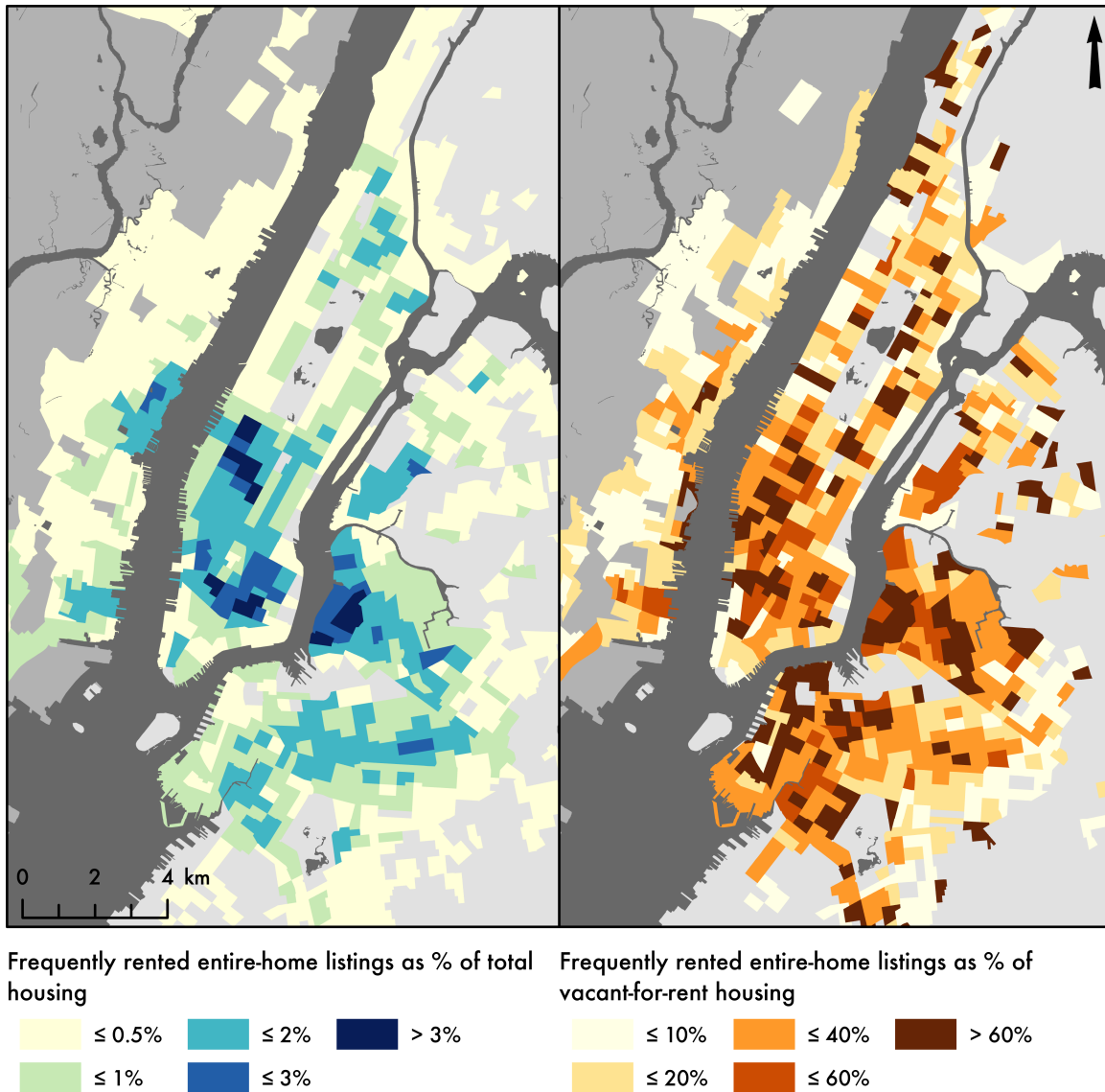


Figure 8. Two estimates of the proportion of housing removed or threatened to be removed from the long-term housing market by Airbnb for the year September 2016 – August 2017: frequently rented entire-home listings as a proportion of total housing (left) or available-for-rent housing (right)

same estimates of Airbnb-induced housing loss in a different context, by taking these estimates as a percentage of available-for-rent housing, as opposed to all housing. The pattern is considerably noisier, since it relies on higher-error estimates of housing which is vacant but for rent, but it is meant to demonstrate that the number of housing units Airbnb has potentially removed from the long-term housing market forms a consistently large proportion of the housing stock which would actually be available to a household looking for an apartment.

Besides direct and exclusionary displacement in neighbourhoods with high levels of short-term rental activity, there is also the prospect that Airbnb has increased housing costs either in specific neighbourhoods or city-wide. There are two plausible mechanisms through which this could occur. First, when long-term rentals are converted to short-term rentals, this reduces the effective supply of available housing, and should therefore cause prices for the remaining supply to be higher. Furthermore, since New York's housing market features extremely low price elasticity of supply (McLaughlin 2016), these upward price impacts are likely to persist beyond the near term, as new housing supply cannot easily be introduced in response to the increased demand from short-term rentals. Second, by increasing the economic potential of some residential properties, Airbnb should cause purchase prices for these properties to increase, and hence the overall equilibrium market price to increase also.

It is outside the scope of this paper to directly estimate the impact of Airbnb's growth on housing affordability in New York City. To properly control for endogenous effects, any such analysis would need to be comparative across many different cities in different geographical and social contexts. Barron et al. (2018) conducted such a study using a custom dataset of all Airbnb activity in the United States, and concluded that a 10% increase in exogenously-determined Airbnb listings leads to a 0.42% increase in rents and a 0.76% increase in house prices. Nationwide, they estimate that Airbnb is responsible for a 1% increase in residential rents and a 2% increase in housing prices from 2012 to 2016, with the effects concentrated in cities such as New York where Airbnb activity is highest. Wachsmuth et al. (2018) applied this model to New York City to estimate that three years of Airbnb growth (from September 2014 to August 2017) led to an increase of approximately \$380 per year in the city-wide median new rent. In neighbourhoods with very high Airbnb activity growth, this amount is considerably higher.

In summary, there appear to be both concentrated and diffuse impacts of Airbnb's rent gaps on New York City. In the areas where short-term rentals have proliferated, there has been substantial loss of long-term housing, driving both direct and exclusionary displacement. City-wide, this reduction in effective housing supply has plausibly translated into a general increase in rents and housing prices.

Conclusions: A research agenda for gentrification and short-term rentals

The purpose of this paper has been to analyze the intersection of gentrification and short-term rentals. Using a case study of New York City, we have argued that Airbnb has introduced a new potential investment flow into housing markets which is systematic but geographically uneven, creating a new form of rent gap in culturally desirable and internationally recognizable neighbourhoods which have generally already been subject to extensive gentrification. This rent gap can emerge quickly in advance of any declining property income and requires minimal new capital to be exploited by a range of different housing actors, from developers to landlords, tenants and homeowners. We now conclude by offering several synthetic observations about the New York case and a series of themes for future research on gentrification and short-term rentals, in the hope of developing a more consistent body of knowledge to inform scholars, policymakers and activists.

The first issue which the New York case study poses is the policy question of Airbnb's impact on housing supply in the city. There are two ways of looking at this. On the one hand, New York City has 2.2 million renter-occupied housing units, and only 12,200 frequently rented, entire-home Airbnb listings. Therefore, looking at the total stock of housing at the urban scale, only half of a percent of New York's rental housing has been converted to short-term rentals. On the other hand, looking at the change in housing supply particularly at the neighbourhood scale paints a direr picture. Only 16,300 new housing units were permitted in New York in 2016, while 23,200 units were completed (New York City Rent Guidelines Board 2017). This means that Airbnb activity has negated something like half to three quarters of a year's worth of new housing supply in the city. In the Manhattan submarket, only 4,000 new units of housing were permitted in 2016, while there were 7,000 frequently rented whole-unit Airbnb listings on the island. In other words, what appears superficially to be the construction of new housing supply in the city is to a large extent the production of new unlicensed hotels.

A second question posed by the New York case is whether the rentier economic activity facilitated by Airbnb is positive sum or simply redistributive. In other words, is Airbnb just shifting profit-making opportunities from land sectorally (away from the hotel industry to Airbnb hosts) and spatially (away from the Midtown Manhattan hotel district to other parts of the city), or is it driving an overall increase in land rents?

There can be little doubt that an increasingly major redistribution of rentier activity is underway. The \$657 million of annual revenue generated by Airbnb in New York City is still dwarfed by the nearly \$10 billion of annual hotel room revenue in the city. However, hotel revenues have been flat or declining in New York for several years, and most observers attribute this fact in part to the explosion of short-term rentals in this time period. Moreover, the hotel industry in New York is highly concentrated around Times Square in Manhattan (although Brooklyn and Queens hotel activity has been growing much faster than Manhattan), while Airbnb activity is distributed across a wider area of Midtown and Lower Manhattan and North Brooklyn. In other words, it is likely that Airbnb has facilitated a sectoral and spatial redistribution of tourism spending away from the (spatially concentrated) hotel industry towards the (spatially dispersed) short-term rental market. Accompanying this redistribution is an increase in overall land rents in New York, because a much larger (globalized) pool of demand is bidding for the use of that land. But this effect is likely to be more modest in New York than in smaller cities, where global demand from transnational gentrification (Sigler and Wachsmuth 2016) will be proportionally larger (see below). On balance, therefore, while the rise of short-term rentals in New York implies some expansion of overall land rents due to expanded global demand, it appears to be more significantly a redistributive de facto rezoning of residential areas to commercial hotel use, carried out by a private corporation.

Our research also raises a number of themes for future research on gentrification and short-term rentals, as well as the broader landscape of the “sharing economy”. The first theme is *uneven development* at both the urban and global scales. As our examination of New York has demonstrated, short-term rental activity is distributed in a highly uneven fashion across the urban landscape. In New York the clusters were most pronounced in the city’s traditional tourism area and in several neighbourhoods which have not historically been major tourism draws but do have internationally recognizable cultural cachet. Does this pattern exist in other cities? Furthermore, the neighbourhoods with the most Airbnb activity are not necessarily the neighbourhoods where the impact on existing rental housing is strongest – a situation we captured in New York with the vulnerability index (Figure 7, above). Understanding geographically-specific vulnerability patterns in other cities is thus an urgent research task. At a global scale, meanwhile, the question is the differential exposure of cities to transnational gentrification (Sigler and Wachsmuth 2016): transnational corporate power facilitating the arrival of transnational tourist demand

for local housing. With short-term rentals supplying a large and growing source of housing demand which is almost completely disconnected from local economies and labour markets, cities face the prospect of heterarchy in their land markets to the extent that they are exposed to this demand. Urban researchers should try to understand both the variation in this exposure and appropriate governance responses to it.

A related theme is *displacement*; just as the impact of short-term rentals on neighbourhoods is geographically uneven, it is also almost certainly socially uneven. Short-term rentals are removing rental housing from the market, but are conversions from standard rental apartments to de facto Airbnb hotels more or less likely to displace existing residents than more traditional forms of gentrification-related urban redevelopment? Our quantitative empirical analysis of New York was unable to measure displacement directly, and without observation and qualitative research, future research will be likewise limited to making neighbourhood-scale inferences about likely displacement. Yet displacement is ultimately the key moral stakes of gentrification (Slater 2009) and understanding the extent to which short-term rentals are displacing people from their homes is a correspondingly vital topic for future research.

A third issue is *everyday life*; how are short-term rentals transforming the fabric of everyday life in the neighbourhoods in which they are proliferating, and at other spatial scales? The sharing economy is not just a new economic opportunity for its “users”, but also a new and perhaps unprecedented commodification of everyday life; as Slee (2016: 10), puts it, the sharing economy “is extending a harsh and deregulated free market into previously protected areas of our lives”. Understanding the parameters and implications of this development is a major opportunity for interview- and ethnography-based qualitative research. Likewise, as we discussed above, short-term rentals generate new economic incentives among rentiers that potentially crosscut existing political interests. Interviews with both small-scale and large-scale Airbnb landlords along with tenants attempting to host short-term rentals clandestinely would help unpack the varied ways in which money is flowing through housing markets and transforming the private sphere.

A fourth theme is *regulation and regulatory conflict*. Existing research suggests that a commonality to the business models of firms in the corporate sharing economy is disruption of existing governance arrangements more than existing market structures (Geobey 2018). Accordingly, cities around the world are currently

scrambling to develop regulations on short-term rentals, but we still have very little understanding about which attempts at regulation have proven effective so far, and which have proven political feasible. Relatedly, as our discussion of Airbnb regulation in New York has demonstrated, regulators do not always speak with one voice, or even share basic interests with respect to the so-called sharing economy. Researchers thus need to understand the political economy of short-term rentals better: what leads different state and civil society actors to take different positions on how short-term rentals should be regulated, and what leads them to invest significant resources into securing their desired outcomes?

The final theme for future research is *labour*. Despite the label “sharing economy”, Airbnb along with Uber, the other leading firm in the corporate sharing economy does not actually involve sharing, in the sense of non-monetary exchange (Eckhardt and Bardhi 2015). Instead Airbnb and Uber have both rolled out a kind of flexibility-slash-precarity for their users, operators and intermediaries. Uber’s drivers are “liberated” from the need to obtain expensive taxi medallions, but they are also “liberated” from union benefits, job security, and regulatory protections (Slee, 2014). Meanwhile, Airbnb operators frequently outsource cleaning and key management labour which is generally unionized in the hotel sector, simultaneously rendering this work more precarious and less visible to guests, who experience short-term rentals as peer-to-peer exchanges. What are the conditions of labour in the sharing economy?

The explosive growth of Airbnb from a few hundred thousand nights booked in 2010 to 25 million in 2015, 50 million in 2016, and 100 million in 2017 makes clear the urgent need for better understanding the impact of short-term rentals on urban housing markets and the regulatory options available for controlling them. At their core, short-term rentals are facilitating a massive and perhaps unprecedented intensification of the commodification of housing. Airbnb and other “sharing economy” corporations are transforming our cities, while communities (aided in many cases by civil society and state actors) are resisting that transformation and articulating other visions for “sharing” in the city. Critical urban researchers should seize the opportunity to contribute to these visions.

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Methodological appendix

This appendix describes in detail the data sources used in the paper and the methodologies employed to analyze the data.

Data sources

The spatial analysis in this paper was conducted using a combination of proprietary data on Airbnb activity obtained from the consulting firm Airdna and public data on housing and demographics from the American Community Survey. Airdna is a firm that specializes in scraping and aggregating data from the publicly available Airbnb website and aggregating the data they find, and it is one of the two widely relied upon third-party estimates of Airbnb's activities. (The other is Murray Cox's open-data effort Inside Airbnb.) It would be preferable to do this analysis with official, accurate data from Airbnb, but the company has historically been secretive about its data, even when faced with legal requirements, and when they have released data, observers have concluded that they have done so in a misleading fashion (Cox and Slee 2016).

The data provided by Airdna for this study is the complete property file for all Airbnb listings in the New York Newark Jersey City, NY NJ PA Metropolitan Statistical Area (henceforth the "New York MSA") as of September 1, 2017, along with the daily activity of each of these properties for the time period September 1, 2014 through August 30, 2017. For the sake of simplicity, the three years in this period are often shortened in this paper as follows:

- "2015": September 2014 – August 2015
- "2016": September 2015 – August 2016
- "2017": September 2016 – August 2017

The property file includes many listings which are now defunct as well as many listings which were added to Airbnb only shortly prior to the end of the study period and therefore haven't yet generated much or any activity. After data cleaning, the property file contains 188,137 listings, 155,558 of which were located in New York City proper. (Although data was available and analyzed for the entire New York MSA, the analytical focus was on New York City. One reason for this choice is that the New York MSA includes substantial summer vacation communities on Long Island and the New Jersey Shore, which present a completely different type of short-term rental activity

that would confound the paper's city-centric analysis.) Out of this total pool of listings, 85,300 across the MSA and 67,100 in New York City received at least one reservation between September 2016 and August 2017 – the main study period. (Hereafter, figures which are the result of estimation are rounded off to avoid giving the impression of perfect accuracy.) When the paper discusses “active” listings, it is these 85,300 or 67,100 to which it is referring. Because of a high rate of churn in listings activity, in any given month the number of active listings is much smaller; in New York City, each month there were between 16,100 and 25,700 listings receiving at least one reservation.

The entry for each listing in the property file provides a large assortment of metadata, including:

- The listing type: private room, shared room, or whole-unit
- The location of the listing: latitude and longitude coordinates
- Unit details: the number of bedrooms and bathrooms, and the maximum number of guests
- Rental policies: the cancellation policy and security deposit, the cleaning fee, check-in and check-out times, etc.
- Other details: the listing URL, the number of photos included in the listing, etc.

The daily activity file provides, for each property, the following information for each day:

- Occupancy status: available, reserved, or blocked
- Price: listed nightly price
- Reservation ID: if the property is reserved, an ID number for the reservation which can be used to calculate the length of individual reservations

With the exception of occupancy status (and hence reservation ID), all these variables are directly observed from the Airbnb website, and thus completely accurate. For 2014 and most of 2015, the occupancy status data was also taken directly from Airbnb. But at the end of 2015, Airbnb stopped disclosing when a non-available property was reserved or was simply blocked from new reservations, which made it impossible to precisely measure occupancy. In response, Airdna developed a machine learning model to estimate this information based on a combination of its existing

historical dataset of activity and other information which remained publicly available (e.g. reviews and ratings). While the activity dataset for 2016 and 2017 therefore cannot be fully accurate, it is the most accurate third-party estimate available. Moreover, our use of this dataset in the paper is for the most part limited to relative comparison of different neighborhoods (e.g. which neighborhood has relatively high amounts of Airbnb revenue). Since the estimates were produced with a consistent methodology, there should be relatively little risk of high levels of spatially autocorrelated error.

Airbnb is the largest home-sharing platform, with a particular dominance in cities, but it is still only one of several large corporate players in this industry. Since we do not have data for competitors (most significantly VRBO, HomeAway, and Booking.com), the result is that all of our estimates of the size and impact of “home sharing” will be systematic under-estimates. Since the thrust of the paper’s argument is that short-term rentals are having an important impact on New York’s housing market, this should strengthen the force of our conclusions to the extent that we are able to demonstrate, with only a subset of the entire market data, that these impacts are real.

Determining the spatial location of listings

Airbnb provides exact latitude and longitude coordinates for each listing, but it is well known that these coordinates have been obfuscated to protect user privacy. Using a dataset of known Airbnb locations, we experimentally determined that this obfuscation is a random shift in the listing’s coordinates by 0 to 150 m. While this amount may initially appear small, for census-tract level analysis it is potentially fatal, because of the high possibility that a listing apparently located in census tract A may actually have originated in census tract B prior to the spatial obfuscation. In fact, 145,300 listings in New York City – which amount to 93.4% of the total – fall within 150 m of a census tract boundary, and therefore would potentially be misidentified for census-tract level analysis.

To address this problem of spatial imprecision, the first author developed a method for producing more reliable estimates of the actual location of a listing, given its reported latitude and longitude coordinates (which is also used in Wachsmuth et al. 2017, 2018). The method is based on the idea of dasymetric mapping, where population density maps enumerated at a relatively coarse spatial scale can be improved by mediating them through land use data. Given that a listing’s true location must lie within a 150-m-radius buffer surrounding the reported coordinates, we

exploit the fact that an Airbnb listing must be located in an actual unit of housing to transform the buffer into a probability surface weighted by the density of housing units. The weighting is performed at the smallest feasible census geography, the block group. Each listing is then randomly assigned an originating block group from its probability surface, and the results are aggregated at the census scale for analysis.

Seasonal adjustment of Airbnb data

Figure 3 in the paper presents monthly trends for listing and revenue growth. Any such attempt to measure growth trends of short-term rental activity must contend with the fact that this activity is highly seasonal. In order to identify underlying trends, we constructed seasonality indices for each variable analyzed in the paper. Using the “ratio-to-moving-average” method, we calculated seasonal indices for the 35-month period October 2014 to August 2017. The values for the active-listing and revenue indices are indicated in Figure A1.

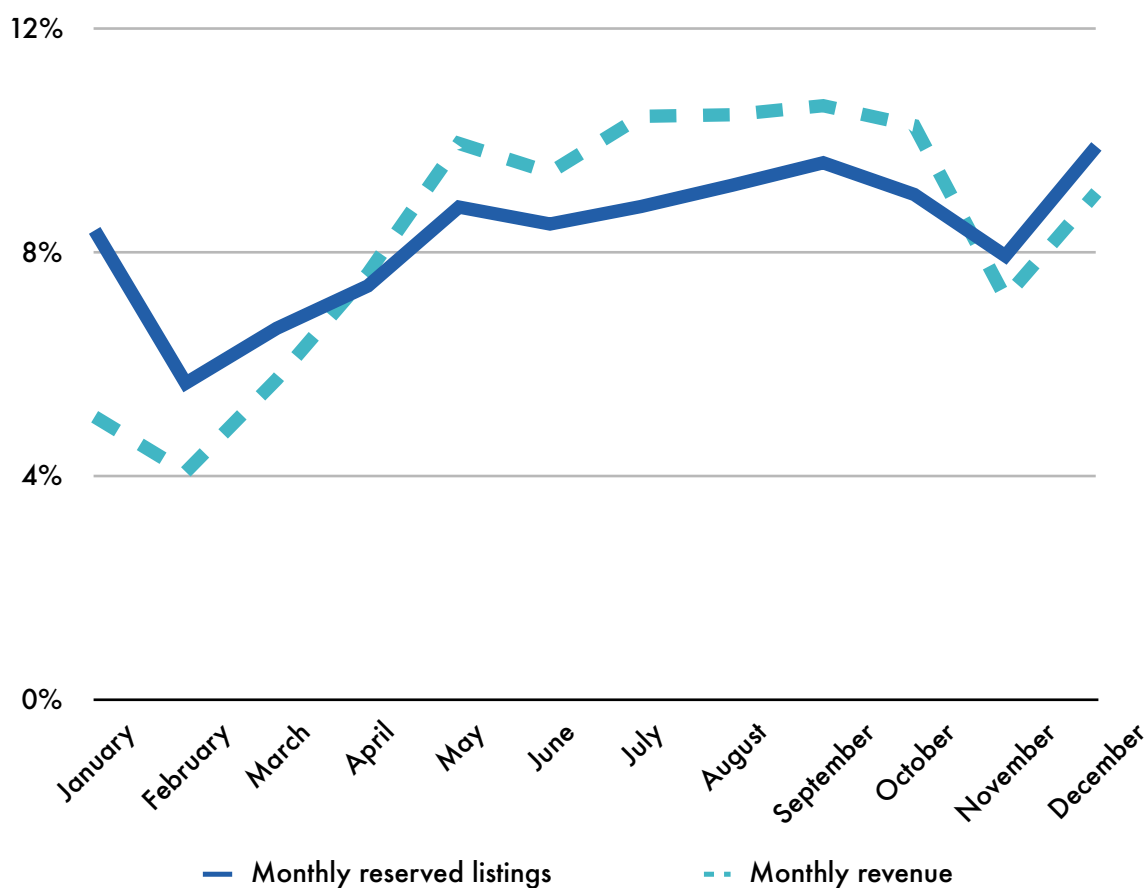


Figure A1. Seasonality curves for Airbnb activity in New York

Calculating the proportion of total residential contract rent generated from Airbnb

The indicator used in the paper to estimate rent gaps which have opened and been (partially or completely) closed is the proportion of total residential contract rent generated from Airbnb. This indicator is calculated on a per-census-tract basis, and takes the form:

$$\frac{Rent_{Airbnb}}{Rent_{Airbnb} + Rent_{Long-term}}$$

The numerator is the sum of all host revenue earned on Airbnb in a given census tract over a given year. The denominator is this sum plus the amount of contract rent generated in the long-term rental market, as measured by the American Community Survey. The specific measure used was “aggregate gross rent” (2015 ACS five-year estimates, table B25065), calculated at the census-tract scale. Gross rent is the sum of the contract rent and any utility payments not included in the contract rent, and is provided in order to increase comparability between cases where utilities are included in the rent and where they are not. Including utility payments in the measure of long-term rents weakens the comparability of long-term rents with Airbnb host revenue, since it overstates the actual revenue long-term landlords receive by bundling their own revenue with money that will be passed along (or paid directly) to utility providers. However, the benefits of having a consistent measurement of long-term rents between neighbourhoods outweighs this downside. Moreover, the effect of including utility payments will be to underestimate the share of rent payments which are generated through Airbnb, so this choice is a conservative one. In Figure 5, the indicator is calculated for 2015 (i.e. September 2014 – August 2015) and 2017 (i.e. September 2016 – August 2017), and data for census tracts with fewer than three revenue-earning Airbnb listings in the relevant time period is not displayed.

Calculating the proportion of neighborhood median long-term contract rent earned on average by hosts of frequently rented entire-home listings on Airbnb

The indicator used to estimate rent gaps which have opened and are not (yet) closed is the proportion of neighborhood median long-term contract rent earned on average by hosts of frequently rented entire-home listings on Airbnb. This is calculated on a per-census-tract basis, and takes the form:

$$\frac{AvgRent_{Airbnb}}{AvgRent_{Long-term}}$$

The numerator is the average annual revenue earned by a frequently rented entire-home listing in a given census tract. The denominator is “median gross rent” from the American Community Survey (2015 ACS 5-year estimates, table B25064). The intuition guiding this variable construction is that, in the absence of strong policies to prevent property owners from converting long-term rentals to short-term rentals, a rough revenue equilibrium should emerge between the two. A landlord earning \$2,000 per month in rent for an apartment in a neighbourhood where they could earn \$4,000 per month on Airbnb will have a strong incentive to convert to a short-term rental. This is a rent gap. If enough landlords take advantage of these opportunities, we would expect 12-month rents to rise somewhat (in response to demand-side competition for a shrinking stock of rental units) and Airbnb rates to fall somewhat (in response to supply-side competition for a relatively fixed tourist demand). Some time later, we might find that median rents have risen to \$2,400 and average Airbnb revenues have fallen to \$2,800. Now the rent gap is smaller, and there will be less pressure on landlords to convert long-term rentals to short-term rentals.

The Airbnb gentrification vulnerability index

The Airbnb gentrification vulnerability index combines the two previous indicators into a single synthetic picture of the areas of New York where rent gaps have opened and the areas where rent gaps have closed. Three regions are indicated in Figure 7: areas of high current impact, areas at high risk of future impact, and areas of both high current impact and future risk. Areas of high current impact were defined as those census tracts whose Airbnb revenue as a proportion of total rental revenue (indicator 1) was more than two standard deviations higher than the regional mean. Areas at high risk of future impact were defined as those census tracts belonging to statistically significant clusters of high average revenue earned by frequently rented entire-home listings on Airbnb in proportion to neighborhood median long-term contract rent (indicator 2). Cluster analysis (using an Anselin local Moran’s i) was used to mitigate the noisiness of the underlying pattern: the selected areas were high-high clusters. Areas of both high current impact and future risk were defined as those census tracts meeting both of the previous criteria.

“Non-white households” in the second panel of Figure 7 were calculated as follows:

$$1 - \frac{Units_{White}}{Units_{Occupied}}$$

The numerator is the total of owner- and renter-occupied households from the American Community Survey table “Tenure (white alone, not Hispanic or Latino householder)” (2015 ACS 5-year estimates, table B25003H). The denominator is the variable “occupied” from the American Community Survey table “Occupancy status” (2015 ACS 5-year estimates, table B25002).

Housing lost to Airbnb

While in theory a “full-time” Airbnb rental is one for which there is no primary occupant (tenant or owner) living in the unit year-round, in practice it is impossible to verify this status unit by unit. Instead, attempts to estimate Airbnb’s impact on housing markets generally choose an occupancy threshold beyond which a unit is considered unlikely to be occupied by a long-term resident. Inside Airbnb (2017), for instance, defines “frequently rented” units in New York City as those rented on Airbnb for 60 or more days per year, arguing that “Entire homes or apartments highly available and rented frequently year-round to tourists, probably don’t have the owner present, are illegal, and more importantly, are displacing New Yorkers”.

We define two occupancy thresholds to estimate conversions from long-term housing to short-term rentals. We use the term “frequently rented” to describe listings rented at least 60 nights a year, and available for rent at least 120 nights a year. Sixty days of occupancy rules out most scenarios of occasional short-term rental, such as a landlord taking advantage of a one-month gap between long-term tenants, or a family leaving on a one-month summer vacation. Setting an additional constraint of 120 days of availability prevents the inclusion of listings which are rented relatively infrequently but with extremely high efficiency; for example, a homeowner who was out of town every weekend and listed their unit on Airbnb would only have 104 days of availability, and so would not be counted as “full-time” by our criteria even if they managed to rent the unit for 60 of those days. We use the term “very frequently rented” to describe listings rented at least 120 nights a year, and available for rent at least 240 nights a year. While it is likely that very few frequently rented listings can also house long-term resident, it would be nearly impossible for a very frequently rented listing to have a

long-term resident, since these listings are on Airbnb for at least 8 months of the year and have short-term tenants for at least 4 months. Figure A2 shows the count of entire-home listings in New York City which meet each of these definitions of “frequently rented” plus a set of several other definitions.

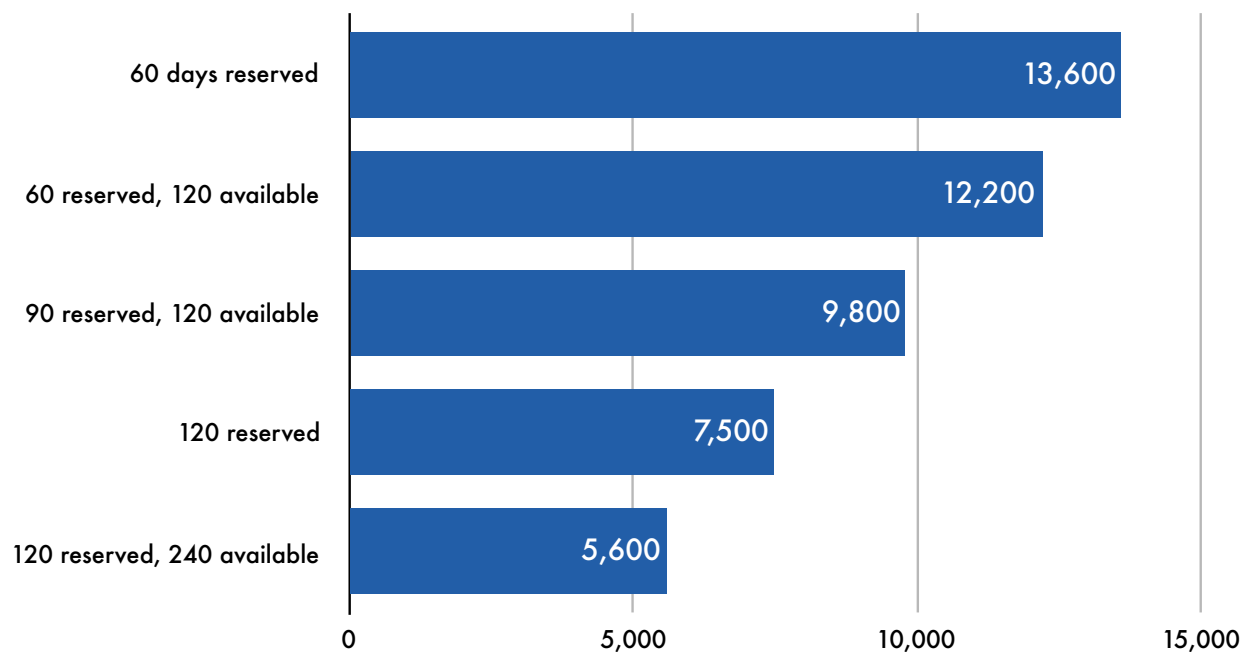


Figure A2. Entire-home listings in New York City at different thresholds of “frequently rented”

The first panel of Figure 8 shows the proportion of each census tract’s housing stock composed of frequently rented entire-home listings. This is calculated as follows:

$$\frac{Listings_{Rented60,Available120}}{Units_{Total}}$$

The denominator is the total number of housing units, occupied or not, in a census tract, as given by the American Community Survey (2015 ACS 5-year estimates, table B25001).

The second panel of Figure 8 shows the proportion of each census tract’s “available for rent” housing stock composed of frequently rented entire-home listings. This contextualizes Airbnb’s impact on housing availability more realistically from the perspective of a household searching for an apartment. The proportion is calculated as follows:

$$\frac{Listings_{Rented60,Available120}}{Listings_{Rented60,Available120} + Units_{VacantForRent}}$$

The denominator is meant to capture all the housing which is either available for rent or would be available if it were not being rented short-term on Airbnb. The second term is the variable “for rent” from the American Community Table “Vacancy status” (2015 ACS 5-year estimates, table B25004).

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