To Lease in the Short or Long Term? Homeowners' Sharing Economy Exit Decisions Amid COVID-19 Uncertainty

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November 18, 2024

Abstract

This paper studies the financial impacts of the COVID-19 pandemic on investment property owners on Airbnb and what economic shocks from the pandemic reveals about their substitution between Airbnb and the long-term rental housing supply for the investment of their property. Prior to the pandemic, homeowners had increasingly used the peer-to-peer platform Airbnb to allocate investment homes to tourists in the short-term rental (STR) markets instead of to residents in the long-term rental (LTR) markets. This has raised policy concerns about the sharing economy's effects on housing affordability within supply price inelastic housing markets. Using a continuous difference-in-differences research design, I estimate the extent to which homeowners exited the STR markets in the short run of the 2020 pandemic. I find that 1 pp greater exposure to pre-pandemic tourism levels for a market at the monthly level causes 1.2 to 2.1 pp decrease in Airbnb supply on average. Furthermore, I show evidence that Airbnb property owners switched to LTR markets through short-run movements in LTR rents during the 2020 pandemic. Airbnb homeowners with two to three bedroom properties in areas with higher costs associated with homeownership, including mortgage payments and property taxes, tended to exit the STR markets at higher rates. This suggests heterogeneous effects that could depend on liquidity constraints or the financial leverage of investment property owners.

Keywords: sharing economy; Airbnb; liquidity constraints; housing rentals; investment properties; household finance; tourism; COVID-19; uncertain demand; difference-in-differences; continuous treatment
JEL Classification: D14, G51, R30, R31, Z30, Z31, Z33

*University of Washington (UW, Email: ngyvonne@uw.edu) and Federal Housing Finance Agency (FHFA, Email: yvonne.ng@fhfa.gov). For helpful comments, I thank my PhD supervisory committee members, Alan Griffith, Xiaoling L. Ang, Jonathan M. Karpoff, and Yuya Takahashi. I am also grateful for comments and suggestions from Yue Yu, Patrick Bajari, Ulrich Doraszelski, and Kate Pennington. For helpful comments I received during my internship at FHFA, I thank Matthew Suandi, Justin Contat, Caroline Hopkins, and Andrew Davenport. Finally, I thank my PhD classmates, Danial Salman, Alejandro González, Jorge A. Rivero, Seyoung Won, Sean Ewen, Lukas Hager, Ken Inosaki, Theradapuzha V. Ninan, Amre Abken, and Robin Luo. All errors are my own. This work reflects my own views and opinions and do not reflect those of FHFA.

1 Introduction

Natural disasters, such as wildfires, earthquakes, and epidemics, present large macroeconomic shocks and uncertainty for homeowners that can threaten their ability to pay their mortgages (Knuth et al., 2023; Gallagher & Hartley, 2017; Guha-Sapir, Santos, & Borde, 2013; Contat, Hopkins, Mejia, & Suandi, 2024). In the case of the COVID-19 pandemic, government lockdowns paused and generated uncertainty regarding tourism demand for short-term housing rentals on Airbnb. This upended a growth trend in home-sharing on the online platform that had persisted for at least the prior six years. Home-sharing had provided a means for homeowners to supplement their income with revenue streams from renting an investment property or a room in a house to tourists instead of long-term residents. At the same time, Airbnb's growth had raised important policy concerns about the impact of home-sharing of investment properties on housing affordability for renters as markets for short-term rentals have grown and taken up the existing housing stock. In this paper, I study both the financial impacts of the COVID-19 pandemic on investment property owners on Airbnb and how these homeowners substitute between Airbnb and long-term rental housing markets on the supply side in the face of unprecedented and uncertain demand shocks in the short run.

In particular, my results illustrate how tourism-related demand shocks during the pandemic affected investment property owners' decisions to exit the short-term rental (STR) markets for alternatives that include listing their properties on the long-term rental (LTR) markets and leaving their properties vacant. I show that 1 pp greater exposure to tourism for a market as measured by pre-pandemic seasonal flight patterns causes 1.2 to 2.1 pp decrease in active Airbnb listings on average for a Census tract. These effects appear to be largest for two to three bedroom properties and properties that have higher costs associated with homeownership.(U.S. Census Bureau, n.d.)[1] Furthermore, I observe that 1 pp change in Airbnb listings induced by these shocks is positively associated with 0.04 percent change in long-term rents for zero to one bedroom homes and 0.03 percent change for two to three bedroom homes.

The importance of studying the impacts of the COVID-19 pandemic on these homeowners' property usage decisions is twofold. On one hand, the COVID-19 pandemic is a natural disaster that created unexpected economic shocks impacting the financial health and decisions of investment property owners. While the pandemic did not cause irreparable physical damage to properties as a tornado or hurricane might, the unprecedented drops in Airbnb bookings and cancellations left many hosts who have come to rely on income generated through Airbnb with sudden liquidity challenges to cover mortgage bills and other expenses (Griffith, 2020).[2] The pandemic created an environment of STR demand uncertainty and a potential shortage of liquidity for preventing Airbnb hosts from becoming delinquent on mortgage payments. If an Airbnb host is unable to quickly switch to the LTR market in the short run due to market frictions like difficulty

[1] These costs consist of "the sum of payments for mortgages, deeds of trust, contracts to purchase, or similar debts on the property (including payments for the first mortgage, second mortgages, home equity loans, and other junior mortgages); real estate taxes; fire, hazard, and flood insurance on the property; utilities (electricity, gas, and water and sewer); and fuels (oil, coal, kerosene, wood, etc.). It also includes, where appropriate, the monthly condominium fee for condominiums and mobile home costs (personal property taxes, site rent, registration fees, and license fees)." See `https://www.census.gov/quickfacts/fact/note/US/HSG650221`.

[2] To try compensating for these hosts' losses, Airbnb wrote a letter—enclosing 100,000 emails from Airbnb hosts that described how the downturn in tourism has affected their lives—to persuade Congressional leaders to enact legislation for helping support Airbnb hosts (Airbnb, Inc., 2020a). As federal government aid, the Coronavirus Aid, Relief, and Economic Security (CARES) Act provided grants and loans covering affected small business owners' operating costs and employee wages. These were Paycheck Protection Program (PPP) loans and Economic Injury Disaster Loans (EIDL) (Airbnb, Inc., 2020a, 2020b). While Airbnb hosts were eligible for these benefits, Airbnb Community Center discussion forums indicated that hosts faced challenges during the application process due to a lack of clear guidance from both Airbnb and the government (Airbnb Community Center, 2020a, 2020b). Furthermore, the financial literature on PPP loan effectiveness during the pandemic indicates that the funds primarily favored businesses with pre-existing relationships with lenders, often neglecting those in greater need (Bartik et al., 2020).

finding a longer-term tenant during the pandemic, the outside option of exiting the STR market and leaving the property vacant may contribute even greater income losses and further constrain the ability of these homeowners to pay their mortgages.

As a second motivation for studying the impacts of the COVID-19 pandemic on investment properties on Airbnb, policymakers have often been concerned about the impact of home-sharing on housing affordability. This has led to implementations of strict regulations requiring homeowner registration of STRs with local governments, limitations on how many properties can be registered as STRs by each owner, or even complete bans. Even after the pandemic, for example, New York City has implemented a de facto ban on short-term rentals as of September 2023. Proponents of home-sharing argue that it allows homeowners to extract value from vacation homes or vacant rooms when these assets would remain underutilized otherwise. But a growing literature has shown that at least a portion of STRs are properties and units reallocated from the market for LTRs, which places upward pressure on rental prices in largely supply price inelastic housing markets throughout U.S. metro areas (Li, Kim, & Srinivasan, 2021; Calder-Wang, 2021; Barron, Kung, & Proserpio, 2020). [3] As a novel contribution to the literature studying how the sharing economy interacts with the LTR markets, I exploit the pandemic as a quasi-natural experiment to find short-run effects of unexpected demand shocks to STR on LTR markets.

Defining an Airbnb market as a Census tract and month combination, my difference-in-differences research design with continuous treatments assumes higher levels of seasonal pre-pandemic tourism exposes a month more to negative COVID-19 STR demand shocks for each metro area.[4] For estimating average effects of STR demand shocks on Airbnb market exits and entry into the LTR markets, my exclusion restrictions are twofold. First, I assume a strong version of parallel trends following the continuous diff-in-diff literature (Callaway, Goodman-Bacon, & Sant'Anna, 2024). In my application, parallel trends means that calendar months that had higher relative pre-pandemic tourism levels would have experienced the same growth paths for Airbnb listings and LTR listings as other months during the pandemic, if it was not for the greater tourism levels that these months had received prior to the pandemic. Second, to interpret the effects on these outcome variables as stemming from the drop in demand for STRs, I assume that variation captured in my tourism measure is orthogonal to other unobserved shocks to the STR and LTR markets that occurred during the pandemic, including pandemic-driven STR supply shocks like increases in cleaning costs for Airbnb properties. My estimates of the heterogeneous effects of STR demand shocks across Census tracts, however, should be interpreted as more descriptive since the interaction terms of my instrument with homeowner characteristics could be correlated with other unobserved sources of heterogeneity that also vary across Census tracts.

Since the 2020 pandemic is a short time frame, I assume in my model that Airbnb homeowners only choose between the options of a STR, LTR, or vacancy for the usage of their property. I rely on monthly data on the full universe of Airbnb STR listings and transactions as well as a sample of long-term rental listings data from scraped Craigslist listings from three metro areas: the Chicago-Naperville-Elgin MSA ("Chicago MSA" or "Chicago metro area"), Seattle-Tacoma-Bellevue MSA ("Seattle MSA" or "Seattle metro area"), and Miami-Fort Lauderdale-West Palm Beach MSA ("Miami MSA" or "Miami metro area"). This allows me to distinguish at the Census tract-level to what extent STR hosts switched to the LTR markets and to what extent they may have exited for other options, including vacancies.[5]

[3] While I focus on the short-run, the majority of the literature has focused on the longer time horizon of a year. An inability to easily switch from one market to another in response to short-run shocks can potentially exacerbate the income losses from exiting Airbnb.

[4] I measure seasonal tourism demand using the average share of flights arriving in the corresponding metro area and calendar month between 2015 and 2017. This leverages monthly flights data from the Bureau of Transportation.

[5] Even though the 2020 pandemic is a short time frame, it is possible that a portion of these may consist of properties that

This paper contributes to the literature on the financial decisions of property-owning households in response to disasters, though my context is distinct in two ways. The COVID-19 pandemic may be comparable to earthquakes and hurricanes in terms of *ex ante* unpredictability, but the pandemic distinctly created (1) a prolonged period of uncertainty for the tourism industry on the scale of months as opposed to a single event that occurred over the course of a day or days and (2) shocks for specific sectors compared to other natural disasters.

First, the prolonged period of uncertainty during the 2020 pandemic uniquely allows for constructing an instrument relying on variation in pre-disaster seasonality patterns for measuring the exposures of different calendar months to the effects of the disaster. Given that many events occurred simultaneously across many markets during the COVID-19 pandemic, it is not easy to separately identify the effects of any particular shock or set of shocks to markets during COVID-19. My paper contributes to the COVID-19-related literature that uses difference-in-differences to perform the rather difficult task of identifying and estimating the reactions of individuals to uncertain, large macroeconomic shocks, especially during the COVID-19 pandemic (Goodman-Bacon & Marcus, 2020).

Second, this paper provides an example of how natural disasters can financially impact investment property owners through their effects on the sharing economy, which facilitates matching between demanders and suppliers of goods and services. Both the literature on the economics of natural disasters and the literature on the industrial organization of the sharing economy have been growing, but not many studies have attempted to measure the causal impacts of uncertain but temporary macroeconomic shocks to peer-to-peer markets on homeowners' sharing economy participation decisions investment decisions for their properties. While a growing body of tourism studies have examined how COVID-19 affected Airbnb bookings and pricing, most of these papers have focused on descriptive effects of the pandemic shocks on STRs and do not separately identify supply and demand shocks, which both impacted STRs in this context (Boros & Kovalcsik, 2020; Buckle & Phibbs, 2021; Moreno-Izquierdo, 2023; Kourtit, Nijkamp, Osth, & Turk, 2022; Sainaghi & Chica-Olmo, 2022; Trojanek, Gluszak, & Hebdzynski, 2021). Some studies that examine Airbnb host pricing behavior have tried to instrument for demand shocks or included neighborhood fixed effects and other control variables in their regressions, but these research designs still suffer from endogeneity issues (Milone, 2023; Boto-Garcia, 2022; Buzzachi, Milone, Paolucci, & Raguseo, 2023).[6] I emphasize the importance of disentangling STR demand shocks from supply shocks in the pandemic context because my descriptive statistics demonstrate that tourism demand shocks were more uncertain than gradual supply shocks like increases in cleaning costs, and so they reveal interesting behaviors regarding the risk that homeowners faced when deciding on their property investment decisions during the pandemic.

Finally, this paper also contributes to the literature studying the causal effects of the sharing economy on the existing housing stock and prices. Li, et al. (2019) and Calder-Wang (2021) have found that homeowners facing higher mortgage pressure and lower income (respectively) tended to list on Airbnb more often due to profits being higher from STRs than LTRs during "normal" times (Li et al., 2021; Calder-Wang, 2021). Meanwhile, I find that Airbnb homeowners with higher monthly costs including mortgage payments tended to exit Airbnb more often during times when demand is low and uncertain. These prior studies present structural

were sold or foreclosed. However, since I do not have direct data on property sales or foreclosures, I do not estimate to what extent demand shocks in the STR markets caused property sales and foreclosures during the pandemic.

[6]For example, Milone et al. (2023) studies Airbnb hosts' price adjustment responses to demand by instrumenting for demand with an index for the stringency of local government lockdown measures, but this could be correlated with pandemic shifts in the cleaning costs of Airbnb STRs (Milone, 2023). Boto-Garcia (2022) studies how Airbnb hosts adjusts prices different in response to COVID-19 demand shocks depending on how many Airbnb properties they operate (their level of "professionalism"), but the study uses monthly dummies to capture pandemic-related shocks that do not seem to separate demand and supply shocks (Boto-Garcia, 2022).

models of homeowners' supply decisions between the STR, LTR, and vacancy options over an *annual* time horizon, which assumes that seasonal patterns of demand for STRs are fixed and that investment property owners make an annual commitment between these choices based partly on predictable revenue streams from expected demand seasonality. Extending this work, I show how investment property owners react to unexpected and uncertain demand shocks to the STR market in terms of their decisions to exit the STR market and the extent that they switch over to the LTR market as a profitable alternative even in the short term of a few months.[7] My paper is also distinct from Barron et al. (2020) because my instrument specifically seeks to capture the effects of uncertain demand shocks during the COVID-19 pandemic to the STR markets on homeowners' investment decisions in the sharing economy, whereas they do not attempt to distinguish between demand or supply shocks when estimating the effects of Airbnb on LTR rents and housing prices using their Bartik instrumental variable—they only capture shocks to the STR markets that are presumably orthogonal to shocks to the LTR markets during pre-COVID-19 times (Barron et al., 2020).[8] It is interesting to focus on demand shocks in this paper because these were more unprecedented and uncertain in duration during the pandemic compared to cost shocks through increased cleaning costs that were more gradual and longer term. The uncertain nature of these demand shocks during the pandemic reveal how different Airbnb homeowners respond to income risk through a quasi-natural experiment.

2 Empirical Overview

In this section, I summarize my data sources and present descriptive statistics to show relevant trends that help to motivate my research design. These include data on Airbnb transactions and listings licensed from AirDNA, LLC., data on long-term rental listings from Craigslist, Census 5-year American Community Survey data for Census tract-level homeowner characteristics, and Bureau of Transportation Statistics data on monthly flights.

2.1 Data

2.1.1 Data on Airbnb STR Listings and Prices

I gather data on all Airbnb listings from both rural and urban Census tracts from the Chicago-Naperville-Elgin ("Chicago MSA" or "Chicago metro area"), Seattle-Tacoma-Bellevue ("Seattle MSA" or "Seattle metro area"), and Miami-Fort Lauderdale-West Palm Beach ("Miami MSA" or "Miami metro area") MSAs spanning October 2014 to October 2022. Licensed from AirDNA, LLC, a third-party STRs data provider, this data has been instrumental in economic, marketing, and tourism studies related to Airbnb (Calder-Wang, 2021; Li et al., 2021; Buzzachi et al., 2023). For each property listed, the dataset from AirDNA includes detailed property characteristics, such as a unique identifier for the host, the property's longitude and latitude (accurate within a 500 meter radius), listing type (whether it is an entire home/apartment, shared room, private room, or hotel room), the number of bedrooms and bathrooms, various amenities, and an identifier for the host of the listing. At the monthly level, the dataset provides property performance including revenue, available

[7] Li, et al. (2019) interprets mortgage pressure as a fixed cost of choosing to supply an investment property as a STR over a LTR or to leave the property vacant, but this may create some misinterpretation of costs associated with homeownership that likely results in a model misspecification. This is because owners must pay mortgage payments, property taxes, and other costs associated with homeownership no matter what they choose to do with their property.

[8] Specifically, the Bartik instrument from Barron, Kung and Proserpio (2020) interacts a plausibly exogenous time-series (Google trend for Airbnb-related search words) to capture shocks to the STR markets with a potentially endogenous cross-sectional exposure variable (the "touristiness" of different zipcodes as measured by local hotel occupancy rates).

days, reserved days, average daily rate (including cleaning fees charged for each booking), and occupancy rate. At the daily level, the dataset provides whether each listing was booked, the date that the property was booked, and the price.

As a snapshot of relevant trends in equilibrium quantities sold over time, Figure 1 shows Airbnb's monotonic growth in terms of deseasonalized booked days prior to 2020 and the COVID-19 pandemic's disruption of this growth in 2020 across the three metro areas surrounding Chicago, Seattle, and Miami.[9] Aggregate booked days dropped from around 15,000 booked days above seasonal average in January 2020 to close to 20,000 below seasonal average by June 2020.

Figure 1: Booked days on Airbnb relative to the seasonal average. This provides a deseasonalized aggregate measure of equilibrium quantities sold in markets for Airbnb listings, which allows a clear view of how sharply the COVID-19 pandemic disrupted Airbnb bookings, even after accounting for seasonal patterns of demand for tourism. The dotted line indicates March 2020, which is the month when the U.S. declared the COVID-19 pandemic a national emergency.

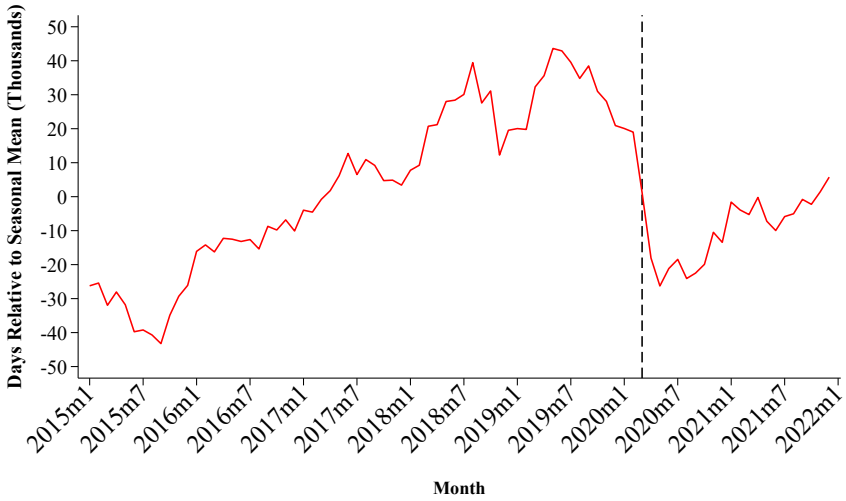


Table 1: Key annual metrics demonstrating that a mix of revenue-side shocks and cost-side shocks to STRs on Airbnb likely resulted in a decline in total booked days during the pandemic years 2020 and 2021 compared to 2019. The last three rows show the percentage change in each metric from 2019 to 2020, 2020 to 2021, and 2019 to 2021, respectively.

Year	Total Days Booked	Total Revenue Net of Cleaning Fees($)	Mean Price of Reserved Booking ($)	Mean Cleaning Fee Per Reservation ($)
2015	955,917	112,574,504	130	37
2016	1,874,731	225,066,048	130	39
2017	2,468,590	311,982,560	132	47
2018	3,122,017	397,125,088	133	55
2019	3,445,313	435,931,744	135	55
2020	2,030,480	253,766,800	132	69
2021	2,086,197	328,407,616	160	81
%Δ 2019-2020	–41	–42	–2	24
%Δ 2020-2021	3	29	22	18
%Δ 2019-2021	–39	–25	19	47

[9]Note that it is well known that STR markets are highly seasonal due to being part of the tourism industry(Calder-Wang, 2021). However, because the focus of this paper is on homeowners' behavior in response to the COVID-19 pandemic's disruption to seasonal trends in demand and supply, I have deseasonalized most relevant data series in my charts to allow for easier visualization of changes in quantities and prices reflecting the pandemic's disruption, with the exception of Figure 2, since there are fewer data points due to the shorter period of the Craigslist data in these graphs.

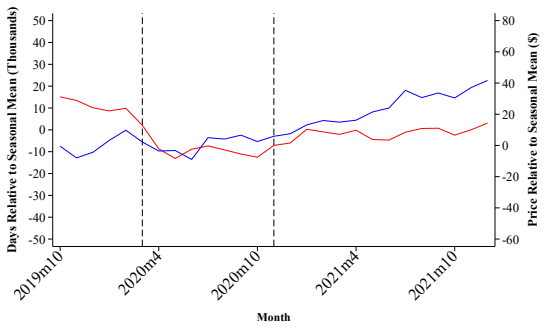
Overall, Table 1 above shows that Airbnb revenue net of cleaning fees declined by 41% and total booked days declined by 42% between 2019 and 2020. Meanwhile, average cleaning fee per reservation increased by 47% and average price increased dramatically by 19% from 2019 to 2021. These statistics demonstrate that the pandemic-induced shocks to STR hosts were likely a mix of shorter term, uncertain demand-side shocks and longer-term cost-side shocks. An example of these longer-term cost-side shocks is higher cleaning costs due to Airbnb's mandate of a new, stricter cleaning process for STR hosts beginning in November 2020.

In this paper, I focus on demand shocks to the STR markets rather than supply shocks because demand shocks were unprecedented and uncertain in duration, and they reveal how STR hosts may respond to financial risk under these conditions. Furthermore, the extent of cost shocks to the LTR markets were largely unobserved. This is because hosts can charge an explicit cleaning fee to guests, include cleaning costs in their nightly rates, or decide on a combination of these two. Assuming that Airbnb is a monopolistic competitive market that offers differentiated goods (Boto-Garcia, Mayor, & De la Vega, 2021; Gunter & Onder, 2017), hosts can pass through some of these increases in costs to guests, whether through higher explicit cleaning fees charged to guests or higher STR daily prices during the pandemic. Since my instrument relies on the exogeneity of the 2020 pandemic shift in the seasonal trends in flights to each metro area, it is unlikely that my instrument is correlated with these cost shocks. To address any possibility that these STR cost shocks correlate with my instrument for demand—even though it is plausible that these are uncorrelated—I include as controls national costs of utilities, maintenance, and cleaning supplies using corresponding national CPI indicators.

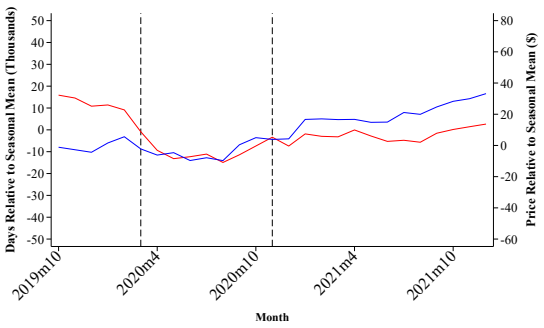
Besides the long-run rise in cleaning costs and prices, Table 1 shows that STR demand recovered somewhat in 2021. Total booked days increased by 45% between 2020 and 2021, though these metrics had not recovered yet to 2019 levels. The partial recovery in 2021 is correlated with the introduction of the first COVID-19 vaccine for most of the population in December 2020 (U.S. Food & Drug Administration, 2021). My results focus on analyzing the short-run effects of COVID-19-induced shocks to STRs in 2020. However, vaccinations may quell some demand uncertainty for STRs in 2021—a contrast to 2020. Future research can extend current results through 2021 by using different instruments to capture demand shocks after the 2020 COVID-19 period.

However, we can still see the clear effects of demand shocks on the STR markets in the data. I graph the deseasonalized total booked days and mean prices during the pandemic in Figure 2, which shows that these series are on average positively correlated. Total booked days and mean prices including cleaning fees have correlation coefficients of 0.74, 0.83, and 0.70 for the Chicago, Seattle, and Miami metro areas between March 2020 and December 2021. The positive co-movement of STR quantities and prices shows that during the 2020 pandemic, demand shocks to the Airbnb STR markets had greater effects in the short run than cost shocks from increased cleaning costs. This features even more prominently when comparing mean prices after netting out explicitly charged cleaning fees in blue to total days booked in red for each metro area, even though this does not net out cleaning costs that hosts may include in their pricing of nightly rates.

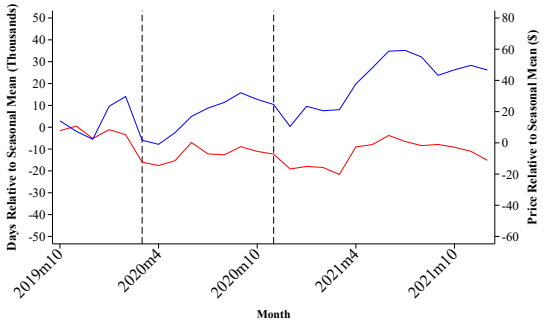
Figure 2: Deseasonalized Airbnb STR mean prices net of cleaning fees in blue and total days booked for Airbnb listings in red are shown for the Chicago, Seattle, and Miami MSAs, respectively, in (a), (b), and (c). The first dotted line marks March 2020, when the COVID-19 pandemic was declared a national emergency, and the second dotted line marks November 2020, when Airbnb mandated a new five-step cleaning process for hosts.



(a) Chicago MSA



(b) Seattle MSA



(c) Miami MSA

Other trends in the Airbnb data help to motivate my identification strategy. Table 2 shows that the average STR reservation length increased during the pandemic, reflecting a shift away from short-term tourists to longer-staying remote workers (Airbnb, Inc., 2020a). My identification strategy exploits this trend by assuming that the effects of demand shocks on STRs during the pandemic differed according to the extent to which different STR markets (defined as a Census tract-month) relied on tourist travel for demand before the pandemic.

As motivation for studying the heterogeneous effects of the pandemic-induced demand shocks, Table 2 shows that the mix of properties on Airbnb changed during the pandemic, which strongly suggests heterogeneous effects of COVID-19 shocks on homeowner exit decisions from STR markets at least along the dimensions of number of bedrooms and listing type. In particular, Airbnb listings that were shared rooms fell the most during the pandemic in 2020, followed by private rooms, and then entire homes. Moreover, the average number of bedrooms on Airbnb increased over the course of the pandemic, suggesting that landlords of mid-sized properties on Airbnb may have been more affected by COVID-19 shocks.

Table 2: Annual trends in the types of properties listed and the length of stays on Airbnb. The mean reservation length is in terms of days, mean bedrooms is the average number of bedrooms across all properties, and other columns show the number of listings for each listing type. The last three rows show the percentage change in each metric from 2019 to 2020, 2020 to 2021, and 2019 to 2021, respectively.

Year	Mean Reservation Length	Mean Bedrooms	Active Listings	Entire Homes	Shared Rooms	Private Rooms
2015	3.78	1.31	17,910	10,882	660	6,368
2016	3.80	1.37	26,847	16,122	966	9,759
2017	3.60	1.43	30,411	18,619	853	10,939
2018	3.44	1.49	33,813	21,141	884	11,788
2019	3.30	1.53	36,110	23,516	980	11,614
2020	3.57	1.58	30,849	21,377	529	8,943
2021	3.45	1.63	26,821	19,785	289	6,747
%Δ 2020-2019	8.13	3.19	–15	–9	–46	–23
%Δ 2021-2020	-3.25	3.08	–13	–7	–45	–25
%Δ 2021-2019	4.62	6.37	–26	–16	–71	–42

2.1.2 Data on Long-Term Rental Listings and Prices

I use data on long-term rentals scraped from Craigslist, a classified ads website. This data runs from February 2017 through November 2023 for the Seattle metro area, February 2018 through November 2023 for the Miami metro area, and July 2018 through November 2023 for the Chicago metro area. While homeowners' usage of Craigslist may vary across regions and months, studies have employed scraped Craiglist data to study urban economics issues, such as the impact of housing development on gentrification and renter displacement (Pennington, 2021). Furthermore, Hess et al. (2021) finds that Craigslist listings may offer a more comprehensive data source for rental housing listings than at least other online platforms, finding that "the disproportionately commercial profile of properties advertised on Apartments.com captures a more socioeconomically selective range of neighborhoods than Craigslist, where both commercial and "mom and pop" landlords are likely to post rental vacancy advertisements" (Hess et al., 2021).

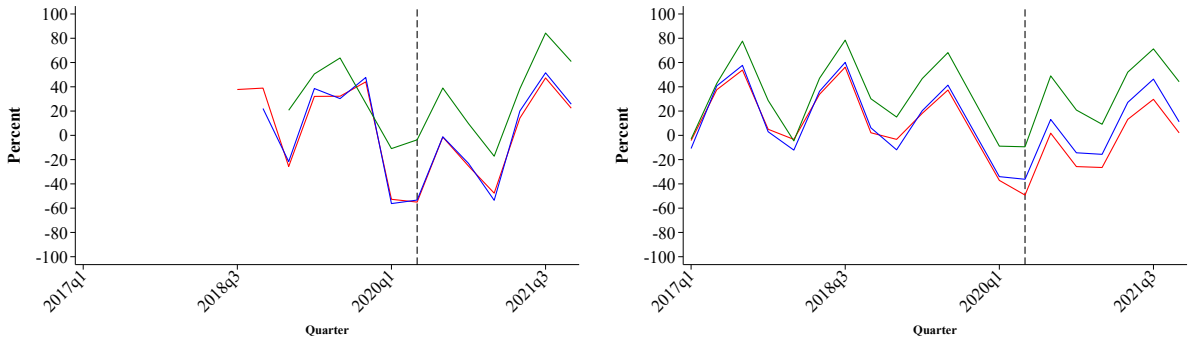
Notably, his paper is one of the first to even try modeling homeowners' decisions during the short-run by constructing a detailed, high-frequency (monthly) panel data that captures variation in listings, prices, and key property characteristics such as number of bedrooms for LTR markets. This approach diverges from related studies that employ structural models for homeowners' switching decisions between STR and LTR markets (Calder-Wang, 2021; Li et al., 2021). While these studies utilize a monthly panel for Airbnb listings, their parameter estimates and simulations rely on annual U.S. Census data, such as the American Housing Survey and the five-year American Community Survey, for LTRs. The advantage of building a monthly panel for LTR listings using Craigslist data is that I can study the short-term market exit decisions of Airbnb homeowners in response to uncertain and unprecedented short-term demand shocks. Meanwhile, much of the prior economic literature on the interaction of Airbnb with the long-term housing markets has modeled owners' property investment decision with a time horizon of a year, assuming that landlords make decisions for the usage of their property while taking tourism-related demand seasonality as expected and fixed.[10]

To motivate how the pandemic incentivized homeowners to switch between the STR and LTR markets,

[10]One exception is Barron et al. (2020), but they capture shocks through a Google trends variable that were not entirely unpredictable or uncertain like the pandemic shocks (Barron et al., 2020) Additionally, this variable can arguably capture both supply and demand shocks.

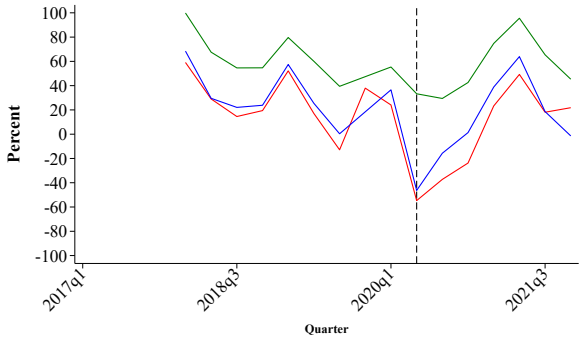
I plot how monthly Airbnb STR revenue compares to LTR rents from the Craigslist data at the median. Figure 3 shows that the growing demand for Airbnb STRs prior to 2020 suggests incentives in terms of revenue gains for homeowners with a vacant investment property to choose to list their property as a STR over a LTR. Furthermore, the premium of median STR revenue over LTR rent for each metro area fell into the negative range when the COVID-19 pandemic hit, and this was especially true for smaller properties that had zero to one bedrooms (in red) or two to three bedrooms (in blue). While costs for each option are not directly observed, these descriptive results provide some preliminary evidence of incentives for homeowners who had relied on Airbnb revenue to switch to the LTR during the pandemic, especially since it was uncertain as to how long the pandemic would last.

Figure 3: Percent difference between median STR revenue and median LTR rent for the Chicago, Seattle, and Miami MSAs, respectively, in (a), (b), and (c). In red are percent differences for zero to one bedroom entire homes, in blue are percent differences for two to three bedroom entire homes, and in green are percent differences for entire homes with greater than 3 bedrooms.



(a) Chicago MSA

(b) Seattle MSA



(c) Miami MSA

2.1.3 Data on Homeowner Demographics and Neighborhood Characteristics

To measure STR host demographics and neighborhood characteristics, I use the Census American Community Survey (ACS) Public Use Microdata. While the Airbnb dataset is high frequency and fairly detailed, it does not shed much light on Airbnb host demographics, except for the number of properties that the host listed on Airbnb and metrics related to the host's reputation on Airbnb, nor does it shed light on local characteristics of each property's neighborhood. However, the dataset is granular enough for me to link the geographic locations of Airbnb listings to geographies used in the U.S. Census data—particularly, at the

Census tract level. This enables a richer understanding of how STR host decisions to exit and to enter the LTR markets vary based on homeownership costs.

However, one limitation of the Census ACS is that it surveys the demographics of residents in each Census tract and does not include those of investment property owners who actually live in the Census tract. As a result, the most reliable factor from the ACS that enters into an investment property owner's liquidity constraint would be the costs associated with homeownership, as defined in footnote 1. While these are not directly the costs that STR hosts may be paying, there is a reasonably strong correlation between mortgage payments, property taxes, etc. paid by residential homeowners and investment property owners in the same Census tract. To supplement this measure for a complete picture of investment property owners' leverage and how it affects their exit decisions from Airbnb, my future work will incorporate average measures of investment property owners' income, credit score, DTI, and LTV at mortgage origination from the confidential Federal Housing Finance Agency (FHFA) National Mortgage Database (NMDB). This is a nationally representative five percent sample of closed-end first-lien residential mortgages in the U.S (Federal Housing Finance Agency, 2024).

2.2 Identification Strategy

2.2.1 Goals for Identification and Estimation

This paper has two sets of goals for identification and estimation using the pandemic-induced demand shocks to the STR markets that I capture with my instrument instrument. My first set of goals is to identify and estimate the average effects of pandemic-induced demand shocks to the STR markets on (a) Airbnb STR exits through equilibrium changes in STR prices and (b) LTR entries from these exiting Airbnb STRs. As a second set of goals, I aim to identify and estimate the heterogeneous effects of pandemic-induced demand shocks to the STR markets on dependent variables (a) and (b) along homeowner demographics measured prior to the onset of the pandemic that can impact their liquidity constraints and therefore their exposure to Airbnb income risk.

2.2.2 Motivation

As motivating evidence for how the pandemic reduced demand from the usual tourists for Airbnb STRs, Airbnb's financial documents from 2020 state that "[many] of our hosts have been severely impacted by COVID-19, with increased cancellations and a drop in booking" and that "many of our guests have been unable to travel during the COVID-19 pandemic." On a more positive note, Airbnb states also that "starting in the second half of 2020, demand from guests grew year-over-year for stays less than 50 miles and within 50-300 miles from guest origin and long-term stays, or stays on our platform of at least 28 nights. We believe the way people travel will fundamentally change."(Airbnb, Inc., 2020a)

To evaluate the extent to which Airbnb's characterization of these demand shifts in the pandemic environment applies to the three metro areas covered in this paper, I plot the average reservation length in Figure 4, which shows that average reservation length relative to the seasonal average increased by one day. At first glance, this change could have three driving factors: a fall in demand due to fewer short-term tourists traveling during the COVID-19 lockdowns, an increase in longer-term stays from locals, or a mix of these. Furthermore, this could differ depending on the metro area. To distinguish between these driving factors, I show the distribution of average reservation lengths of Airbnb reservations in Table 3 separately for each of the three metro areas. In the Chicago and Seattle metro areas, it is clear that the overall number of reser-

vations fell substantially, and the length of stays only increased for the top quintile of Airbnb reservations between 2019 and 2020. Thus, for Chicago and Seattle, demand from shorter-term tourists fell substantially, and demand from longer-term residents did not increase by much. Meanwhile, the Miami metro area both experienced a decrease in the overall number of reservations, and the length of stays decreased slightly. Since Miami and the surrounding areas (e.g., West Palm Beach) tend to be tourist destinations more so than Chicago and Seattle, this may just reflect that there was an overall drop in demand for Airbnb STRs from short-term tourists with no significant increase in demand for Airbnb STRs from longer-term locals.

Figure 4: Deseasonalized average STR reservation lengths over time in the Chicago, Seattle, and Miami metro areas. The dotted line marks March 2020, when the U.S. declared a nationwide emergency for the COVID-19 pandemic.

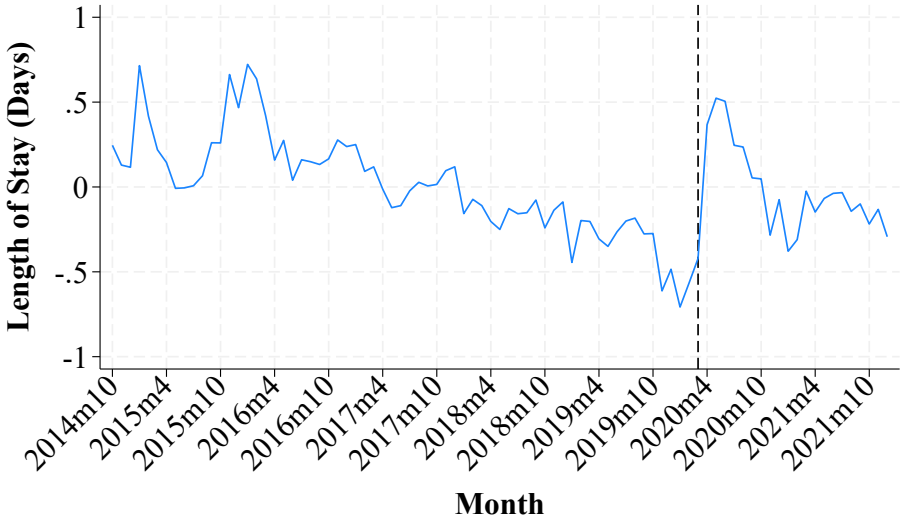
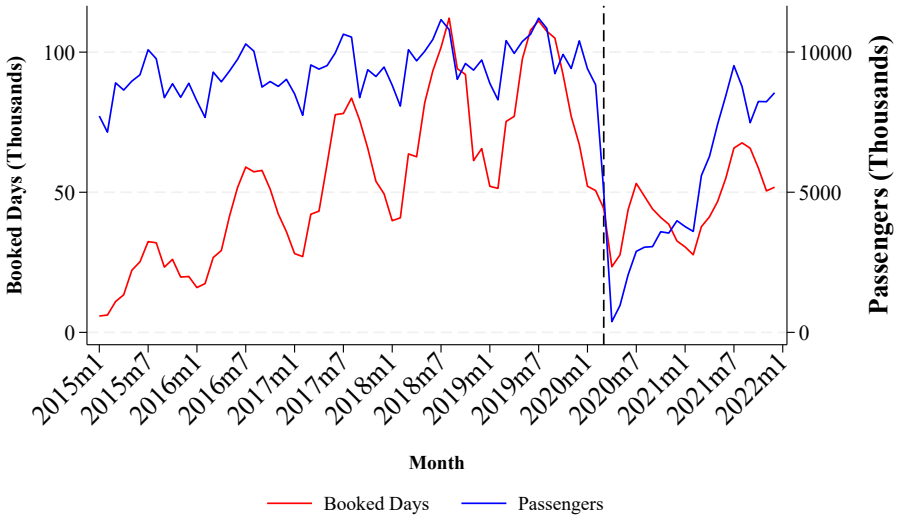


Table 3: Statistics showing the distribution of Airbnb reservation lengths for each of the three metro areas in 2019 and 2020. Since the pandemic starts in March 2020, the data in this table includes only March through December for the corresponding year shown in the second column.

MSA	Period	Reservations	Mean	Std Dev	Min	p5	p10	p25	p50	p75	p90	p95	Max
Chicago	2019	299,179	3.12	2.96	1	1	1	2	2	4	5	7	51
Chicago	2020	152,077	3.38	4.05	1	1	1	1	2	4	6	9	55
Seattle	2019	389,444	3.22	3.19	1	1	1	1	2	4	6	7	54
Seattle	2020	194,112	3.57	4.19	1	1	1	1	2	4	7	9	55
Miami	2019	261,151	3.87	3.7	1	1	1	2	3	5	7	9	53
Miami	2020	142,028	3.47	3.82	1	1	1	1	2	4	7	8	55

Based on this evidence, it is clear that the 2020 COVID-19 pandemic induced negative demand shocks to STRs by reducing demand for shorter term accommodations from tourists. Since tourists rely on flights to travel to a metro area, it is natural to measure seasonal patterns of demand from tourists for Airbnb STRs for each calendar month using flights to the MSA. We can observe the correlation in seasonality between Airbnb bookings and flights prior to the pandemic in Figure 5, as well as the disruption of these seasonal patterns of travel and bookings.

Figure 5: Seasonal patterns in the total days booked on Airbnb across all listings (in red) in the three metro areas studied compared to the seasonal patterns in total flights (in blue) to the three metro areas covered by the data. The dotted line indicates March 2020, when the U.S. declared the COVID-19 pandemic as a national emergency.



2.2.3 Instrument Definition

In my research design, I define a market for Airbnb STRs as a specific month and Census tract combination, assuming that homeowners make decisions for the usage of their properties on a monthly basis. My instrument interacts a dummy variable that indicates treatment—a month is on or after March 2020—and exogenous shares of STR market exposure to this shock—a variable for the share of annual flights across all three metro areas that occurred before the pandemic. This is a continuous difference-in-differences research design because exposure to treatment is measured by the share of annual flights, which is a continuous variable. Specifically, I construct each market's pre-pandemic seasonal exposure to tourism using the corresponding calendar month's annual share of flights for the corresponding metro area averaged across 2014 through 2017[11] This variable reflects a given calendar month's pre-pandemic popularity with short-term travelers, and during the pandemic, a higher volume of visitors for a calendar month prior to the pandemic would indicate greater negative demand shocks for the corresponding month in 2020.

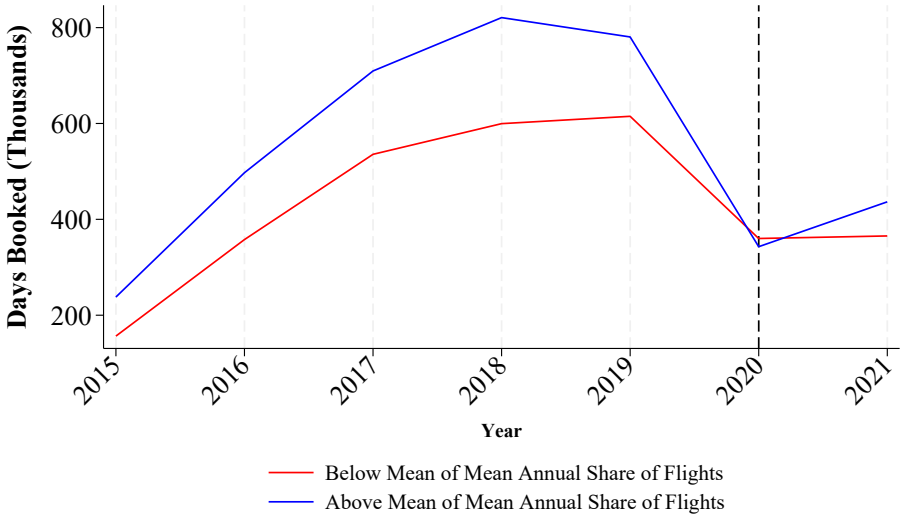
For estimating average effects of STR demand shocks on Airbnb market exits and entry into the LTR markets, the validity of this instrument relies on two assumptions. First, I assume a strong version of parallel trends following the continuous diff-in-diff literature (Callaway et al., 2024). This means that calendar months that had higher relative pre-pandemic tourism levels would have experienced the same growth paths for Airbnb listings and LTR listings as other months during the pandemic, if it was not for the greater tourism levels that these months had received prior to the pandemic. Second, to interpret the effects on these outcome variables as stemming from the drop in demand for STRs, another exclusion restriction is that pre-pandemic annual seasonal shares of flights–calculated for each MSA and calendar month–are orthogonal to other unobserved shocks to the STR and LTR markets that happened during the pandemic. Defining my exposure to treatment as seasonal trends in demand varying across calendar months rather than variation in demand across geographic regions or across years has a few advantages. This approach

[11] This is constructed using monthly data on flights from the Bureau of Transportation Statistics.

avoids reliance on variation in COVID-19 cases, which could inadvertently capture unobserved shocks to the LTR markets, such as tenant hesitancy to move. My approach using pre-pandemic seasonal variation also avoids reliance on spatial variation in pre-pandemic tourism, which could correlate with spatial trends in unobserved pandemic-induced shocks to LTR markets (Monte, Porcher, & Rossi-Hansberg, 2023).

Furthermore, I do a visual robustness check for parallel trends by first computing the mean across markets of the mean annual flight shares for each calendar month. Then, I separate markets into two groups: those that are above this mean of means and those that are below. Finally, in Figure 6, I plot over years the aggregate daily booked rooms for Airbnb STRs for each of these groups. Figure 6 demonstrates that the growth paths of Airbnb booked rooms for markets above and below the mean exposure to treatment are similar and mostly parallel, with the pandemic shock indicated by the dotted line clearly disrupting these parallel trends and pulling down the number of booked rooms for markets above the mean to about the same level as for those below the mean.

Figure 6: After calculating the mean across markets of the year-over-year mean annual flight shares for each calendar month and metro area, this shows the aggregated daily booked rooms year-over-year for markets that are above and below this mean of means.



Given the presence of COVID-19-induced cost-side shocks to the STR market like increased cleaning costs, I include additional control variables to help separately identify the effects of COVID-19-related demand shocks from the effects of cost shocks, as can be seen in the Appendix tables. These include year-over-year first differenced values of national U.S. consumer price indices (CPIs) tracking the costs of home maintenance and repairs, utilities, furnishings, household equipment, and housekeeping supplies.

However, it is important to interpret the heterogeneous effects I estimate as more descriptive than causal because costs associated with homeownership could be correlated with other unobserved homeowner characteristics. For example, costs associated with homeownership could be correlated with employment in the tourism industry across Census tracts, which may have produced differential shocks to homeowners' income streams unrelated to their Airbnb sharing economy participation. Furthermore, a demand-side explanation for why I observed these heterogeneity in effects for two to three bedrooms and properties in higher cost areas could be that these properties were the most attractive to tourists before the pandemic and so these

segments of the STR markets were hit hardest by the shock captured by my instrument.

To show that my results support the liquidity constraints explanation for why homeowners in areas with higher homeownership costs or homeowners of two to three bedroom properties tend to exit Airbnb at higher rates, my future work will leverage other more direct proxies for liquidity constraints at the market-level like DTI and LTV from the FHFA NMDB. I will do so to verify that investment property owners in areas with higher average values of these metrics also tended to have higher mean exit rates from Airbnb during the pandemic. Results from this analysis—while still not conclusive—may provide more support for the theory that choosing between STR and LTR options involves a trade-off between a risky short-term investment from listing a property on Airbnb and a long-term contract with a fixed income stream from renting a property to a tenant, so more liquidity constrained homeowners have a larger incentive to substitute away from the STR markets to the LTR markets in an environment of uncertain demand shocks.

As for relevance, the motivating descriptive results described in Section 2.2.2. demonstrate that my instrument is highly relevant. Furthermore, the first stage F-statistics in my results for the 2SLS and 3SLS regressions in Section 3 also support the strength of my instrument. Overall, my instrument's relevance relies on the highly plausible assumption that demand for each calendar month during the pandemic relative to the previous year varies based on the month's average pre-pandemic annual share of tourists traveling to the metro areas.

3 Estimation and Results

3.1 Reduced Form Effects on Airbnb Listings

First, I present a reduced form model and results to show that the COVID-19 pandemic's disruption to seasonal patterns of tourism created large, negative demand shocks on Airbnb listings and that these shocks had heterogeneous effects for different demographics of homeowners. Let c be a Census tract, m be a calendar month, and y be a year. Let $\text{PostCOVID}_{m,y}$ be a dummy indicating whether a market is on or after March 2020, the start of the COVID-19 pandemic in the U.S. I define the exposure shares variable measuring pre-pandemic levels of tourism as the annual share of flights arriving in the relevant metro areas for the relevant calendar month m in prior years, which I denote as $\overline{\text{Shares}}_m = \frac{1}{2017-2015}\sum_{y=2015}^{2017}\text{Shares}_{m,y}$.[12]. My reduced form equation estimating the effects of COVID-19 shocks on Airbnb STR active listings is

$$\begin{aligned}\%\Delta\text{AirbnbListings}_{c,m,y} = \alpha_1\text{PostCOVID}_{m,y} \times \overline{\text{Shares}}_m \\ + \text{CostShocks}_{m,y} + \%\Delta\eta_y + \%\Delta\epsilon_{c,m,y}\end{aligned} \tag{1}$$

Given that the identifying assumptions from Section 4 hold, the coefficient of interest in this equation is α_1, the causal effect of 1 pp greater pre-pandemic tourism exposure (and therefore greater demand shock) on the change in supply for Airbnb listings for calendar month m in the metro area for Census tract c. [13]

[12] I define the shares using data before 2018 because this allows for enough periods of pre-pandemic data (2018 and 2019) to test the difference-in-differences assumption that calendar months with different levels of pre-period shares had parallel pre-trends in my dependent variables, after conditioning on control variables for cost shocks and the fixed effects. This assumption is important for validity.

[13] This equation results from taking relative differences year-over-year of a regression of the level of Airbnb listings $\text{AirbnbListings}_{c,m,y}$ on $\overline{\text{Shares}}_m$, $\text{PostCOVID}_{m,y} \times \overline{\text{Shares}}_m$, cost levels $\text{Costs}_{m,y}$, Census tract fixed effects, calendar month fixed effects, and year fixed effects. This eliminates Census tract fixed effects, calendar month fixed effects, and the demand seasonality in the absence of COVID-19 captured by $\overline{\text{Shares}}_m$. Furthermore, first differencing constructs a differenced year trend fixed effect $\%\Delta\eta_y$ on the right hand side. A first differenced equation makes more sense than two-way fixed effects here because two-way fixed effects is only efficient if the error terms in a regression in terms of levels are serially uncorrelated

To further improve causal interpretation of my results, I control for cost shocks that may possibly correlate with $\overline{\text{Shares}}_m$ using first differenced national CPI indicators for costs associated with maintaining a STR for guests, which are shown in tables in the Appendix.

My main estimation results for Equation 1 are reported in Table 4. I find that an additional 1 pp greater average share of flights for a calendar month in a metro area decreased active Airbnb listings by 2 pp on average for private rooms and 2.8 pp for entire homes.[14] Furthermore, the effects on market exits are strongest for two to three bedroom homes. This provides some support for the theory that liquidity constraints might play a role in exit decisions, perhaps since homeowners who own two or three bedroom homes do not have as much wealth as those with greater than three bedroom homes, but their mortgage payments and other costs associated with homeownership are higher than homeowners of studios and one bedroom homes.

Table 4: Reduced form effects of COVID-19 demand shocks on year-over-year changes in Airbnb listings, after controlling for cost shocks and fixed effects detailed. For full regression results, see Table A.1 Results exclude heterogeneous effects of tourism-related demand shocks along homeowner demographics. Robust standard errors clustered at the Census tract level are in parentheses. Data used is from the Chicago, Seattle, and Miami MSAs from 2018 through 2020.

	(1)	(2)	(3)	(4)	(5)
Variables	Private Rooms	Entire Homes	0-1 Bedroom Entire Homes	2-3 Bedroom Entire Homes	>3 Bedroom Entire Homes
$\text{PostCOVID}_{m,y} \times \overline{\text{Shares}}_m$	-1.997***	-2.104***	-1.831***	-2.011***	-1.244***
	(0.174)	(0.131)	(0.170)	(0.154)	(0.228)
Observations	62,549	71,975	45,808	52,112	23,279

*** p<0.01, ** p<0.05, * p<0.1

To explore how homeowners' financial conditions affects their Airbnb STR market exit decisions in response to uncertain demand shocks, I run another set of regressions showing that tourism-related demand shocks have heterogeneous effects on the year-over-year change in Airbnb listings for markets with different homeowner demographics. I include terms that interact my instrument for average demand shocks for each calendar month and MSA with median monthly costs of homeownership, median income, and mean number of properties owned Airbnb hosts in each Census tract. For median monthly homeownership costs and income, I use Census tract-level data available from the 2020 Census 5-year ACS data. For the median number of properties owned by Airbnb homeowners in each Census tract HostProperties_c, I take the median of the maximum number of properties that each Airbnb host listed across years for each Census tract and then subtract the median across Census tracts. This provides a de-medianed measure of Airbnb ownership concentration.

My results for heterogeneous effects of tourism-related demand shocks are shown in Table 5. I find that the effects of these demand shocks on changes in Airbnb listings are negative and greater in magnitude for Census tracts with median homeownership costs above the mean across Census tracts, which include mortgage payments and property taxes. Furthermore, the effects of the terms interacting my instrument and homeownership costs is greatest for two to three bedroom homes, out of the other categories of entire homes. Specifically, for every $1000 of median homeownership cost above the mean across Census tracts,

(Wooldridge 2001). This is unlikely because Airbnb listings were growing year-over-year prior to the pandemic and so the error terms $\epsilon_{c,m,y}$ in a regression prior to first differencing YoY likely follows a random walk instead, in which case first relative differences year-over-year is more efficient.

[14] As a caveat, it is hard to say how the demand shocks affected shared rooms based on these results, since there are not quite enough observations of these listings for the F-statistic to indicate joint significance of all covariates.

the corresponding Census tract experienced 0.9 pp greater Airbnb exits (decrease in Airbnb listings year-over-year) on average for entire homes overall, 0.82 pp on average for zero to one bedroom homes, 0.9 pp on average for two to three bedroom homes, and 0.86 pp on average for greater than three bedrooms. It is interesting to note that these heterogeneous effects are greatest for two to three bedroom properties. One possible explanation may be that these homeowners are most impacted by the demand shocks since they are more leveraged–they are not as wealthy as owners of larger properties but they also have higher mortgage payments and other costs of homeownership than owners of smaller properties. However,

As a measure of Airbnb ownership concentration, I also include a term that interacts my instrument with HostProperties_c, as defined above. I find that when a Census tract's median number of properties owned by each host is greater than the median across Census tracts by one property, that Census tract experienced a 0.01 pp greater Airbnb exits for two to three bedroom homes. However, the effects are not statistically significant for properties of other sizes. Owners of two to three bedroom homes are more prone to exit on average in response to the pandemic STR demand shocks if they have properties in areas with higher ownership concentration of Airbnb properties. This is a somewhat surprising finding relative to the tourism studies literature on Airbnb. These studies have largely found that "professional" hosts with a greater number of properties tend to have price setting power, so we would expect them to adjust prices in reaction to demand shocks rather than exiting the STR markets (Boto-Garcia et al., 2021; Buzzachi et al., 2023). While this part of my results are more descriptive than causal, it is possible that owners of properties with two to three bedrooms in particular are more prone to exit when they have the cost burden of paying for mortgages, property taxes, etc. on multiple properties.

While the heterogeneous effects of tourism-related demand shocks along homeowner income of tourism-related demand shocks appear to be negative and statistically significant for two to three bedroom homes, I find that the median income variable as a measure of homeowner income is noisy. I draw this variable from the ACS data, which provides median income of residents for each Census tract, but many homeowners who participate on either the STR market or the LTR market may not necessarily live in the same neighborhood as the property that they are leasing out. This means that the median income for the Census tract I use for the second row in Table 5 may not reflect the income of homeowners who would list their property on the STR or the LTR market. Instead, the negative coefficients in the second row could reflect the fact that Census tracts where neighboring residents to a STR have higher income tend to have homes with higher mortgages in general, which would pressure Airbnb hosts who own properties in those neighborhoods to exit the market. Further work on characterizing how homeowners with different income responded to tourism-related demand shocks will require a more precise measure of homeowner income at the Census tract level.[15]

[15]For example, my future work can use borrower income at the time of mortgage origination on investment properties from the confidential FHFA NMDB.

Table 5: Reduced form effects of COVID-19 demand shocks on year-over-year changes in Airbnb listings, after controlling for cost shocks and fixed effects. For full regression results, see Table A.2. Results include heterogeneous effects of tourism-related demand shocks along homeowner demographics. HostProperties_c is a measure of Airbnb ownership concentration defined as the maximum number of properties that Airbnb hosts listed across years. Robust standard errors clustered at the Census tract level are in parentheses. Data used is from the Chicago, Seattle, and Miami MSAs from 2018 through 2020.

	(1)	(2)	(3)	(4)	(5)
Variables	Private Rooms	Entire Homes	0-1 Bedroom Entire Homes	2-3 Bedroom Entire Homes	>3 Bedroom Entire Homes
$\text{PostCOVID}_{m,y} \times \overline{\text{Shares}}_m$	-1.849***	-1.928***	-1.769***	-1.922***	-1.214***
	(0.180)	(0.137)	(0.169)	(0.156)	(0.229)
$\text{PostCOVID}_{m,y} \times \overline{\text{Shares}}_m$	-1.170***	-0.949***	-0.823***	-0.902***	-0.856***
$\times$ Median Homeownership $\text{Costs}_{c,2020}$	(0.313)	(0.192)	(0.264)	(0.209)	(0.255)
$\text{PostCOVID}_{m,y} \times \overline{\text{Shares}}_m$	-0.008	-0.020	0.031	-0.046*	0.026
$\times$ Census Tract Median $\text{Income}_{c,2020}$	(0.042)	(0.026)	(0.036)	(0.028)	(0.035)
$\text{PostCOVID}_{m,y} \times \overline{\text{Shares}}_m$	0.021	-0.001	-0.003	-0.010***	-0.001
$\times$ HostProperties_c	(0.026)	(0.014)	(0.012)	(0.013)	(0.011)
Observations	60,619	70,811	45,109	50,874	22,934

*** p<0.01, ** p<0.05, * p<0.1

3.2 2SLS Estimates of STR Supply Price Elasticities

Given these reduced form results showing heterogeneous effects of COVID-19 demand shocks across homeowner demographics, I leverage my instrument, along with my control variables, to obtain simple estimates of average STR market price elasticities of supply. These measure the sensitivity of changes in Airbnb listings to changes in mean STR prices induced by COVID-19 demand shocks. Overall, I find that two to three bedroom owners of entire homes tended to be the most sensitive to price changes induced by COVID-19 demand shocks, and a possible explanation for this is that these property owners may be more leveraged. To provide more support for this explanation, my future work will include richer measures of leverage for investment property owners, which will include Census-tract level mean debt-to-income ratio, mortgage loan-to-value ratios, and mortgage origination credit scores from the confidential version of the FHFA NMDB.

For now, I run the following two-stage least squares model:

$$\begin{aligned}\%\Delta\text{MeanAirbnbPrice}_{c,m,y} &= \beta_1 \text{PostCOVID}_{m,y} \times \overline{\text{Shares}}_m \\ &+ \beta_2 \text{PostCOVID}_{m,y} \times \overline{\text{Shares}}_m \times \text{HomeownershipCosts}_{c,2020} \\ &+ \beta_3 \text{PostCOVID}_{m,y} \times \overline{\text{Shares}}_m \times \text{HostProperties}_{c,2020} \\ &+ \text{CostShocks}_{m,y} + \%\Delta\nu_{c,m,y} \qquad (2.1)\end{aligned}$$

$$\%\Delta\text{AirbnbListings}_{c,m,y} = \theta_1 \%\Delta\text{Mean}\widehat{\text{Airbnb}}\text{Price}_{c,2020} + \text{CostShocks}_{m,y} + \%\Delta\nu_{c,m,y} \qquad (2.2)$$

where cost shocks are terms for the same control variables and fixed effects that I included in Equation (1). The coefficient of interest here is θ_1 in the structural equation (2.2) which can be interpreted as the average STR supply price elasticity across markets (Census tract and month combinations) during the 2020 pandemic.

The results, including the first stage F-statistic, are shown in Table 6. On average, 1 pp change in price leads to about 1 pp change in Airbnb private rooms, 1.8 pp change in zero to one bedroom homes, 2.2

pp change in two to three bedroom homes, and 0.6 percentage point change in greater than three bedroom homes. These results show that not only did two to three bedroom properties exit at higher rates in response to the pandemic demand shocks, but also that they tended to respond to these negative demand shocks by exiting the STR markets rather than lowering prices.

Table 6: Two-staged least squares estimates of STR supply price elasticities. Robust standard errors clustered at the Census tract level are in parentheses. Mean number of properties owned by Airbnb hosts is defined as the mean of the maximum of the number of Airbnb listings owned by the host of each Airbnb listing between the current year or the previous year. Data used is from the Chicago, Seattle, and Miami MSAs from 2018 through 2020. See Table A.3 for full regression results.

	(1)	(2)	(3)	(4)	(5)
Variables	Private Rooms	Entire Homes	0-1 Bedroom Entire Homes	2-3 Bedroom Entire Homes	> 3 Bedroom Entire Homes
%Δ Mean Airbnb Price	0.996***	2.452***	1.825***	2.207***	0.635**
	(0.220)	(0.342)	(0.259)	(0.267)	(0.305)
First Stage F-Statistic	18.10	21.33	19.40	25.31	10.36
Observations	59,016	69,550	44,381	49,773	22,118

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

I also quantify exactly how price sensitivity of STR hosts changes with the maximum number of Airbnb properties operated across years and homeownership costs, which can be compared later to similar average supply price sensitivity of homeowners estimated using pre-pandemic data. To do so, I run two additional first stage equations:

$$\begin{aligned}\%\Delta\text{MeanAirbnbPrice}_{c,m,y} \times \text{HomeownershipCosts}_{c,2020} &= \beta_1^{HC}\text{PostCOVID}_{m,y} \times \overline{\text{Shares}}_m \\ &+ \beta_2^{HC}\text{PostCOVID}_{m,y} \times \overline{\text{Shares}}_m \times \text{HomeownershipCosts}_{c,2020} \\ &+ \beta_3^{HC}\text{PostCOVID}_{m,y} \times \overline{\text{Shares}}_m \times \text{HostProperties}_{c,2020} \\ &+ \text{CostShocks}_{m,y} + \%\Delta\nu_{c,m,y}^{HC} \qquad (3.1)\end{aligned}$$

$$\begin{aligned}\%\Delta\text{MeanAirbnbPrice}_{c,m,y} \times \text{HostProperties}_{c,2020} &= \beta_1^{HP}\text{PostCOVID}_{m,y} \times \overline{\text{Shares}}_m \\ &+ \beta_2^{HP}\text{PostCOVID}_{m,y} \times \overline{\text{Shares}}_m \times \text{HomeownershipCosts}_{c,2020} \\ &+ \beta_3^{HP}\text{PostCOVID}_{m,y} \times \overline{\text{Shares}}_m \times \text{HostProperties}_{c,2020} \\ &+ \text{CostShocks}_{m,y} + \%\Delta\nu_{c,m,y}^{HP} \qquad (3.2)\end{aligned}$$

Since I have now endogenized two additional variables (the interactions of y-o-y changes in the mean Airbnb price with these homeowner demographics), these predicted dependent variables on the left hand side can enter as inputs into a new structural equation:

$$\begin{aligned}\%\Delta\text{AirbnbListings}_{c,m,y} &= \theta_1\%\Delta\widehat{\text{MeanAirbnbPrice}} \\ &+ \theta_2\%\Delta\widehat{\text{MeanAirbnbPrice}} \times \text{HomeownershipCosts}_{c,2020} \\ &+ \theta_3\%\Delta\widehat{\text{MeanAirbnbPrice}} \times \text{HostProperties}_{c,2020} + \text{CostShocks}_{m,y} + \%\Delta\nu_{c,m,y} \qquad (4)\end{aligned}$$

where the coefficients of interest are θ_1, θ_2, and θ_3. My estimates for these elasticities are shown in Table 7

below:

Table 7: Two-staged least squares estimates of STR supply price elasticities, including heterogeneity of elasticities across homeowner demographics. Robust standard errors clustered at the Census tract level are in parentheses. Mean number of properties owned by Airbnb hosts is defined as the mean of the maximum of the number of Airbnb listings owned by the host of each Airbnb listing between the current year or the previous year. Data used is from the Chicago, Seattle, and Miami MSAs from 2018 through 2020.

	(1)	(2)	(3)	(4)	(5)
Variables	Private Rooms	Entire Homes	0-1 Bedroom Entire Homes	2-3 Bedroom Entire Homes	> 3 Bedroom Entire Homes
%Δ Mean Airbnb Price	2.045***	2.397***	2.109***	1.825***	1.978*
	(0.355)	(0.482)	(0.300)	(0.276)	(1.018)
First Stage F-Stat	18.10	21.33	19.40	25.31	10.36
%Δ Mean Airbnb Price	1.849**	1.209*	0.478	1.502**	1.970
× Median Homeownership Costs$_{c,2020}$	(0.777)	(0.701)	(0.422)	(0.674)	(2.733)
First Stage F-Stat	3.028	3.051	3.971	3.520	1.069
%Δ Mean Airbnb Price	-0.025***	-0.010*	-0.006*	-0.006	-0.015*
× HostProperties$_c$	(0.009)	(0.005)	(0.003)	(0.004)	(0.008)
First Stage F-Stat	3.516	4.668	6.827	3.232	2.333
Observations	59,016	69,550	44,381	49,773	22,118

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The results show that at average costs and median host properties, 1 percentage point change in price implies 2 pp change in private rooms, 2.4 pp change in zero to one bedroom homes, 0.9 pp change in two to three bedroom homes, and 0.02 pp change in greater than three bedroom homes. While the F-statistic appears a bit smaller in these regressions than in Table 4, they still indicate joint statistical significance of the estimates. An interesting result is that the two to three bedroom properties group appears to be the least price sensitive at baseline, but the coefficient estimate on the interaction term with homeownership costs, $\hat{\theta}_2$, is large. This means that the additional price sensitivity from each $1000 of median homeownership costs in the respective market above the mean is very large for two to three bedroom entire homes in particular. Meanwhile, this is not the case for zero to one bedroom and greater than three bedroom entire homes.

Overall, these results suggest that homeowners who are likely more leveraged tended to exit the STRs market in response to price changes that occurred in response to tourism-related demand shocks during the pandemic. Further research will consider using more instruments that can be formed from seasonal variation of hotel visits to each metro area prior to the pandemic to gain more power in the estimates.

3.3 3SLS Estimates of STR and LTR Cross-Price Elasticities of Supply

Finally, as direct preliminary evidence that Airbnb homeowners switched to the LTR market, I estimate the cross-price elasticity of supply between the STR and the LTR markets, with the predicted year-over-year changes in Airbnb listings estimated from running the 2SLS routine specified through Equations (2.1) and (2.2) as inputs into the following equation:

$$\%\Delta \text{LTRPrice}_{c,m,y} = \beta_1 \%\Delta \widehat{\text{AirbnbListings}}_{c,m,y} + \%\Delta \mu_{c,m,y} \tag{3}$$

where $\text{LTRPrice}_{c,m,y}$ is the median long-term rental prices observed on Craigslist for each Census tract c, month m, and year y. To estimate this equation, I will have to bootstrap my standard errors for these results

to account for having less power from a smaller sample of Craigslist listings relative to Airbnb listings. For now, I estimate preliminary results for average inverse cross-price elasticities between the LTR and STR markets without accounting for these sampling challenges. These are positive and statistically significant for the zero to one bedroom and two to three bedroom segments, as expected in the case that homeowners switch from the STR to the LTR markets:

Table 8: Three-staged least squares estimates of inverse cross-price elasticities of supply between the LTR and STR markets. Mean number of properties owned by Airbnb hosts is defined as the mean of the maximum of the number of Airbnb listings owned by the host of each Airbnb listing between the current year or the previous year. Data used is from the Chicago, Seattle, and Miami MSAs from 2018 through 2020. I plan to bootstrap standard errors and to readjust the sample of Craigslist LTR listings by appropriately interpolating data for some months for which some Census tracts are missing data.

	(1)	(2)	(3)
Variables	0-1 Bedrooms	2-3 Bedrooms	$>$ 3 Bedrooms
$\%\Delta\widehat{\text{AirbnbListings}}$	0.035***	0.025**	-0.009
	(0.008)	(0.010)	(0.032)
F-Statistic	12.85	2.974	0.795
Observations	3,542	4,549	323

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

3.4 Benchmarking with Pre-pandemic Data

As a point of comparison with my results using data including the pandemic period so far, I compute benchmark estimates of comparable average STR supply price elasticities using only pre-pandemic data. To do this, I rely only on variation in the metro area demand seasonality captured by the $\overline{\text{Shares}}_m$. I show in this exercise that the pandemic created an unusual environment of uncertain demand shocks and that homeowners' price sensitivities and exit decisions would depend on their mortgage payments, property taxes, and other factors impacting their overall leverage during the pandemic, but not in the benchmark scenario I present in this section. The contrast in STR hosts' price sensitivities between my results in the previous section and these benchmark results using pre-pandemic reveal that liquidity constraints push homeowners out of the sharing economy only during times of uncertain demand, since a STR during the pandemic appears to be a riskier option than leasing a LTR.

To run the benchmark results, I recognize that the share of flights for each market, $\overline{\text{Shares}}_m$, is year-invariant, and in the previous section, this term was eliminated in (2.1) after having taken first differences year-over-year. However, first-differencing year-over-year is not feasible when my only source of variation for demand using data from the pre-pandemic period is the $\overline{\text{Shares}}_m$ variable measuring average annual shares of flights for each calendar month. In order to predict how STR supply changes on average in response to seasonal fluctuations in demand during the pre-pandemic period, I run another 2SLS system of equations that uses two-way fixed effects regressions instead of first differences:

$$\begin{aligned}\log\left(\text{MeanAirbnbPrice}_{c,m,y}\right) &= \beta_0^{\text{Pre},P} + \beta_1^{\text{Pre},P}\overline{\text{Shares}}_m \\ &+ \beta_2^{\text{Pre},P}\overline{\text{Shares}}_m \times \text{HomeownershipCosts}_{2020,c} \\ &+ \beta_3^{\text{Pre},P}\overline{\text{Shares}}_m \times \text{HostProperties}_{2020,c} \\ &+ \text{CostShocks}_{c,m,y}^{\text{Pre},P} + \eta_y^{\text{Pre},P} + \lambda_c^P + \epsilon_{c,m,y}^{\text{Pre},P} \quad (5.1)\end{aligned}$$

$$\begin{aligned}\log\left(\text{MeanAirbnbPrice}_{c,m,y}\right) \times \text{HomeownershipCosts}_{2020,c} &= \beta_0^{\text{Pre},HC} + \beta_1^{\text{Pre},HC}\overline{\text{Shares}}_m \\ &+ \beta_2^{\text{Pre},HC}\overline{\text{Shares}}_m \times \text{HomeownershipCosts}_{2020,c} \\ &+ \beta_3^{\text{Pre},HC}\overline{\text{Shares}}_m \times \text{HostProperties}_{2020,c} \\ &+ \text{CostShocks}_{c,m,y}^{\text{Pre},HC} + \eta_y^{\text{Pre},HC} + \lambda_c^{HC} + \epsilon_{c,m,y}^{\text{Pre},HP} \quad (5.2)\end{aligned}$$

$$\begin{aligned}\log\left(\text{MeanAirbnbPrice}_{c,m,y}\right) \times \text{HomeownershipCosts}_{2020,c} &= \beta_0^{\text{Pre},HP} + \beta_1^{\text{Pre},HP}\overline{\text{Shares}}_m \\ &+ \beta_2^{\text{Pre},HP}\overline{\text{Shares}}_m \times \text{HomeownershipCosts}_{2020,c} \\ &+ \beta_3^{\text{Pre},HP}\overline{\text{Shares}}_m \times \text{HostProperties}_{2020,c} \\ &+ \text{CostShocks}_{c,m,y}^{\text{Pre},HP} + \eta_y^{\text{Pre},HP} + \lambda_c^{HP} + \epsilon_{c,m,y}^{\text{Pre},HP} \quad (5.3)\end{aligned}$$

$$\begin{aligned}\log\left(\text{AirbnbListings}_{c,m,y}\right) &= \theta_0^{\text{Pre}} + \theta_1^{\text{Pre}}\log\left(\widehat{\text{MeanAirbnbPrice}}_{c,m,y}\right) \\ &+ \theta_2^{\text{Pre}}\log\left(\widehat{\text{MeanAirbnbPrice}}_{c,m,y}\right) \times \text{HomeownershipCosts}_{2020,c} \\ &+ \theta_3^{\text{Pre}}\log\left(\widehat{\text{MeanAirbnbPrice}}_{c,m,y}\right) \times \text{HostProperties}_c \\ &+ \text{CostShocks}_{c,m,y}^{\text{Pre},Q} + \eta_y^{\text{Pre}} + \lambda_c^Q + \epsilon_{c,m,y}^{\text{Pre},Q} \quad (6)\end{aligned}$$

As shown in Table 9 below, I find that 1 percent point change in price corresponds to about 0.14 to 0.16 percentage point change in Airbnb STR listings for entire homes. Furthermore, I find that these average supply price elasticities, unlike during the pandemic, do not vary with homeownership costs and median Airbnb properties.

Table 9: Two-staged least squares estimates of STR supply price elasticities, including heterogeneity of elasticities across homeowner demographics, for the pre-pandemic period. Robust standard errors clustered at the Census tract level are in parentheses. Mean number of properties owned by Airbnb hosts is defined as the mean of the maximum of the number of Airbnb listings owned by the host of each Airbnb listing between the current year or the previous year. Observations are used from the Chicago, Seattle, and Miami MSAs from 2018 through 2019, though the $\overline{\text{Shares}}_m$ instrument does not vary over years.

	(1)	(2)	(3)	(4)	(5)
Variables	Private Rooms	Entire Homes	0-1 Bedroom Entire Homes	2-3 Bedroom Entire Homes	> 3 Bedroom Entire Homes
log (Mean Airbnb Price)	-0.104***	0.158***	0.135***	0.146***	0.152***
	(0.040)	(0.023)	(0.032)	(0.025)	(0.032)
First Stage F-Stat	90.20	122.8	109.6	133.4	44.90
log (Mean Airbnb Price)	-0.001	-0.050**	-0.034	-0.018	0.016
× Median Homeownership Costs$_{c,2020}$	(0.044)	(0.024)	(0.038)	(0.026)	(0.036)
First Stage F-Stat	90.18	133.8	157.4	195.7	87.38
log (Mean Airbnb Price)	0.001***	0.000**	0.000**	0.000	-0.000***
× Host Properties$_c$	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
First Stage F-Stat	3.516	4.668	6.827	3.232	2.333
Observations	43,669	47,327	30,724	34,041	15,310

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Comparing **??** to Table 9, the significance of these results is that the monthly STR supply price elasticities calculated using pre-pandemic data are very different from those using both pre- and post-pandemic data. Specifically, I find that during the pandemic, the costs of homeownership play a significant role in how sensitive monthly sharing economy exit decisions are to changes in prices induced by seasonal demand shocks. While others like Li et al. (2021) find that mortgage pressure plays a significant role in determining homeowners' decisions to switch between STRs and LTRs on an annual basis prior to the pandemic, I find that the median costs of homeownership in a Census tract can play an important role in homeowners' decisions on a short-run, monthly basis, but only in an environment where the STRs markets are undergoing significant and uncertain macroeconomic shocks (Li et al., 2021).

4 Conclusion

Overall, my results show that the pandemic created large and uncertain demand shocks through the tourism industry for investment property owners on Airbnb. Furthermore, I find heterogeneous effects for homeowners with different costs of homeownership, including mortgage payments, on STR market exits. These show that it is possible for pre-pandemic liquidity constraints and leverage of investment property owners to potentially affect their exposure to unprecedented and uncertain shocks stemming from a natural disaster like COVID-19. To provide stronger evidence on this point, my future research will estimate heterogeneous effects using data from the FHFA NMDB on Census tract-level measures of leverage. I also benchmark average STR supply price elasticities for the COVID-19 pandemic period when demand for STRs was uncertain against comparable elasticities using pre-pandemic data. This provides evidence that costs associated with homeownership might play a role regarding STR exit decisions in the short-run (month to month) during times when demand and therefore profits are stable, but not when demand and profits are uncertain.

In addition, I provide direct preliminary evidence to show that at least some Airbnb owners of smaller properties (less than four bedrooms) responded by switching to the LTR markets when this was possible and

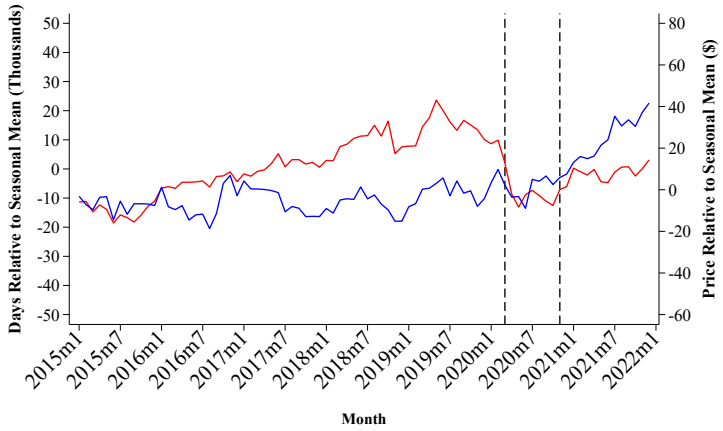
profitable. I compute inverse cross-price elasticities of supply between the STR and LTR markets and find that these are positive, which means that the STR market exits decreased prices in the LTR markets. This result holds as long as I assume that my instrument capturing seasonal STR demand is plausibly orthogonal to unobserved shocks to the LTR markets. However, these results are preliminary because the Craigslist data is missing data for some months and Census tracts, so I will have to adjust my sample by interpolating across time for these missing observations. Furthermore, I will also bootstrap my standard errors for these results to account for the smaller sample of Craigslist listings relative to Airbnb listings.

As for this paper's contributions to prior literature, my findings add to the literature that tries to estimate the effects of certain shocks stemming from the COVID-19 context on household behavior, the literature on natural disasters, and the literature on how the sharing economy interacts with housing markets. When evaluating the effects of COVID-19 on any economic behavior, it can be difficult to identify the causal effects of one shock or one set of shocks from others, even when applying a difference-in-differences research design (Goodman-Bacon & Marcus, 2020; Milone, 2023). I show that a natural disaster can affect homeowners not just through physical damage to properties, but also through short-run income shocks to the sharing economy (Knuth et al., 2023; Gallagher & Hartley, 2017; Guha-Sapir et al., 2013; Contat et al., 2024). In addition, I find that short-run shocks can have heterogeneous effects on monthly market exits for investment property owners with different costs associated with homeownership when demand shocks are uncertain, whereas my benchmark results using pre-pandemic data show that this is not the case when demand shocks are more predictable. Li et al. (2021) also shows that mortgage pressure enters into investment property owners' decisions to choose between listing on Airbnb and the LTR market, but only within the longer time horizon of a year (Li et al., 2021).

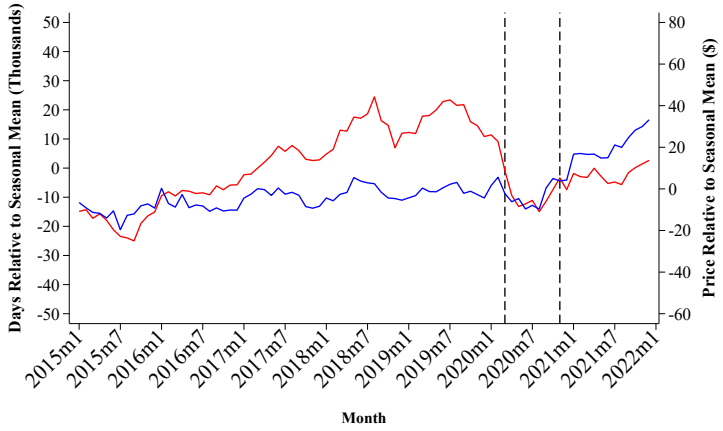
Finally, since the decision to sign a long-term lease with a tenant could foreclose the option to list on Airbnb for the near future, these decisions to switch from the STR to the LTR markets are likely dynamic. As a result, further research may look into building a discrete choice dynamic structural model of homeowner property usage decisions. Such a model would enable examining how these same demand shocks to STR markets impacted the full financial conditions of homeowners, such as through mortgage delinquency rates, and the resulting distributional welfare effects across homeowner demographics.

A Appendix

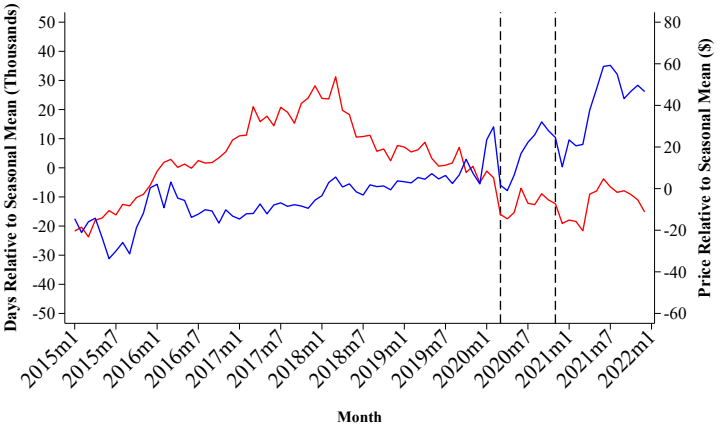
Figure A.1: Deseasonalized Airbnb STR mean prices net of cleaning fees in blue and total days booked for Airbnb listings in red are shown for the Chicago, Seattle, and Miami MSAs, respectively, in (a), (b), and (c). The first dotted line marks March 2020, when the U.S. declared the COVID-19 pandemic a national emergency, and the second dotted line marks November 2020, when Airbnb mandated a new five-step cleaning process for hosts.



(a) Chicago MSA



(b) Seattle MSA



(c) Miami MSA

Table A.1: Reduced form effects of COVID-19 demand and supply shocks on year-over-year changes in Airbnb listings, excluding heterogeneous effects of tourism-related demand shocks. For the median number of properties owned by Airbnb homeowners in each Census tract HostProperties_c, I take the median of the maximum number of properties that each Airbnb host listed across years for each Census tract and then subtract the median across Census tracts. This provides a de-medianed measure of Airbnb ownership concentration. Robust standard errors clustered at the Census tract level are in parentheses. Data used is from the Chicago, Seattle, and Miami MSAs from 2018 through 2020.

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Shared Rooms	Private Rooms	Entire Homes	0-1 Bedroom Entire Homes	2-3 Bedroom Entire Homes	> 3 Bedroom Entire Homes
$\text{PostCOVID}_{m,y} \times \overline{\text{Shares}}_m$	-1.261	-2.062***	-2.762***	-2.157***	-2.783***	-1.278*
	(1.613)	(0.547)	(0.432)	(0.571)	(0.495)	(0.658)
%Δ CPI for Household Furnishings, Equipment, Routine Maintenance	-4.282*	-4.971***	-5.272***	-3.381***	-5.282***	-3.193***
	(2.420)	(0.585)	(0.445)	(0.576)	(0.526)	(0.782)
%Δ CPI for Maintenance and Repairs	-0.227	-0.051	0.303**	0.306	0.412**	-0.352
	(0.819)	(0.204)	(0.153)	(0.200)	(0.188)	(0.264)
%Δ CPI for Water Supply and Misc Services	1.360	5.678***	8.653***	6.755***	7.821***	7.283***
	(2.538)	(0.549)	(0.442)	(0.561)	(0.507)	(0.754)
%Δ CPI for Electricity, Gas, and Other Fuels	-1.088	-0.320	-2.108***	-1.506***	-2.500***	-0.506
	(1.395)	(0.350)	(0.278)	(0.346)	(0.340)	(0.497)
%Δ CPI for Housekeeping Supplies	0.247	-1.911***	-2.305***	-2.352***	-2.083***	-1.304**
	(1.802)	(0.434)	(0.301)	(0.413)	(0.366)	(0.508)
PostNewCleaning × CPI for Housekeeping Supplies	0.068	0.009	0.003	0.015**	-0.009	-0.019*
	(0.046)	(0.008)	(0.006)	(0.007)	(0.008)	(0.010)
PostNewCleaning × CPI for Housekeeping Supplies× HostProperties_c	-0.011**	-0.001	-0.000**	-0.000*	0.000	0.001
	(0.006)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)
Census Tract Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Calendar Month Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Trend Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
F-Statistic	1.373	91.65	220	81.41	142.5	35.86
Observations	3,443	62,549	71,975	45,808	52,112	23,279

*** p<0.01, ** p<0.05, * p<0.1

Table A.2: Reduced form effects of COVID-19 demand and supply shocks on year-over-year changes in Airbnb listings, including heterogeneous effects of tourism-related demand shocks along Census tract-level demographics. For the median number of properties owned by Airbnb homeowners in each Census tract HostProperties_c, I take the median of the maximum number of properties that each Airbnb host listed across years for each Census tract and then subtract the median across Census tracts. This provides a de-medianed measure of Airbnb ownership concentration. Robust standard errors clustered at the Census tract level are in parentheses. Data used is from the Chicago, Seattle, and Miami MSAs from 2018 through 2020.

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Shared Rooms	Private Rooms	Entire Homes	0-1 Bedroom Entire Homes	2-3 Bedroom Entire Homes	> 3 Bedroom Entire Homes
$\text{PostCOVID}_{m,y} \times \overline{\text{Shares}}_m$	-0.804	-1.849***	-1.928***	-1.769***	-1.922***	-1.214***
	(0.640)	(0.180)	(0.137)	(0.169)	(0.156)	(0.229)
$\text{PostCOVID}_{m,y} \times \overline{\text{Shares}}_m \times$	-0.205	-1.170***	-0.949***	-0.823***	-0.902***	-0.856***
$\times$ Median Homeownership $\text{Costs}_{c,2020}$	(0.660)	(0.313)	(0.192)	(0.264)	(0.209)	(0.255)
$\text{PostCOVID}_{m,y} \times \overline{\text{Shares}}_m \times$	0.105	-0.008	-0.020	0.031	-0.046*	0.026
$\times$ Census Tract Median $\text{Income}_{c,2020}$	(0.100)	(0.042)	(0.026)	(0.036)	(0.028)	(0.035)
$\text{PostCOVID}_{m,y} \times \overline{\text{Shares}}_m \times$	0.009	0.021	-0.001	-0.003	-0.010***	-0.001
$\times$ HostProperties_c	(0.021)	(0.019)	(0.006)	(0.004)	(0.003)	(0.006)
%Δ CPI for Household Furnishings, Equipment,	-3.856	-5.056***	-5.312***	-3.314***	-5.340***	-3.254***
	(2.426)	(0.591)	(0.448)	(0.579)	(0.534)	(0.791)
%Δ CPI for Maintenance and Repairs	-0.431	0.010	0.321**	0.343*	0.392**	-0.385
	(0.821)	(0.207)	(0.154)	(0.202)	(0.191)	(0.267)
%Δ CPI for Water Supply and Misc Services	1.841	5.490***	8.654***	6.777***	8.002***	7.536***
	(2.572)	(0.559)	(0.449)	(0.567)	(0.516)	(0.770)
%Δ CPI for Electricity, Gas, and Other Fuels	-1.009	-0.289	-2.134***	-1.556***	-2.502***	-0.562
	(1.421)	(0.357)	(0.282)	(0.350)	(0.345)	(0.503)
%Δ CPI for Housekeeping Supplies	-0.425	-1.852***	-2.209***	-2.344***	-2.045***	-1.320***
	(1.777)	(0.434)	(0.300)	(0.413)	(0.367)	(0.510)
PostNewCleaning $\times$ CPI	0.081*	0.009	0.002	0.014*	-0.012	-0.020**
for Housekeeping Supplies	(0.044)	(0.008)	(0.006)	(0.007)	(0.008)	(0.010)
PostNewCleaning $\times$ CPI for Housekeeping	-0.012**	-0.001*	-0.000	-0.000	0.001	0.001
Supplies $\times$ Mean Properties Owned by Airbnb Hosts	(0.005)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)
Census Tract Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Calendar Month Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Trend Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
F-Statistic		73.63	171.4	61.87	112.2	28.61
Observations	3,383	60,619	70,811	45,109	50,874	22,934

*** p<0.01, ** p<0.05, * p<0.1

Table A.3: First stage results from running Equation (2.1), showing the effects of COVID-19 demand- and supply-side shocks on YoY changes in Airbnb STR price, including heterogeneous effects of tourism-related demand-side shocks. Robust standard errors clustered at the Airbnb listing level are in parentheses. For the median number of properties owned by Airbnb homeowners in each Census tract HostProperties_c, I take the median of the maximum number of properties that each Airbnb host listed across years for each Census tract and then subtract the median across Census tracts. This provides a de-medianed measure of Airbnb ownership concentration. Data used is from the Chicago, Seattle, and Miami MSAs from 2018 through 2020.

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Shared Rooms	Private Rooms	Entire Homes	0-1 Bedroom Entire Homes	2-3 Bedroom Entire Homes	> 3 Bedroom Entire Homes
$\text{PostCOVID}_{m,y} \times \overline{\text{Shares}}_m$	-0.932**	-0.815***	-0.719***	-0.828***	-0.976***	-0.401**
	(0.419)	(0.095)	(0.103)	(0.093)	(0.102)	(0.188)
$\text{PostCOVID}_{m,y} \times \overline{\text{Shares}}_m$	-0.153	-0.116	-0.188**	-0.186**	-0.245***	-0.126
$\times$ Median Homeownership $\text{Costs}_{c,2020}$	(0.251)	(0.095)	(0.085)	(0.077)	(0.094)	(0.148)
$\text{PostCOVID}_{m,y} \times \overline{\text{Shares}}_m$	-0.175***	-0.209***	-0.069***	-0.062***	-0.064***	-0.118***
$\times$ HostProperties_c	(0.011)	(0.007)	(0.002)	(0.002)	(0.002)	(0.006)
%Δ CPI for Household Furnishings, Equipment,	0.439	0.530	0.301	0.149	0.205	-0.689
and Routine Maintenance	(2.221)	(0.387)	(0.396)	(0.349)	(0.400)	(0.732)
%Δ CPI for Maintenance and Repairs	0.030	-0.238**	-0.130	-0.315**	-0.165	0.296
	(0.589)	(0.120)	(0.134)	(0.125)	(0.136)	(0.227)
%Δ CPI for Water Supply and Misc Services	-0.237	-0.403	-0.462	-0.608**	-1.065***	-0.501
	(1.163)	(0.274)	(0.310)	(0.253)	(0.310)	(0.543)
%Δ CPI for Electricity, Gas, and Other Fuels	0.492	-0.473**	0.782***	0.298	0.688***	1.587***
	(0.947)	(0.197)	(0.218)	(0.191)	(0.237)	(0.399)
%Δ CPI for Housekeeping Supplies	-0.683	-0.270	-0.212	0.060	0.265	0.763
	(1.349)	(0.263)	(0.275)	(0.246)	(0.273)	(0.486)
PostNewCleaning $\times$ CPI	0.087**	0.031***	0.030***	0.026***	0.038***	0.034***
for Housekeeping Supplies	(0.034)	(0.005)	(0.005)	(0.004)	(0.005)	(0.009)
PostNewCleaning $\times$ CPI for Housekeeping Supplies	-0.002	0.001**	0.000	0.000**	0.000	0.000
$\times$ Mean Properties Owned by Airbnb Hosts	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Census Tract Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Calendar Month Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Trend Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
F-Statistic		18.10	21.33	19.40	25.31	10.36
Observations	3,173	59,016	69,550	44,381	49,773	22,118

*** p<0.01, ** p<0.05, * p<0.1

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