OXFORD ECONOMICS

Vrbo

THE DRIVERS OF HOUSING AFFORDABILITY

An assessment of the role of short-term rentals

NOVEMBER 2019

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EXECUTIVE SUMMARY

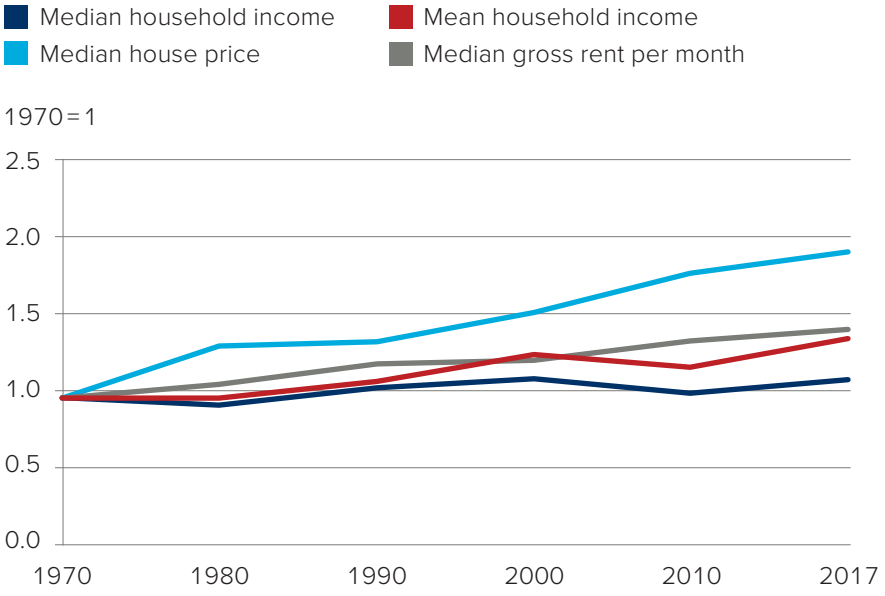
In the past year, **the US-wide affordable housing crisis has consistently made headlines.** Today, some 18 million US households spend more than half their gross income to pay basic accommodation costs.[1]

The root causes of the housing crisis can be traced back to changes that significantly pre-date the growth of the short-term rental (STR) market. The rising unaffordability of housing is a long-term trend reflecting four decades during which rental and house prices have grown consistently faster than incomes (Fig. 1). Indeed, Fig. 1 also provides a strong indication of the underlying causes of the problem. While the income of a typical (median) household stagnated between 1970 and 2010, average US household incomes grew strongly, supporting sustained growth in house prices. These trends were the manifestation of the significant increase in income inequality that occurred in the US during this period.

18.2 million

Number of US households who now spend more than half their income paying basic housing costs.

Fig. 1. Growth rate of median and mean household incomes, median house prices and median gross rent per month, 1970–2017[2]



Source: 1970–2000 Decennial Censuses, 2010 and 2017 ACS

[1] Joint Center for Housing Studies of Harvard University, "The State of the Nation's Housing 2019", 2019.

[2] It is important to note that rents have been growing faster than incomes over the past decades, as illustrated in Fig. 1. However, over the past few years, incomes have picked up and therefore, during our study period, the real growth in income was greater than that in rents.

> *"The shortfall in new homes is keeping the pressure on house prices and rents—eroding affordability, particularly for modest-income households in high-cost markets."*
>
> *—Joint Center for Housing Studies*

Recently, public attention has increasingly focused on supply side issues in the market, which have been argued to have exacerbated the current crisis. For example, in a recent study, the Joint Center for Housing Studies concluded that the core of this crisis is a supply issue, with net new housing supply held back mainly by high building costs, zoning restrictions, and labor shortages in the construction sector. On the other hand, other commentators have focused on the role of STRs, as they allegedly reduce the supply of affordable housing by removing properties from the rental market, displacing long-term tenants, and raising the cost of living.

Given this context, Oxford Economics was commissioned by Vrbo to carry out a study to:

1) learn the key drivers of increasing house prices and rents; and
2) analyze the role played by STRs with regard to housing affordability.

The dynamics of housing markets have been the subject of academic literature for decades, with the general consensus concluding that:

- **rent** is mainly determined by the number of housing units, the number of households, and income levels; while
- **house prices** depend positively on disposable income and demographic growth, and negatively on housing stock and the "user cost of capital".[3]

Our study borrows the backbone of its modeling framework from this literature. We also included STR density and a mix of other explanatory variables to answer our second research question.

MODEL FINDINGS

For this study we constructed a comprehensive dataset of all US counties over the period 2014–2018.[4] The dataset included over 70 variables, ranging from average household income to the number of residential building permits in each county.[5] We then used this database to build two econometric models, one aimed at determining the drivers of rents, and

[3] The user cost of capital includes the mortgage interest payments that an owner has to make, but also annual property taxes, depreciation costs, and any expected capital gain.

[4] 2014 was the first year covered in the AirDNA database, our data source for STR listings. Listing data were missing for some US counties, so we had to exclude those from our study.

[5] Building permits represent the number of new privately-owned housing units authorized by building permits in the United States. As shown later in this document, we derive our "permits per household" variable by dividing the number of building permits by the number of households.

the second focusing on house prices. In both models, all variables have the expected effect and are statistically significant—for example:

- Household income is found to have a *positive* impact on both rents and house prices—the greater purchasing power afforded by higher incomes enables households to increase expenditure on housing.
- On the other hand, housing supply is found to have a *negative* impact on rents and house prices—more abundant supply, as defined as a higher number of housing units per household, allows house buyers to shop around more, helping to keep a lid on price growth.[6]

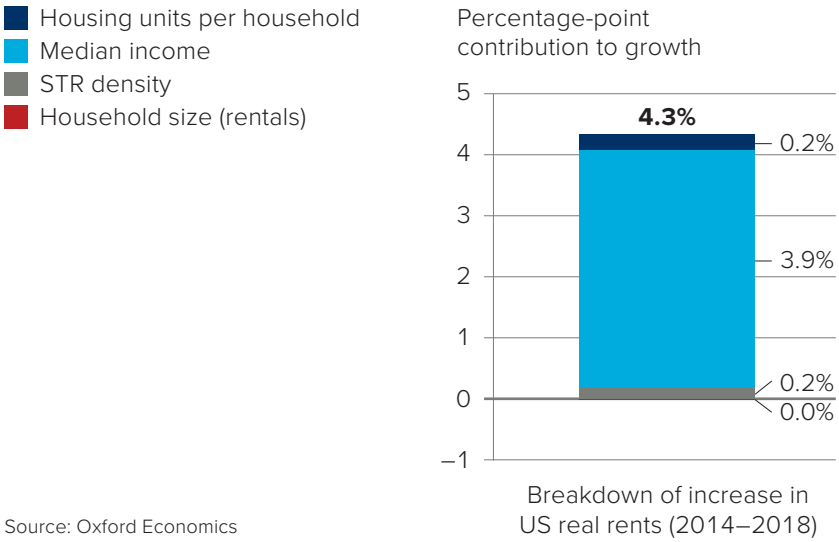
The findings of our rental model, combined with changes in the explanatory variables over the study period, show that the **overwhelming driver of the observed increase in real rental prices during the 2014–18 period was household earnings.** Median income increased by 10.4% in real terms over our study period. We estimate that this growth alone was responsible for around 3.9 percentage points (or 91%) of the overall 4.3% increase in median real rents in this period (see Fig. 2).

3.9 percentage points

Estimated increase in real rents attributed to rising household earnings between 2014 and 2018.

The overall increase was 4.3%.

Fig. 2. Drivers of the growth in real rents between 2014 and 2018



Source: Oxford Economics

[6] Housing supply is measured as the number of housing units divided by the number of households in each county. As a result, our housing supply variable is independent of the STR density. For example, if one unit is subtracted from the STR market and added back to the long-term rental market, this will not have any impact on housing stock per household. In other words, the effect of this change would be fully captured by the impact of STR density and would not "double up" as a boost in housing stock.

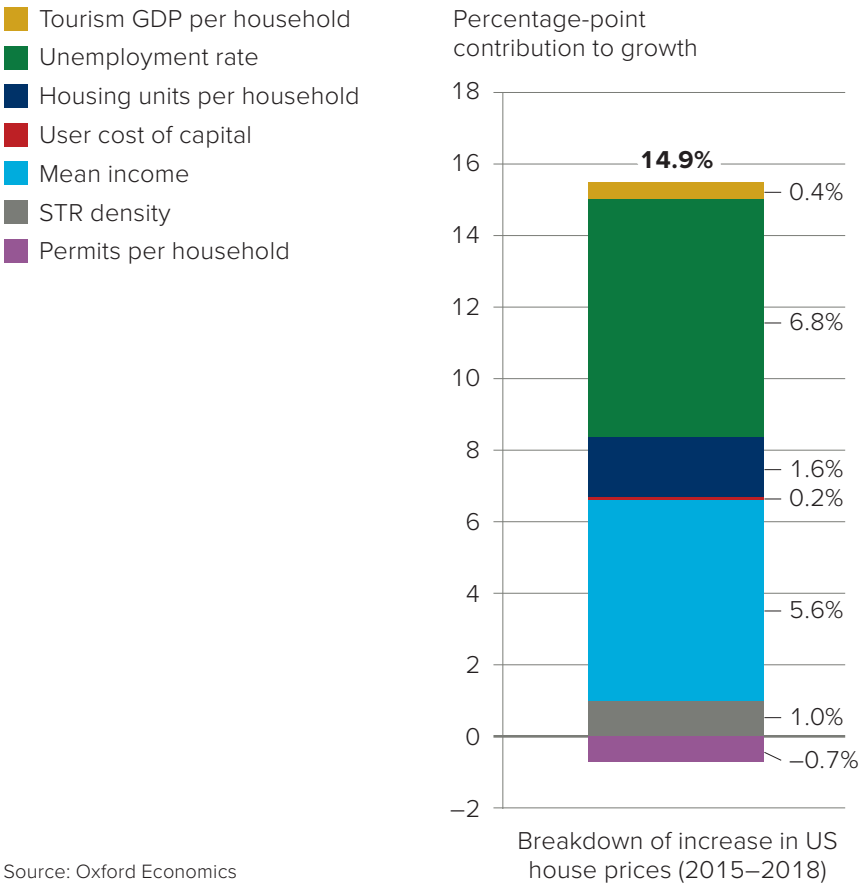
6.8 percentage points

Estimated increase in real house prices attributed to dropping unemployment over the study period.

The overall increase was 14.9% between 2015 and 2018.

In our house price model, we found that **the biggest contribution to the growth in house prices came from labor market improvements.** Specifically, the drop in US unemployment over the study period is estimated to have added 6.8 percentage points to US house prices growth (see Fig. 3). Income was another major contributor, adding 5.6 percentage points to house price growth over the study period. We also find that housing supply and building permits had an impact on house prices growth during the period.

Fig. 3. Drivers of growth in US house prices between 2015 and 2018[7]



Source: Oxford Economics

[7] The inclusion of lagged variables in the house price model implies that their growth between 2014 and 2015 starts affecting prices in 2015–16. For this reason, the contribution analysis for house prices only covers the period 2015–18 and not 2014–18.

THE IMPACT OF SHORT-TERM RENTALS

Our modeling indicates that **the presence of STRs has not substantially driven the US house price and rent increases over the past few years.**

For the period 2014–18, we find that, in the absence of any growth in the number of STRs, real rents would still have grown by 4.1%, as opposed to the actual growth rate of 4.3%. Put another way, **median monthly rents would have been only $2 lower in 2018** if STRs had remained at their 2014 levels. In the homeowners' market, the impact attributable to the growth in STR density represents less than a one-percentage-point difference in house prices growth. In other words, we estimate the **average annual mortgage payment would have been $105 cheaper** if STRs had remained at their 2014 levels.

What do these findings tell us about affordability? To answer this question, we estimated the 2018 median price of a property in the US in a counterfactual scenario where STRs did not grow over the study period. When considering these counterfactual house prices in relation to average household incomes, we found that **the price-to-income ratio would have increased to 2.39 in 2018 in a scenario with no STR growth, as opposed to the actual value of 2.41.**

Interestingly, an extension of our baseline models suggests that, in the long run, **the effect of STRs on both house prices and rents is weaker in highly seasonal areas.**[8] One explanation for this is that, in vacation markets, homes are less likely to be rented on a long-term basis. In addition, home owners of properties in seasonal destinations have been renting out their properties long before the advent of internet platforms offering STRs (through agencies and brokers) and therefore the value from such rental revenue has long been priced in the value of homes in these localities.

Our findings suggest that adopting stricter regulations on STRs is unlikely to solve the housing affordability crisis faced by many American households, in both the rental and homeowners' market. Moreover, it is important to weigh these potentially modest affordability benefits against the associated negative consequences for the local economy, e.g. lower levels of tourist expenditure and tax receipts.

$2

Estimated reduction in median monthly rent for 2018 if STR density remained at its 2014 level.

$105

Estimated increase in average annual mortgage payment attributed to growing STR density over the study period.

> *"Adopting stricter regulations on STRs is unlikely to solve the housing affordability crisis faced by many American households."*

[8] Short-run effects look at the immediate impact of a variable X over Y. Over time, given the dynamic nature of the housing market, there will be several equilibrating adjustments to the short-run effects, as the economy and people readjust. As a result, the long-run effect of a given variable X over Y is different.

1. SCOPE AND STRUCTURE OF THIS REPORT

Oxford Economics was commissioned by Vrbo to carry out a study of housing affordability and short-term rentals. Specifically, our analysis sought to:

- learn the key drivers of house prices and rents;
- analyze the role played by short-term rentals on affordability; and
- establish whether relationships vary across housing market types.

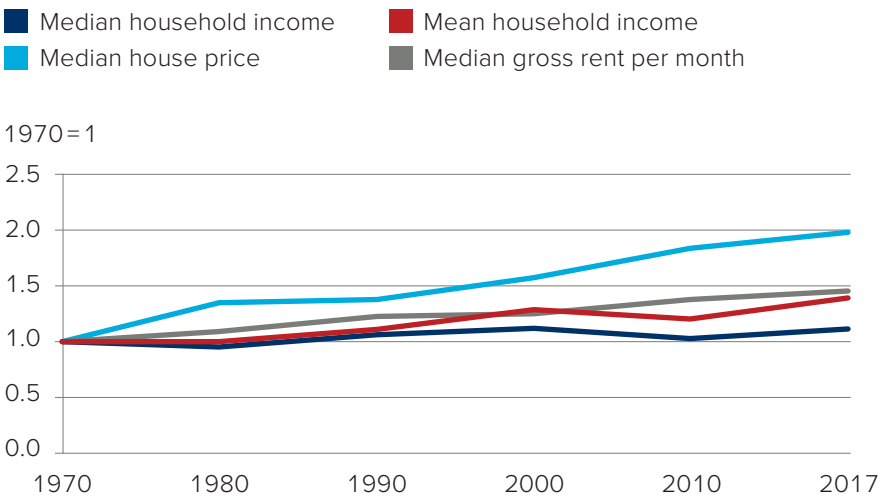
The resulting report begins by introducing the US affordability crisis (Chapter 2), before reviewing existing literature on housing and short-term rentals (Chapter 3). First and foremost, this study aims to contribute to the literature on housing market dynamics, as well as adding to the still limited literature studying the effect of short-term rentals on housing markets.

In Chapter 4, we set out a new approach to modeling house prices and rents, based on a panel dataset covering the period 2014–18, with the objective of identifying which variables are statistically significant drivers of prices and rents.

Our results from this approach, set out in Chapter 5, illustrate the sensitivity of house prices and rents to different macroeconomic drivers, including the supply of housing, cost of capital, and household earnings, as well as STR density. Armed with these results, we then calculated the contribution that each macroeconomic driver made to the housing market variable. We find that economic and labor market conditions explain the lion's share of housing market developments during our study period.

2. AMERICA'S AFFORDABLE HOUSING CRISIS

Fig. 4. Growth rate of median and mean household incomes, median house prices and median gross rent per month, 1970–2017[9]



Source: 1970–2000 Decennial Censuses, 2010 and 2017 ACS

Housing is increasingly an issue of public policy concern, as the US faces an affordable housing crisis. For decades, rents have been growing faster than incomes (Fig. 4), and nearly 200 US cities had a median home value of at least $1 million as of June 2018.[10] After a few years of decline, the number of people experiencing homelessness has grown again over the past couple of years.[11]

Theoretical models and the empirical literature on the housing market suggest that, over the long run, house prices depend positively on disposable income and demographic needs, and negatively on user costs and the housing stock.[12] This last factor in particular has been thoroughly discussed in the policy debate.

Many experts have argued that, at its core, the US housing crisis is a supply issue.[13] Between 2014 and 2018 (the period covered in our study), 5.1 million new households are estimated to have formed in the US, while net new housing supply was up only 4.1 million.[14] This implies the ratio of housing units-to-households declined between 2014 and 2018.

In the remainder of this chapter, we present snapshots of the affordability issue for renters and homeowners in turn. We then introduce the short-term rental market, the growth of which has created debate among local governments, housing activists, and residents about its impact on the availability of affordable long-term housing.

[9] It is important to note that rents have been growing faster than incomes over the past decades, as illustrated in Fig. 4. However, over the past few years, incomes have picked up and therefore, during our study period, the real growth in income was greater than that in rents.

[10] Zillow, "List of $1M (Home Value) Cities Could Grow by 23 in the Next Year", 9 August 2018.

[11] HUD Exchange, "2018 AHAR: Part 1 – PIT Estimates of Homelessness in the U.S.", December 2018.

[12] A variable X is said to have a positive impact on variable Y when an increase in X is associated with an increase in Y. A variable X is said to have a negative impact on variable Y when an increase in X is associated with a drop in Y. IMF, "Fundamental Drivers of House Prices in Advanced Economies", *IMF Working Paper*, July 2018.

[13] Joint Center for Housing Studies of Harvard University, "The State of the Nation's Housing 2019", 2019.

[14] These numbers represent the net growth in the two variables. In other words, more than 5.1 million households may have formed over the study period, but at the same time some households may have dissolved. The net household formation was 5.1 million between 2014 and 2018.

WHY CAN'T THE US BUILD ENOUGH HOUSES TO MEET THE DEMAND?

Since 2011, residential housing construction has increased, but not enough to meet demand, according to Freddie Mac. There are various reasons for this.

First, the **housing boom in the early 2000s** produced an excess stock of houses, making builders and creditors more cautious of speculative construction projects that would inflate the housing stock too fast. Another contributing factor is **home building cost**, which encompasses the cost of land and raw materials. The price of raw materials has risen by over 20% since the recession, according to Bureau of Labor Statistics' data.

Laws and regulations such as local **zoning restrictions** on lot sizes, building height, and minimum number of parking spots also increase the cost of building a home, in turn reducing the supply of new houses. The National Association of Home Builders (NAHB) estimates that regulatory costs increased by 29% between 2011 and 2016.

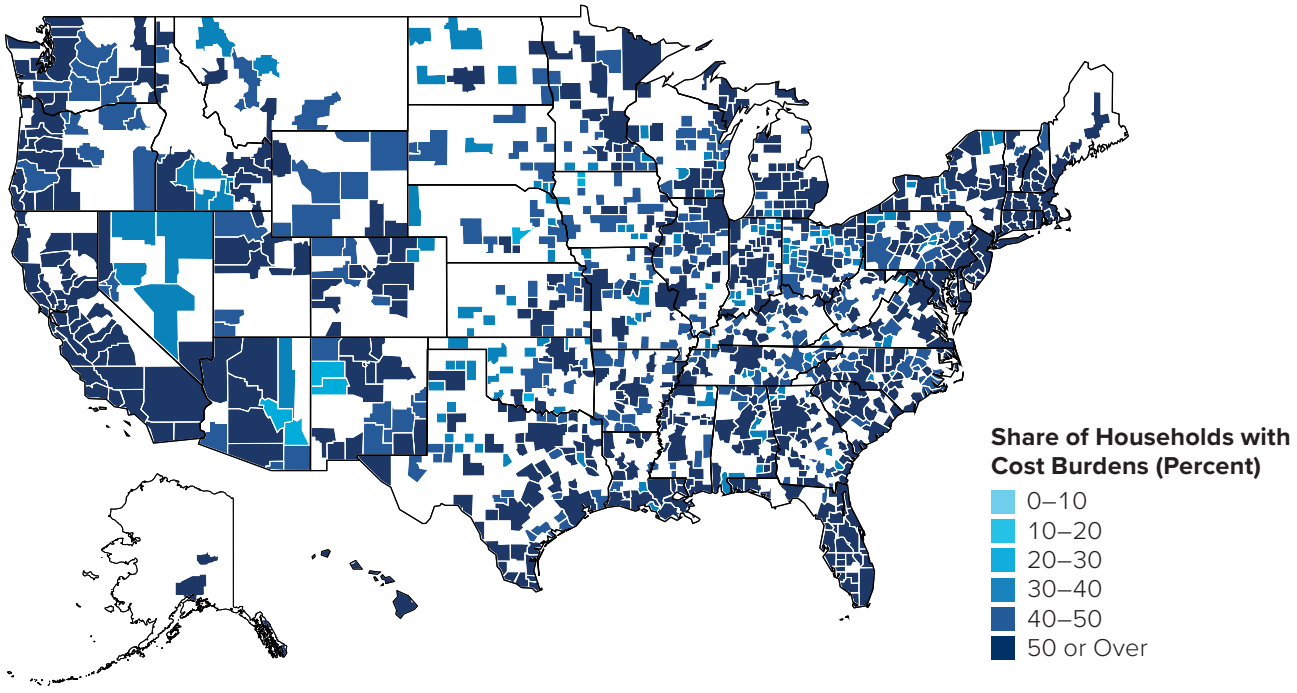
Another reason for the lower level of housing production, relative to the population, is said to be the **shortage of skilled labor** currently faced by the construction industry. The NAHB reports that the number of unfilled jobs in the construction sector reached post-crisis highs in 2018.

2.1. THE RENTAL MARKET

A study by the Joint Center for Housing Studies of Harvard University found that renters appear to be more burdened by housing costs than homeowners, with cost-burdened renters outnumbering cost-burdened homeowners by more than 3.0 million (where cost-burdened is a household paying more than 30% of its gross income for housing).[15] In addition, renters make up 10.8 million of the 18.2 million severely burdened households that pay more than half of their incomes for housing.

The spread of renter cost burdens is most evident in expensive metropolitan areas such as Los Angeles, New York, San Francisco, and Seattle (see Fig. 5). Not surprisingly, households with the lowest incomes have the highest cost-burden rates, although such rates are rising rapidly among renters higher up the income scale. The cost-burdened share is highest among among African American and Latinx American renters, suggesting minorities are heavily hit by America's housing affordability crisis.

Fig. 5. Share of cost-burdened households, renters



Source: Joint Center for Housing Studies of Harvard University

[15] Joint Center for Housing Studies of Harvard University, "The State of the Nation's Housing 2019", 2019.

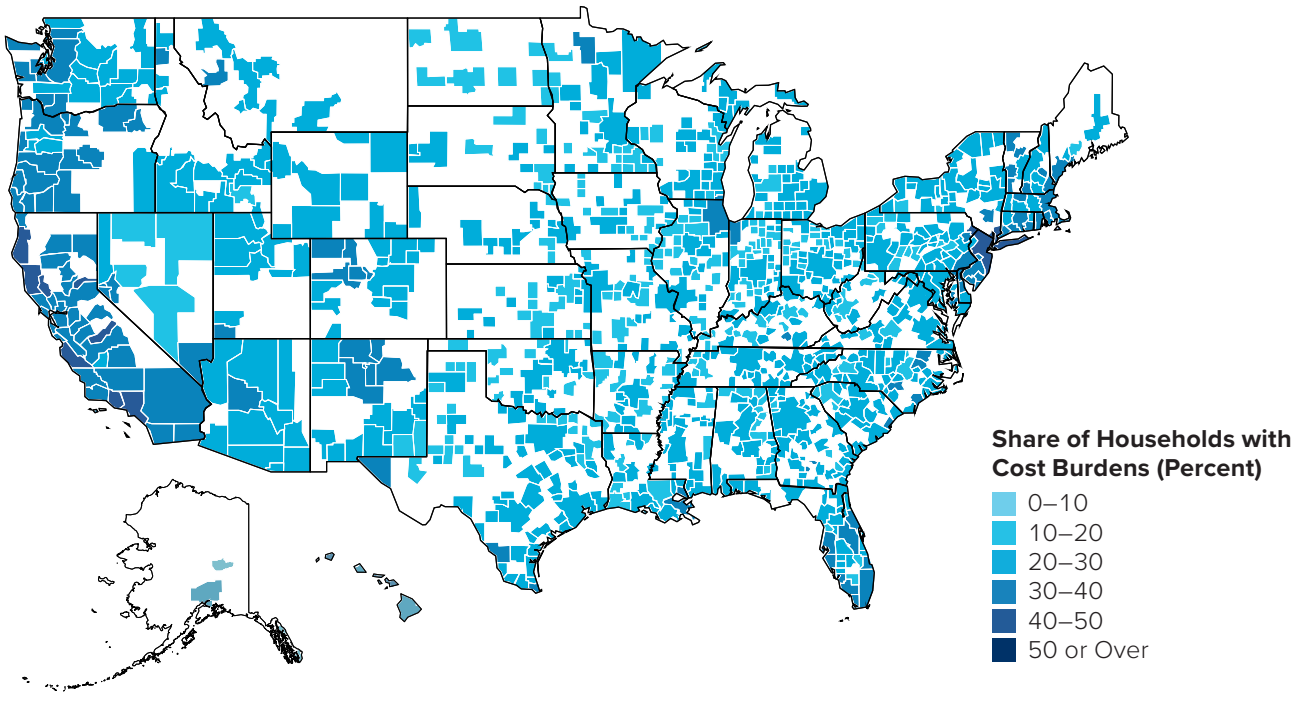
2.2. THE HOME-OWNER MARKET

In the owners' market, much lower proportions of households appear cost-burdened.[16] After falling for over a decade, US homeownership rates edged up in both 2017 and 2018, reaching 64.4%. This rebound in homeownership comes amid worsening affordability, with house prices having climbed steadily since the recession. Nationwide, the ratio of median house price to median household income rose sharply from a low of 3.3 in 2011 to 4.1 in 2018, having reached its peak at 4.7 in 2005.

Interestingly, however, cost burdens are improving for homeowners, with the latest American Community Survey reporting the share of cost-burdened households inched down 0.5 percentage point. Much of this progress was among homeowners, whose overall cost-burden rate declined by nearly 8.0 percentage points in 2010–2017. Its 2017 value was the lowest level since 2000. Among the metropolitan areas characterized by the highest cost-burden shares among owners are Los Angeles, New York, and Miami (Fig. 6).

Even if house prices have made homeownership less accessible

Fig. 6. Share of cost-burdened households, owners



Source: Joint Center for Housing Studies of Harvard University

[16] For homeowners, housing costs include mortgage payments (including interest), taxes and insurance.

for the median US resident, those who are able to move up the housing ladder are less burdened than they used to be a decade ago.

2.3. THE SHORT-TERM RENTAL MARKET

Short-term rentals (STRs) are often cited as intensifiers of the affordability crisis. Increasingly, affordable housing advocates have argued that STRs are displacing long-term tenants and raising their cost of living. Therefore, in the name of protecting affordable long-term housing, several cities are reducing the number and type of housing units that can be offered as short-term rentals.[17] These include Washington, D.C., New York, Chicago, and San Francisco.

On the other hand, short-term rental advocates argue that the presence of STRs lowers travel costs by increasing the supply of travel accommodation. This in turn attracts a wider pool of visitors, whose spending benefits the local economy, supporting jobs and business creation in the area. In addition, the earnings from renting out their properties are likely to be spent locally, further contributing to the economy. Lastly, tax revenues raised on short-term rental income can be used to fund housing services, as demonstrated by the city of Seattle, which earmarked such revenues to support affordable housing.

[17] The Pew Charitable Trusts, "Cities Tell Airbnb to Make Room for Affordable Housing", 18 October 2018.

3. THE HOUSING MARKET: AN ANALYSIS OF EXISTING STUDIES

Our study contributes to two key research questions: (i) what are the key drivers of house prices and rents? and (ii) what is the impact of short-term rentals on these variables? Before we introduce our modeling, this chapter presents a review of some of the existing academic literature addressing these questions.

3.1. EXISTING LITERATURE ON HOUSING MARKET DYNAMICS

Housing market dynamics have been widely studied in academic literature for decades. Because this literature is well established, this section does not point to individual studies, but rather takes a meta-analysis approach by reviewing the key drivers of housing market dynamics.

Academic studies of the rental market show that rent is determined by the **number of housing units, the number of households, and income levels.**[18] Similarly, theoretical models and empirical literature on house prices suggest that, over the long run, house prices depend positively on **disposable income** and **demographic needs**, and negatively on the **housing stock** (undersupply conditions can contribute to housing price gains) and **user cost**.[19]

This last factor—user cost—requires further explanation, as it comprises many elements. These include not just the mortgage interest payments that an owner has to make, but also annual property taxes, depreciation costs, and any expected capital gain. Taken all together, and adjusted for expected inflation, these costs are referred to as the real user cost of capital. Multiplying this by the house price gives us the annual user cost of owning and can be understood as the rent equivalent for homeowners.

Housing market equilibrium is described in Fig. 7. When rents and annual user costs of owning are not aligned, markets automatically move toward equilibrium conditions through adjusting demand for housing investments.

Fig. 7. Housing market equilibrium conditions

RENT = COST OF OWNING

- Equilibrium conditions
- Costs of owning a given house equals the cost of renting it

RENT > COST OF OWNING

- Purchasing a home is more attractive for a given level of rent (for example, when mortgage rates fall)
- More demand for housing for sale in turn bids up house prices to the point where the user cost of owning is brought back in line with rents

RENT < COST OF OWNING

- Purchasing a home is less attractive for a given level of rent (for example, when mortgage rates rise)
- Lower demand for housing for sale in turn depresses house prices to the point where the user cost of owning is brought back in line with rents

[18] For example, C. Swan, "Model of Rental and Owner-Occupied Housing", *Journal of Urban Economics*, 16(2) (1984): 297–316.
[19] For example, IMF, "Fundamental Drivers of House Prices in Advanced Economies", *IMF Working Paper*, July 2018.

3.1.1. Applications for our study

We borrow the backbone of our modeling framework from the studies referenced above. In particular, we exploit the fact that rents are found to have an impact on house prices and, following the example of other studies, in our house price equation we replace real rent with its main determinants—real income, housing stock, and household numbers.

In addition, a recent Oxford Economics (2016) study of the UK housing market found rising employment was among the main drivers of the boom; we therefore also include labor market conditions as an additional driver.[20] Moreover, our price model takes into account the hedonic characteristics of the area, measured by tourism GDP, and supply constraints, measured by building permits per household.

3.2. EXISTING LITERATURE ON SHORT-TERM RENTALS

We are aware of only a handful of academic papers that directly study the effect of short-term rentals on housing costs. There are two main reasons for the dearth of literature. First, the STR phenomenon is relatively recent and therefore a limited amount of data exists. Second, the research question is methodologically challenging, since many cities have become increasingly popular among both locals and tourists in recent years, leading to higher housing prices and a higher number of STR listings. In other words, "popularity" affects both prices and listings positively, as locals and tourists have a preference for living and staying in neighborhoods with high-quality amenities. This "popularity" variable, however, is unobservable, and its omission in the model implies that the impact of STR on prices is biased upwards, as part of the popularity impact gets erroneously captured by STRs.

The study whose methodology most closely aligns with our approach is that of Barron et al. (2018), which assesses the impact of STRs on residential house prices and rents.[21] The authors, however, fail to control for a number of explanatory variables included in our models. Using a dataset of Airbnb listings from the entire United States and an instrumental variables estimation strategy, they find that a 10% increase in the number of Airbnb listings leads to a 0.39% increase in rents and a 0.65% increase in home values. In Section 5.3.3, we show how our results compare to this study and conclude that our findings show a much smaller impact over our study period.

Most other studies, however, differ from ours (and Barron's) in two key respects. First, they focus on specific housing markets, rather than looking at US-wide relationships. Secondly, they use sales-level data to determine whether the proximity to STR-intensive areas affects sale prices.

[20] Oxford Economics, "Forecasting UK house prices and home ownership", November 2016.

[21] Barron, Kyle and Kung, Edward and Proserpio, Davide, "The Effect of Home-Sharing on House Prices and Rents: Evidence from Airbnb", 29 March 2018. More detail on the instruments used can be found in Fig. 18.

Among these studies, Horn and Merante (2017) use Airbnb listings data from Boston in 2015 and 2016 to study the effect of Airbnb on rental rates.[22] Similarly, Sheppard and Udell (2018) present an evaluation of the impacts of Airbnb on residential property values in New York City.[23] A third example is the article by Koster et al. (2019), which studies the effects of STRs in Los Angeles County using a quasi-experimental research design.[24] The main findings of these studies, and their main limitations, are summarized in the Appendix.

Another strand of literature provides descriptive analysis of STRs in specific markets. For example, Lee (2016) focuses on the Los Angeles housing market and makes recommendations on how municipal policymakers can best regulate Airbnb.[25] Other articles simply apply coefficients from other authors' analyses to their specific markets to derive estimates of local STR impacts (for example, Wachsmuth et al., 2018).[26]

3.2.1. Applications for our study

We build upon the studies referenced above to produce a nation-wide estimate of the impact of STRs on the housing market. In particular, this work presents the first econometric estimate that uses comprehensive data from across the US, as well as covering more STR platforms than only Airbnb. This means that we are able to include both owner-occupied home sharing and whole-property STRs. Our study does not have the objective of challenging existing literature, but rather to provide context for the findings and contribute to the body of work on housing dynamics.

As discussed earlier, one of the challenges in determining the impact of STRs on prices (and rents) relates to the fact that neighborhoods (and cities) tend to become popular with residents and tourists at the same time. In order to try to control for the so-called hedonic features of an area, we have used tourism GDP as a proxy. As an area becomes more popular for residents, bars and restaurants will start to appear, and at the same time hotels will start attracting tourists. Astoria in New York City or Corktown in Detroit are great examples of these popularity bursts.

[22] Keren Horn and Mark Merante, "Is home sharing driving up rents? Evidence from Airbnb in Boston", *Journal of Housing Economics*, 38 (2017): 14–24.

[23] Stephen Sheppard and Andrew Udell, "Do Airbnb properties affect house prices?", 1 January 2018.

[24] Hans R.A. Koster and Jos van Ommeren and Nicolas Volkhausen, "Short-term rentals and the housing market: Quasi-experimental evidence from Airbnb in Los Angeles", 8 March 2019.

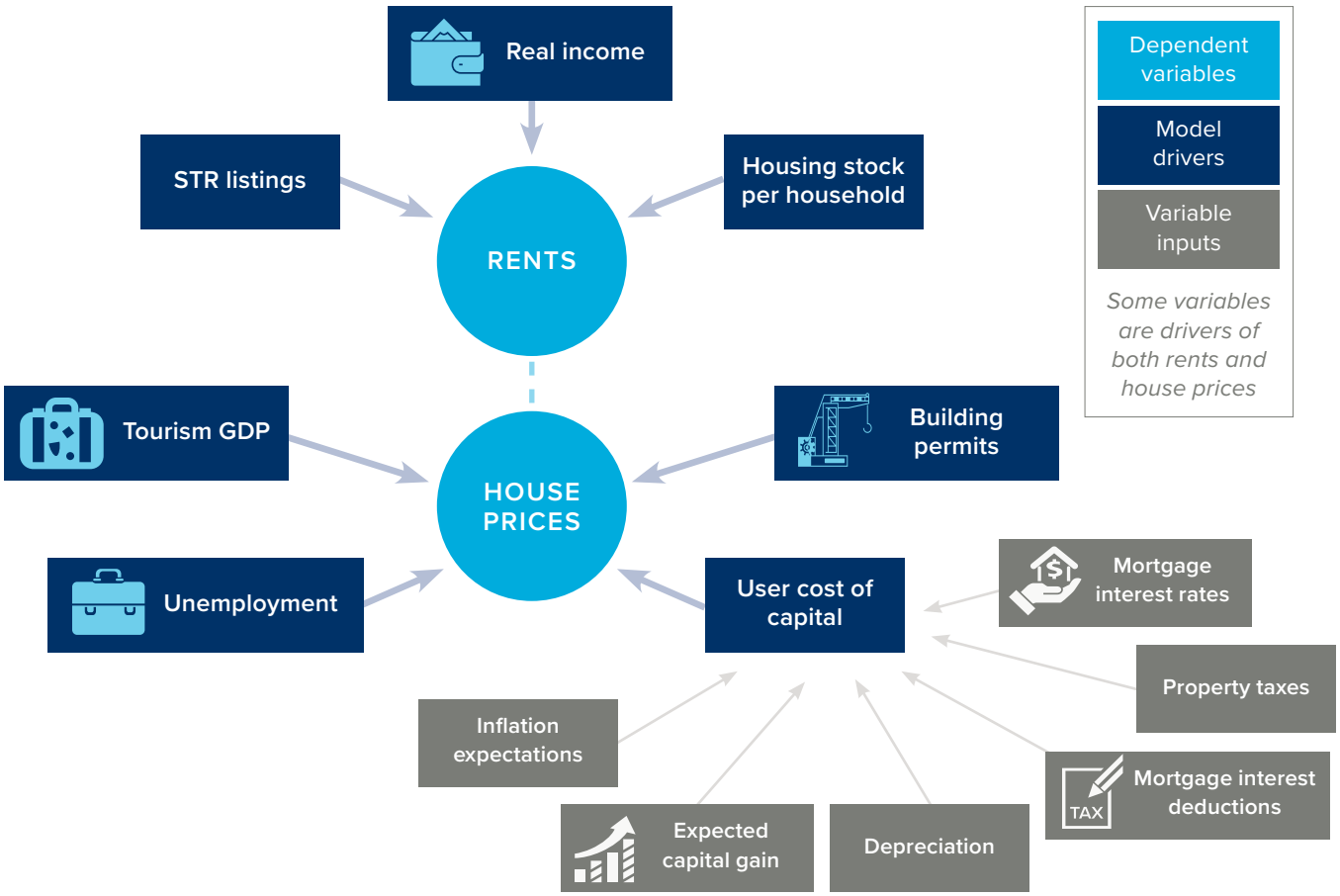
[25] Dayne Lee, "How Airbnb Short-Term Rentals Exacerbate Los Angeles's Affordable Housing Crisis: Analysis and Policy Recommendations", 2 February 2016.

[26] Urban Politics and Governance research group - School of Urban Planning - McGill University, "The High Cost of Short-Term Rentals in New York City", 30 January 2018.

4. MODELING APPROACH AND DATA

This chapter sets out our approach to modeling rents and house prices, in the context of the housing market relationships explained in the previous chapter. For this study we constructed a comprehensive dataset of all US counties over the period 2014–2018. The dataset included over 70 variables, ranging from average household income to the number of residential building permits in each county. This chapter begins by considering how best to model rents, and then moves on to house prices. All the relationships analyzed in this work are illustrated in Fig. 8.

Fig. 8. Drivers of rents and house prices



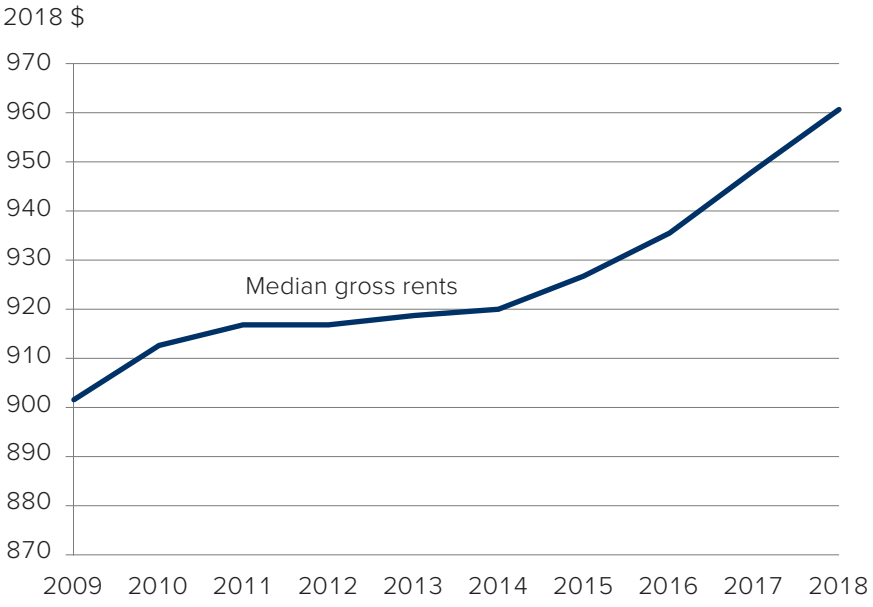
4.1. THE RENTAL MODEL

In this chapter, we argue that household income, housing stock, and the number of households are the main determinants of residential rent. We do so by analyzing rental prices, STRs and several socio-economic features of over 2,500 counties between 2014 and 2018.[27] Each variable is described below in turn.

4.1.1. Median rents

The dependent variable of this first model is real median rent (in logarithmic form, to be more specific). Real rents increased by just over 1% per year over the study period, but they had been flat in the years just before that (Fig. 9). The data were sourced from the American Community Survey (ACS), and the 2018 data point was estimated using historical growth rates.

Fig. 9. Median gross rents



Source: ACS

4.1.2. The STR density variable

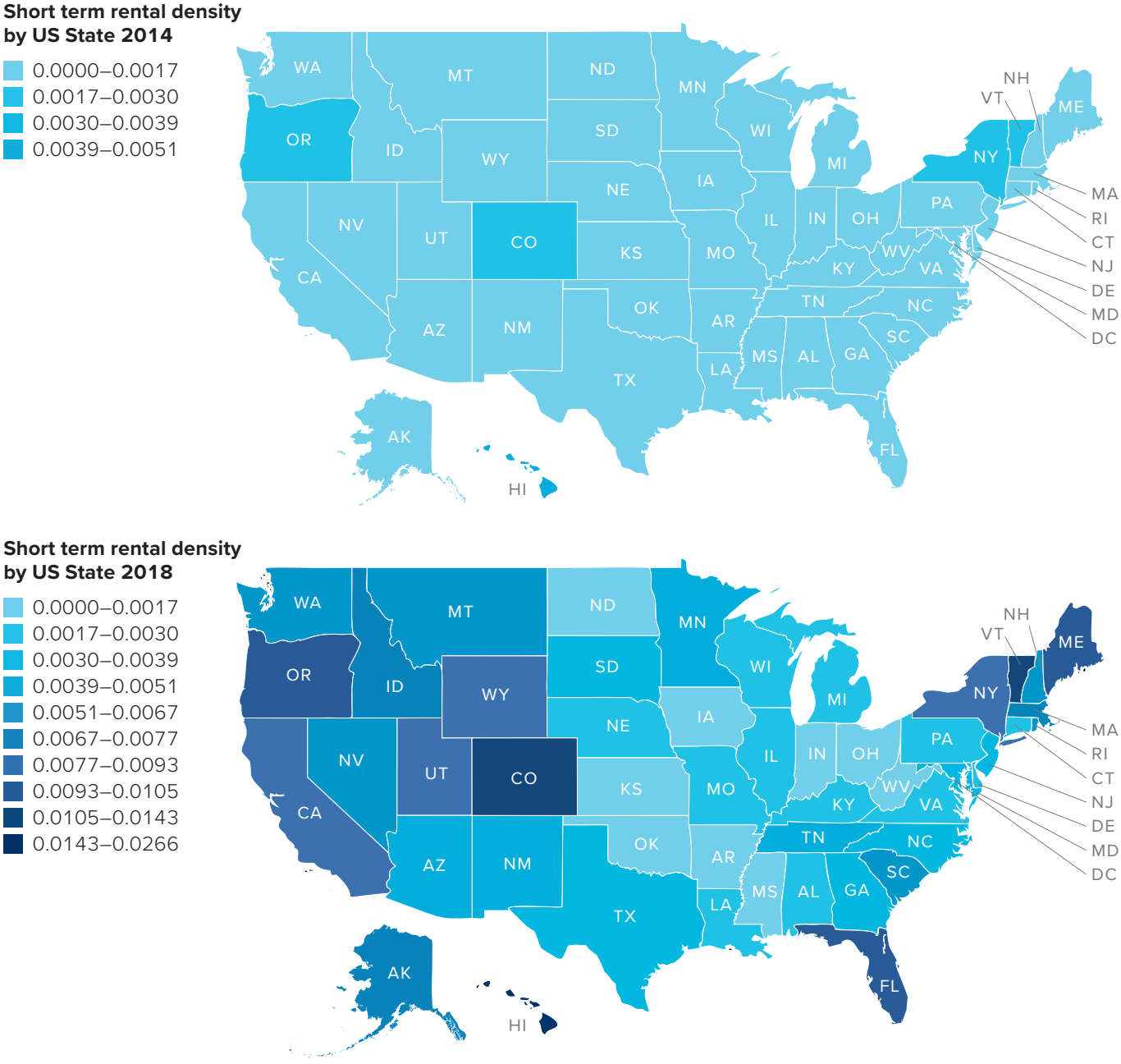
The advent and fast growth of the sharing economy have impacted the accommodation sector. While vacation rentals have been a critical component of communities across the globe for well over a hundred years, the technology revolution in flexible accommodations brought about by platforms like Vrbo and Airbnb has not only opened up millions of unique rental options for travelers but also changed the foundation of the travel ecosystem.

Data provider AirDNA suggests there were over 1.3 million active listings across the US as of June 2019, rising from just over 70,000 five years earlier.[28] Back in 2014, for every 1,000 housing units there was just over one STR listing, while in 2018 this ratio grew to 8 listings per 1,000 housing units.[29]

Fig. 10 shows the geographic distribution of STR density in 2014 and 2018. It shows there is significant geographic heterogeneity in STR density, with most listings occurring in states with large cities and along the coasts. Moreover, there exists significant geographic heterogeneity in the growth of STR density over time. The

[27] Listing data were missing for some US counties, so we had to exclude those from our study.
[28] This study does not distinguish between whole-home rentals and owner-occupied units and includes both types of STRs.
[29] This is how we define STR density, i.e. as the number of STR listings per 1,000 housing units.

Fig. 10. STR density in 2014 and 2018, by state



Source: AirDNA, ACS, Oxford Economics

number of listings per housing unit grew exponentially in some states, while in others there was no growth at all.

4.1.3. Real incomes

Real mean household income data from the Census Bureau show a marked slowdown in growth in 2018 relative to previous years (Fig. 11). Median household incomes also only rose slightly in 2018 and 2017, after registering more impressive gains in the two years prior: a 5.2% gain in 2015 and a 3.2% gain in 2016.

Income data by county and over time were obtained from the American Community Survey and complemented with Oxford Economics' North American Cities and Regions databank to fill the gaps left in 2018 by the ACS (the latest available edition was 2017).

4.1.4. Housing supply

Since reaching their lowest point in 2011 at just 633,000 new housing units that year, additions to the housing stock have grown at a fairly slow pace, partly in response to persistently weak growth in the number of households after the recession. With the economy finally back on track, household growth picked up in 2016–2018, but new construction was still depressed relative to demand, with additions to supply barely keeping pace with the number of new households.

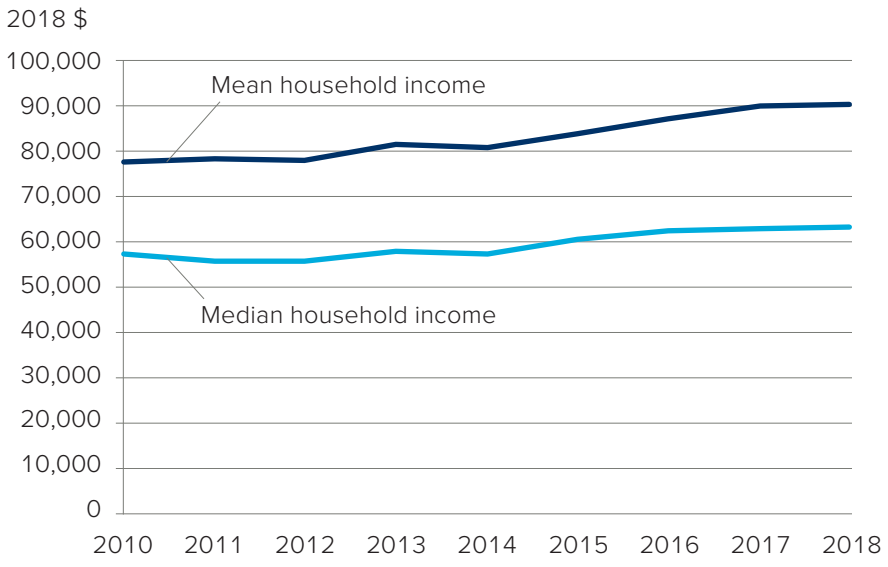
In our dataset, the number of housing units was drawn from the Census' Population Estimates, while the number of households was drawn from the ACS and carried forward to 2018 using Oxford Economics' North American Cities and Regions databank.

4.1.5. Household size

As one might expect, median rents are also related to the size of the average household (average number of people in one household). As this grows, households will require bigger properties, resulting in higher median rents. In particular, we restrict our analysis to households that occupy rented accommodations (i.e., in our rental model, we disregard the size of owner-occupier households as this should not affect rents; only the size of renter households is expected to impact rents).

Generally speaking, household size has been on a declining trend for centuries, with an

Fig. 11. Average and median household income, constant prices, 2010–18



Source: Oxford Economics

average of 5.79 people per household in 1790 to 2.58 in 2010.[30] However, Census Bureau data suggests this might be the decade when this long-term trend is reverted, with 2018 size ticking up to 2.63. Going forward, this might have impacts on housing demand, and therefore housing costs (provided it does not immediately translate into weaker residential construction).

4.2. THE HOUSE PRICE MODEL

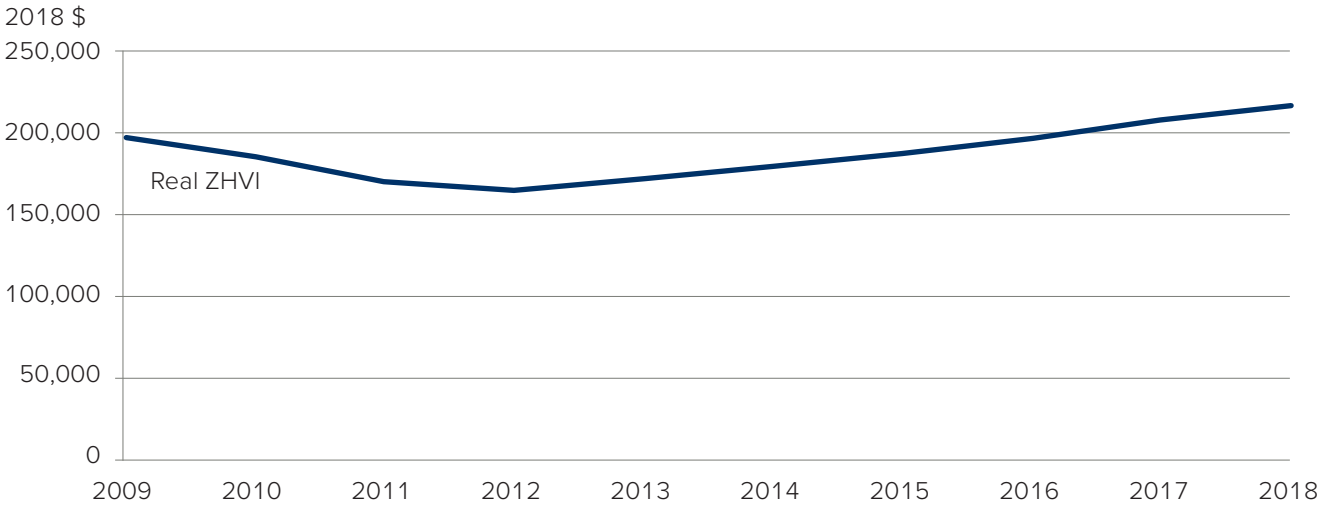
As discussed in Section 3.1, rents are likely to affect home buying decisions, and therefore most of the drivers of rents are also included in the house price model. Above and beyond these, we also included labor market outcomes, the user cost of capital, the availability of building permits, and the size of the tourism sector as additional explanatory variables. The rest of this chapter describes each variable in turn and provides a rationale for inclusion in the model.

4.2.1. House price index

As a dependent variable for our second econometric model, we used the Zillow Home Value Index (ZHVI), a smoothed measure of the median home value across all US counties. This is a dollar-denominated figure, which we then adjusted for inflation using the Consumer Price Index (CPI). This variable was available on a monthly basis for all counties in the US.

Since the recession, house prices have climbed steadily, boosted by low interest rates and the recovering economy (Fig. 12). This study aims at identifying the key drivers of house prices during the period between 2015 and 2018.

Fig. 12. Real US Zillow Home Value Index, 2008–2019



Source: Zillow, Oxford Economics

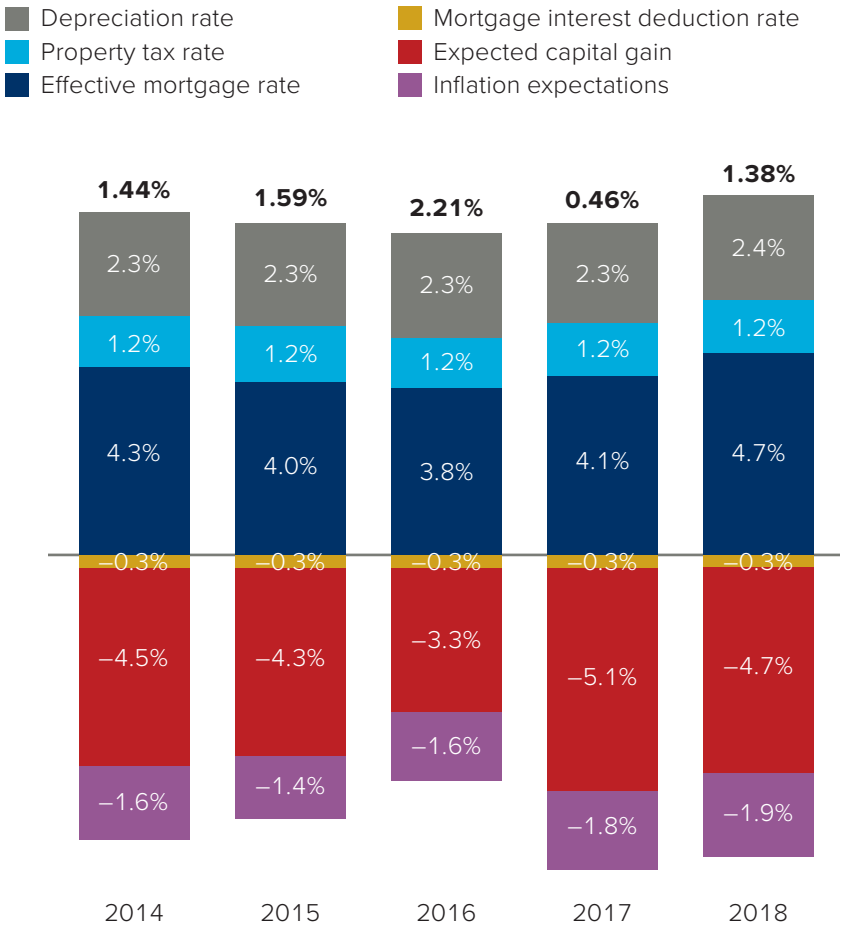
[30] Pew Research Center, "The number of people in the average U.S. household is going up for the first time in over 160 years" <https://www.pewresearch.org/fact-tank/2019/10/01/the-number-of-people-in-the-average-u-s-household-is-going-up-for-the-first-time-in-over-160-years/> [accessed 22 October 2019]

4.2.2. User cost of capital

As discussed in Chapter 3.1, the so-called "user cost of capital" is determined most obviously by the mortgage interest rate (Fig. 13); if this rises so does the cost of owning a property at any given price level. In addition to this, property taxes (minus mortgage interest deductions), expectations of inflation and capital gains, and depreciation rates all affect how costly it is to own a house of any given price.

Not all components of this variable could be gathered at the county level; for example, effective interest rates paid by mortgage holders were obtained from the Federal Housing Finance Agency by state. Expected inflation, capital gains, depreciation and mortgage interest deductions were estimated for the US as a whole. Average property tax rates, however, were estimated using ACS data at the county level, dividing the median tax value by the median property value.

Fig. 13. Estimated user cost of capital, 2014–18



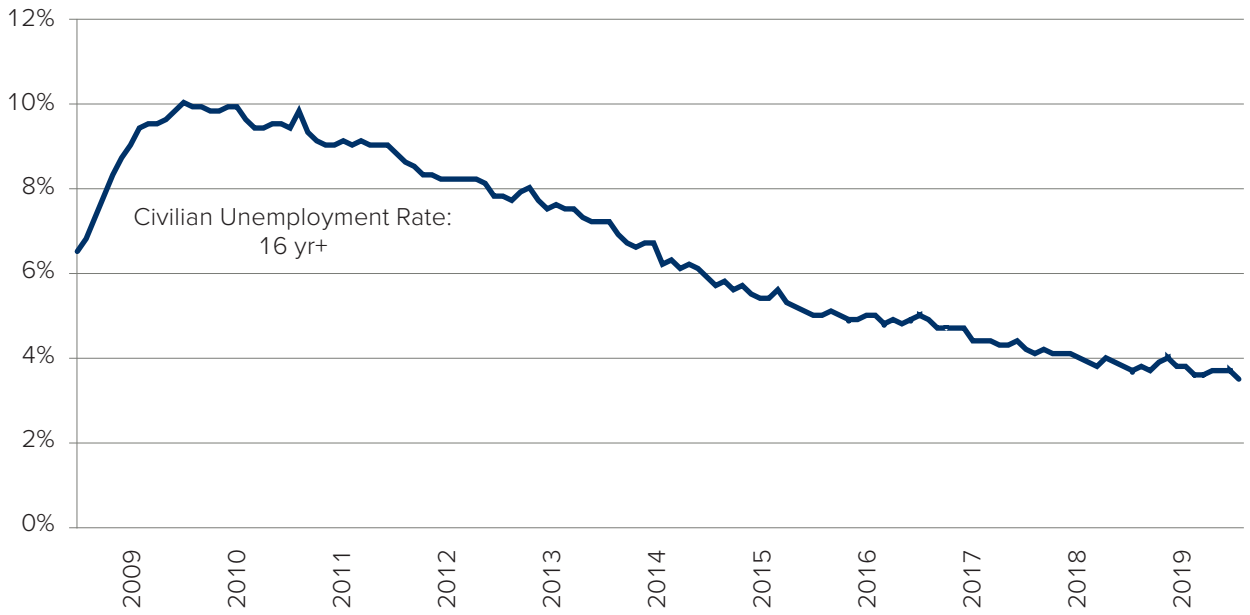
Source: Oxford Economics

4.2.3. Unemployment rate

Existing academic research provides an analysis of the extent to which unemployment influences housing market outcomes (see for example Gan and Zhang, 2018, among others).[31] Intuitively, a stronger local labor market makes an area more desirable to potential migrants and increases willingness to pay for housing in the area, and vice versa.

This channel is particularly relevant in light of the recent positive developments of the US labor market. September's unemployment rate hit a 50-year low, reaching 3.5% (Fig. 14). These labor market improvements are found to have had an impact on house prices, as we will discuss in Chapter 5.

Fig. 14. US unemployment rate



Source: BLS

[31] Li Gan and Qinghua Zhang, "Market Thickness and the Impact of Unemployment on Housing Market Outcomes", *Journal of Monetary Economics*, 98 (2018): 27–49.

4.2.4. Building permits

As described in Section 4.1.4, housing supply is a key determinant of housing market dynamics. However, the actual number of housing units is not the only supply-related factor that is likely to affect house prices. Projected housing supply is also potentially relevant for today's house prices. In our model, building permits are used as a proxy for this. This variable was obtained from the Building Permits Survey, produced by the Census Bureau.

The latest national level data released in September show that permits for future home construction rose to levels last seen in 2007. The recent surge in both housing starts and permits relieved some of the pressure on house prices over our study period, as we will describe in Chapter 5.

4.2.5. Tourism

As discussed earlier, one of the challenges in determining the impact of STRs on prices (and rents) relates to the fact that neighborhoods (and cities) tend to become popular with residents and tourists at the same time. In order to try to control for the so-called hedonic features of an area, we propose using tourism GDP as a proxy.

This work controls for growth in the tourism sector (food and beverage and accommodation services), as we believe **it is important to break down the impact of tourist attractiveness of a locality from the pure impact of STRs**. We measure tourism as the average GDP produced by the hospitality sector for each resident household. Therefore, areas where hospitality GDP has grown at a faster pace than household formation will see a growth in their tourism variable, and vice versa.

In the US as a whole, tourism GDP has grown at a slightly faster pace than households during our study period, thus exerting a slight positive pressure on house prices, as shown in Chapter 5.

5. RESULTS AND DISCUSSION

In this chapter, we set out the results of our models of rents and house prices and explain their interpretation. We also compare our results with those of past studies where comparable analysis has been carried out.

5.1. THE RENTAL MODEL

In the rental model, all variables have the expected impact and are statistically significant. The effect of income is positive and significant, while that of housing stock per household is negative and significant, as expected.

The long-run impact of STR listings is equivalent to 0.0007, or in other words, an increase of one listings per 1,000 housing units is associated with a 0.07% increase in median rents.[32] In a hypothetical county with a $1,000 median rent, if STR density increased by one listing per 1,000 units, the associated long-run increase in median rents is equivalent to $0.7 per month.

The long run coefficients from the model for the other explanatory variables can be interpreted as follows:

- a 10% increase in real median income is associated with an 8.8% increase in median rents.
- a 10% fall in the housing units-to-household ratio is associated with a 4.9% increase in median rents.
- a 10% increase in the average household size is associated with a 2.6% increase in median rents.

How well does this model reflect the reality of how rent is determined? We can calculate a MAPE (Mean Absolute Percentage Error) to assess our model accuracy.[33] We calculated this to be 2%; in other words, considering the average rent across the counties used in our dataset, the margin of error in our model prediction will be around $14.

5.2. THE HOUSE PRICE MODEL

In the house price model, all variables have the expected impact and are statistically significant. The effect of income is positive and significant, while that of housing stock per household is negative and significant, as expected.

Focusing on some of the long-run effects, the coefficient for the variables can be interpreted as follows:

- an increase of one STR listing per 1,000 housing units is associated with a 0.13% increase in the real house price index. In other words, in a hypothetical county with a $100,000 house price index, if STR density increased by one listing per 1,000 units, the associated long-run increase in the price index is equivalent to $130.
- a 10% increase in mean income is associated with a 3.2% increase in the real house price index.
- a 10% fall in the housing units-to-household ratio is associated with approximately a 18.9% increase in the real house price index.
- a 1-percentage-point increase in the unemployment rate is associated with a 2.4% fall in the real house price index.

[32] Short-run effects look at the immediate impact of a variable X over Y. Over time, given the dynamic nature of the housing market, there will be several equilibrating adjustments to the short-run effects, as the economy and people readjust. As a result, the long-run effect of a given variable X over Y is different. Our econometric methodology can distinguish between the long-run and short-run effects. The estimated coefficients presented in Fig. 19 represent the short-run effects, and the long-run effects are estimated using the Delta method, whereby the short-run effects are discounted by one minus the coefficient on the lagged dependent variable.

[33] The mean absolute percentage error (MAPE) is the mean or average of the absolute percentage errors of forecasts. Error is defined as actual or observed value minus the forecasted value (in our case, the model predicted value). This measure is easy to understand because it provides the error in percentage terms.

- a 1-unit increase in the number of building permits per household is associated with a 6.9% fall in the real house price index.

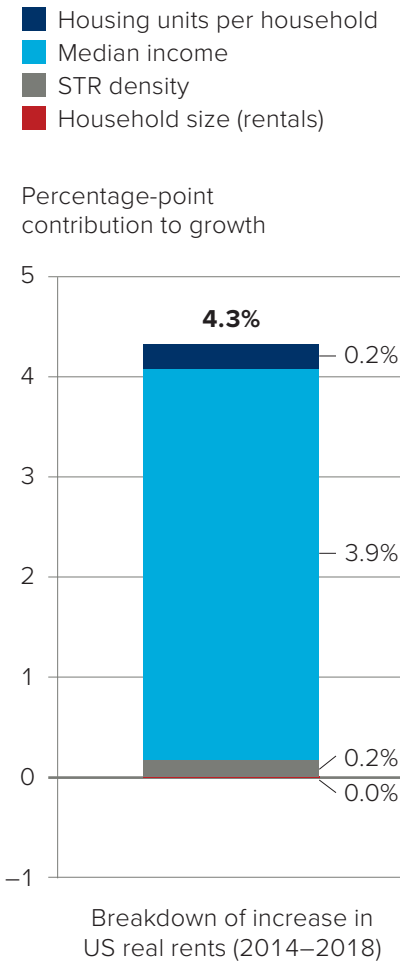
Here too, the house price model fits the actual data well, as illustrated by the MAPE. We calculated this to be 1.7%. In other words, considering the average house price across the counties used in our dataset, the margin of error in our model prediction will be around $2,600.

5.3. CONTRIBUTION ANALYSIS

5.3.1. Rent growth between 2014 and 2018

In the four years between 2014 and 2018, US median rental prices rose by 4.3% in real terms. The findings of our rental model, combined with changes in the explanatory variables over the study period, show that the **overwhelming driver of the observed increase in real rental prices during the 2014–18 period was household earnings.** Median income increased by 10.4% in real terms between 2014 and 2018 and we estimate that this growth alone was responsible for around 3.9 percentage points of the 4.3% increase (Fig. 15).

Fig. 15. Drivers of the growth in real rents between 2014 and 2018[34]



Source: Oxford Economics

Between 2014 and 2018, 5.1 million new households are estimated to have formed in the US, while net new supply was 4.1 million in the same period. This implies the ratio of housing units-to-households has declined between 2014 and 2018, pushing up rents. We estimate this drop contributed about 0.2 percentage point of the 4.3% increase in real rents.

The ratio of STR listings to housing units has grown by a factor of 6 during the study period. This increase, however, contributed to 0.2 percentage point of the increase in rents. Putting it all together, Fig. 15 reveals the contributions of various factors to the 4.3% increase in rents in the four years from 2014 to 2018.

5.3.2. House price growth between 2015 and 2018

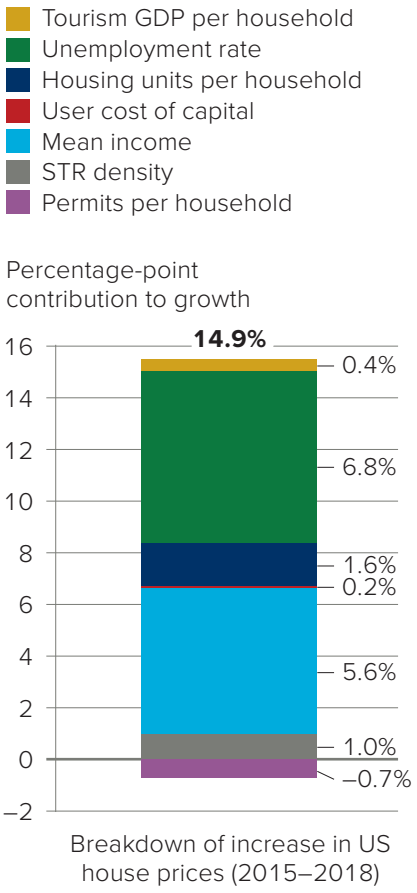
House prices have increased steadily during our study period, with real US median price index estimated to have increased by 14.9% during the period 2015–18.[35] Using the model to break down the causes of this rapid growth, we see that **the biggest contribution to the increase came from labor market improvements.**

[34] This section and chart assume that 100% of the growth in median rents can be explained through the model's explanatory variables. This is a simplifying assumption, and we are aware that our model's variables do not explain the totality of the change.

[35] As the house price model contains some lagged variables, the focus of this contribution analysis will be limited to the period 2015–18. The inclusion of lagged STR in the model implies that STR growth between 2014 and 2015 (the first available year-on-year growth rate) only starts affecting house prices in 2015–16. For this reason, the contribution analysis presented here only covers the period 2015–18 and not 2014–18.

More specifically, the drop in unemployment rate is estimated to have contributed 6.8 percentage points to US house price growth by the end of 2018 (Fig. 16).

Fig. 16. Drivers of the growth in house prices between 2015 and 2018[36]



Source: Oxford Economics

The second-largest contributor to the house price growth was the increase in average incomes. Over the whole period, higher real incomes are estimated to have boosted house prices growth by 5.6 percentage points.

The drop in housing stock-per-household has also contributed to house price growth. This reduction contributed to an increase in house price growth over the period of around 1.6 percentage points. The ratio of STR listings to housing units has grown by a factor of 3 during 2015–18. This increase contributed 1.0 percentage point to the house price increase based on our econometric model. The number of building permits per household has grown over this period, which offset some of the increase driven by other factors. Lastly, tourism GDP growth and the drop in user cost of capital contributed around 0.4 and 0.2 percentage points to price growth, respectively.

5.3.3. Discussion

Summing up the findings presented in Fig. 15 and Fig. 16, we estimate the growth in STR density only contributed to 0.2 percentage point of the 4.3% increase in rents (or 6%) and 1.0 percentage point of the 14.9% increase in house prices (or 5%) over our study period.[37]

This result is more modest than than the conclusions drawn by Barron et al., who found that the growth in Airbnb listings contributed to about one-fifth of the average annual increase in US rents and about one-seventh of the average annual increase in US housing prices. Our model includes a number of explanatory variables not considered by Barron et al., suggesting their results are likely to suffer from omitted variable bias.

5.3.4. What does this tell us about affordability?

When interpreting the house price model, it is important to note that, while house prices are interesting per se, housing affordability is a more relevant metric for policy makers. In this work, we measure affordability as the median house price divided by the mean household income.

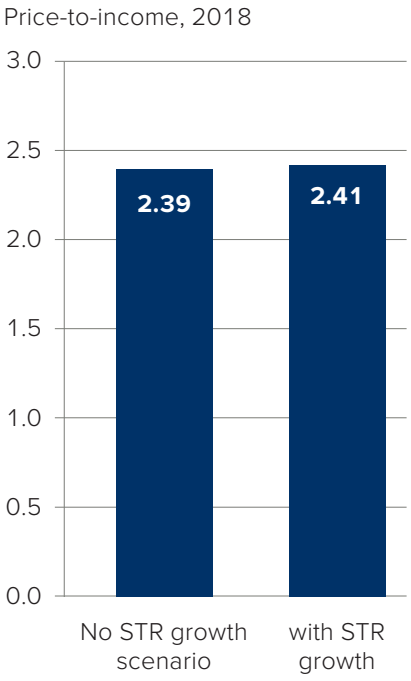
[36] This section and chart assume that 100% of the growth in median house prices is explained through the model's explanatory variables. This is a simplifying assumption, and we are aware that our model's variables do not explain the totality of the change.

[37] Adding up all the individual explanatory variables' contributions (measured in percentage points) results in the total growth rate in the dependent variable (measured as a percent increase).

In this study, we found that house prices have increased by 14.9% during the period 2015–18, and that only 1.0 percentage point of this growth can be attributed to increased STRs. We are therefore able to estimate the 2018 median price of a property in the US in a counterfactual scenario where STR numbers did not grow. We do so by subtracting from the current house price value the amount that was due to STR growth. By dividing this estimated counterfactual house price by the average household income in 2018, we obtained the price-to-income ratio for the scenario where STR did not grow.[38]

We find that the price-to-income ratio would have increased to 2.39 in 2018 (from 2.23 in 2015) in a scenario with no STR growth (Fig. 17). In the current baseline scenario (with STR growth), the price-to-income ratio was at 2.41 in 2018. This suggests that STRs are estimated to be responsible for a 0.02-point fall in affordability (or increase in the price-to-income ratio).

Fig. 17. Price-to-income ratio in 2018, with and without STR growth



Source: Oxford Economics

[38] The underlying assumption here is that the lack of STR growth would have no impact on average incomes.

MODEL EXTENSION 1: THE IMPACT OF STRS IN VACATION DESTINATIONS

Is the impact of STRs on prices and rents different in traditional vacation markets? In both the house prices and the rental model, we find that, in the long run, the effect of STRs on the dependent variable is weaker in these highly seasonal areas.

This result is in line with expectations. As far as the **rental market** is concerned, in vacation markets, homes are less likely to be rented on a long-term basis. That means that STRs have an even smaller effect on rents in these markets. For example, **Tillamook County, OR,** popular for its scenic coastline and rivers, has seen its STR density grow by a factor of 10 between 2014 and 2018, but its median rents have actually fallen in real terms. Some 88% of its vacant housing is for seasonal use in the area.

In the **homeowners' market**, by their very definition, vacation-destination housing markets have higher vacancy rates that reflect more volatile seasonal housing demand. The impact of STRs on house prices is found to be weaker in these areas, as home owners have been renting out their properties long before the advent of internet platforms offering STRs (through agencies and brokers) and therefore the value from such rental revenue has long been priced in the value of homes in these localities. An example of this is **Barnstable County, MA,** home to popular New England beach destination Cape Cod. In this county, over 91% of vacant properties are for seasonal use, and STR density has increased by a factor of four between 2015 and 2018, which was faster than the national average. Real house prices, however, have increased by 11.2% over the same period, a slower pace than the US as a whole.

MODEL EXTENSION 2: THE IMPACT OF STRS IN URBAN AREAS

Does the impact of STRs on prices and rents vary across urban and rural counties? In both the house prices and the rental model, we find that the effect of STRs on the dependent variable does not depend on the level of urbanization. In other words, we do not see a significant difference in the long-run impact of STRs on prices and rents between urbanized and rural areas.

San Diego is an example of how the US-wide results apply to highly urbanized areas. Its house prices have grown by an estimated 15.0% between 2015 and 2018, and its STR density has grown by a factor of 3 within the same period. This compares to a very similar US-wide house price growth of 14.9% and an STR density growth of a factor of 3.

6. CONCLUSION

The aim of this study was to assess the contribution of STR growth on the growth in house price, rental price, and affordability. We have found that **the rapid US house price and rent increases of the past few years have not been substantially driven by STRs.** We estimate the growth in STR density only contributed to 0.2 percentage point of the 4.3% increase in rents and 1.0 percentage point of the 14.9% increase in house prices over our study period. This compares to a 3.9 percentage points impact of median incomes to rental growth and a 6.8 percentage points effect on house price growth stemming from the drop in US unemployment over the study period.

This has important implications for a policy debate that has focused heavily on short-term rentals as both the cause of the problem of high house prices and its solution. It suggests instead that **the major sources of volatility in rental and house prices lie in economic and labor market outcomes.**

Second, this study has found that **additional housing supply and more abundant building permits are likely to have a meaningful impact on house prices.** It is estimated that in the long run, a 10% increase in the housing units-to-household ratio is associated with approximately a 18.9% fall in the house price index, and a one-unit increase in the number of building permits per household is associated with a 6.9% fall in the house price index.

Finally, our analysis has pointed to the fact that **adopting strict regulations on STRs is unlikely to solve the housing affordability crisis faced by many US households.** During the period 2014–18, in the absence of STR growth, real rent would have grown by 4.1%, rather than 4.3%. In other words, monthly rents would have been $2 lower in 2018 if STRs had not increased from their 2014 levels.

Similarly, in the homeowners' market, prices would have been only $1,800 lower in 2018 if STR density had not gone up from its 2014 level. Considering that most households do not pay the full price of a house upfront, but rather apply for long-term mortgages, the expected annual impact attributable to the STR sector is $105.[39]

Interestingly, a model extension suggests that the effect of STRs on both house prices and rents is weaker in vacation destinations. Possible explanations for this are that, in vacation markets, homes are less likely to be rented on a long-term basis and home owners in these destinations have been renting out their properties long before the advent of internet platforms offering STRs. On the other hand, the effect of STRs on both variables does not appear to depend on the level of urbanization.

[39] Mortgage maturity and effective interest rate are assumed to be as reported in the latest Federal Housing Finance Agency's Monthly Interest Rate Survey.

STR LITERATURE FINDINGS

Fig. 18 summarizes the main findings of the studies presented in Chapter 3.2, and their main limitations.

Fig. 18. Summary of existing STR literature

Author	City of interest	Main findings	Main limitation
Barron et al. (2017)	US-wide	A 10% increase in Airbnb listings leads to a 0.39% increase in rents and a 0.65% increase in home values.	The authors construct an instrument based on Google Trends searches for Airbnb. Unfortunately, these are not accurately available at the zip code level, so to obtain an instrument that varies at the zip code level they interact these searches with a measure based on the number of hospitality establishments in the zip code area. The validity of this instruments can therefore be disputed.
Horn and Merante (2017)	Boston	0.4% increase in asking rents associated with a one-standard-deviation increase in Airbnb listings	The authors rely on weekly rent data from September 2015 through January 2016 and Airbnb data from September 2014 to January 2016. Thus their time dimension is fairly limited. We believe this hinders their ability to establish meaningful relationships between the various variables.
Sheppard and Udell (2018)	New York	6.46% increase in NYC property values associated with a doubling in the number of total Airbnb accommodations	The authors do not convincingly account for the fact that neighborhoods tend to become more attractive to residents and tourists at the same time.
Koster et al. (2019)	Los Angeles	3% fall in house prices as a result of Home Sharing Ordinances in Los Angeles	The authors use Airbnb listings as a proxy for tourism demand, which means that they do not control for other tourism variables. That runs the risk of overestimating the impact of Airbnb and attributing the entire “touristic location” effect to the fact that STRs are present. In contrast, this work controls for tourism GDP unrelated to STR activity.

METHODOLOGICAL APPENDIX

INTRODUCTION TO DYNAMIC PANEL MODELS

House prices (or rents) in the current period might be affected by past trends in house prices (or rents), as well as housing supply and general economic conditions. In such cases, dynamic panel methods, such as the Arellano Bond estimator (also known as Difference GMM) and Blundell Bond estimator (System GMM), would allow us to account for the presence of such "dynamic effects." Difference GMM estimation starts by transforming all regressors, usually by differencing, and uses the generalized method of moments (GMM). This work employs Difference GMM.

Dynamic panel models have become increasingly popular in many areas of economic research, and their use has provided new insights. Using dynamic panel models allows us to find overall (long-run) coefficients for the explanatory variables as well as the contemporaneous (or short-run) ones.

The advantages of dynamic models include:

- controlling for the impact of past values of house prices (or rents) on current values;
- estimation of overall (long-run) and contemporaneous (short-run) effects; and
- use of past values of explanatory variables as instrumental variables to mitigate the bias due to: two-way causality between economic conditions and the housing market, omitted variable bias and measurement error.

The need for a dynamic model: Wooldridge test for serial correlation

The Wooldridge test allows us to test whether the errors are serially correlated; if these are found to be autocorrelated, we may infer that there is a need for a dynamic model.[40] The disadvantage of a dynamic panel model, however, is that it can add considerable complexity to the modeling process. A simpler static model might therefore be a preferable approach if the Wooldridge test does not suggest a dynamic panel is necessary.

[40] Strictly speaking, the Wooldridge test is a test for autocorrelation and not a definitive test to choose between static and dynamic panel methods. However, it is commonly applied to inform choices between static and dynamic panels.

Use of instruments

Instruments are used to control for potential endogeneity in a regression. We have found median incomes (rent model), permits per household, housing supply per household and STR density (house prices model) to be endogenous variables, and therefore the instrumental variable method was used to estimate their impact.

MODEL RESULTS

As explained, our model specification is known as Difference GMM; such approach, by virtue of being a dynamic model, has both a short- and long-run impact. The short-run results from the rent and house price models are given in Fig. 19. To obtain the long-run impact, we used the Delta method and discounted the short-run impact by one minus the coefficient on the lagged dependent variable.

Contribution analysis

The modeling results shown in Fig. 19 tell us about the sensitivity of rents and prices to changes in their macroeconomic determinants. But these results can also be used to find out which of the determinants were responsible for past changes in the dependent variables. For instance, Fig. 19 shows that the user cost of capital has a significant negative effect on house prices. But while house prices may be sensitive to changes in the user cost of capital, if there was no (or little) change in the user cost over the study period, then this variable will not have influenced house prices during that period.

The "contribution" of a given variable in explaining changes in house prices or rents is therefore a combination of both the estimated sensitivities and the change in that variable over the period under analysis.

Fig. 19. Models results

Rental price model *Dep var: Log real median rents*	**Short-run coefficients**
Lagged log real median rents	0.706***
STR density	0.0002**
Log median income	0.259***
Log housing units per household	-0.144*
Log household size (rental)	0.076*

House price model *Dep var: Log real median house prices*	**Short-run coefficients**
Lagged log real median house prices	0.719***
Lagged STR density	0.0004*
Lagged log mean income	0.091***
Lagged user cost of capital	-0.161***
Log housing units per household	-0.531***
Lagged unemployment rate	-0.663***
Lagged tourism GDP per household	6.345**
Permits per household	-1.929***

legend: * p < 0.1; ** p < 0.05; *** p < 0.01

Models with interactions

Is the impact of STRs on prices and rents different in traditional vacation markets? The model coefficients described so far measure the average impact of STRs on the dependent variables (prices and rents). Our baseline model looks as follows (in the example of prices):

$$house\ prices_{it} = \alpha \times STR_{it} + \beta X_{it} + \gamma house\ prices_{it-1}$$

However, in order to isolate vacation markets, we added an interaction term to our models, using the percentage of seasonal housing as a proxy to define these areas.[41] The model is now specified as follows:

$$house\ prices_{it} = \alpha 1 \times STR_{it} + \alpha 2 \times STR_{it} \times vacation_{i} + \beta X_{it} + \gamma house\ prices_{it-1}$$

Without the interaction term, α would be interpreted as the total effect of STRs on prices. But the interaction means that the effect of STRs on prices is different for vacation markets and less touristic areas. The effect of STRs on prices in non-touristic counties is equal to $\alpha 1$. However, in vacation markets the effect is equal to $\alpha 1 + \alpha 2$.

In both the house prices and the rental model, the interaction term for vacation markets is negative and statistically significant, suggesting that the effect of STRs on the dependent variable is weaker in these highly seasonal areas.

We run a similar model replacing the vacation dummy variable with an urban dummy variable.[42] In this case, however, the interaction term for urban centers is not statistically significant, suggesting that the long run effect of STRs on the dependent variable (either house prices or rents) does not depend on the level of urbanization.

[41] The vacation variable is a dummy taking value 1 if the county's % of seasonal housing is above average, and 0 otherwise.
[42] The urban variable is a dummy taking value 1 if the county's % of urban population is above average, and 0 otherwise.

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RESEARCH LEADS ON THIS REPORT

Alice Gambarin, Senior Economist

Alice is experienced in economic impact and econometric studies. While at Oxford, she worked on several econometric projects including a study to assess the value of the academic publishing ecosystem, and a forecast of infrastructure needs globally.

agambarin@oxfordeconomics.com, (646) 503 3054

Hamilton Galloway, Head of Consultancy, Americas

Hamilton's work includes leading Oxford's consulting practice in the US, conducting bespoke economic and labor market research and engaging public and private sector clients.

hgalloway@oxfordeconomics.com, (646) 503 3068

Oxford Economics, 5 Hanover Sq., 8th Floor, New York, NY 10004.

Tel: +1 646-786-1879 Web: www.oxfordeconomics.com/consulting Twitter: @OxfordEconomics

OXFORD ECONOMICS

Global headquarters
Oxford Economics Ltd
Abbey House
121 St Aldates
Oxford, OX1 1HB
UK
Tel: +44 (0)1865 268900

London
4 Millbank
London, SW1P 3JA
UK
Tel: +44 (0)203 910 8000

New York
5 Hanover Square, 8th Floor
New York, NY 10004
USA
Tel: +1 (646) 786 1879

Singapore
6 Battery Road
#38-05
Singapore 049909
Tel: +65 6850 0110

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Email:
mailbox@oxfordeconomics.com

Website:
www.oxfordeconomics.com

Further contact details:
www.oxfordeconomics.com/about-us/worldwide-offices