Differential drivers of rent burden in growing and shrinking cities

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Abstract

Housing affordability is an issue of increasing importance and interest, particularly in the United States. Much of this interest is due to skyrocketing rents in coastal cities with tight housing markets. Shrinking cities, in contrast, are often characterized as rich in low-cost housing, providing an affordable alternative to superstar cities. This paper compares income and rent dynamics in cities with growing versus shrinking populations. While costs may be lower in shrinking cities, falling incomes have likely rendered housing unaffordable for many residents. We employ multiple lines of evidence to test for different dynamics between growing and shrinking cities. Matching is used to explore changes in income and rent between 1980 and 2017 in shrinking and the most similar non-shrinking cities. After controlling for baseline conditions, shrinking cities exhibit faster falling incomes and growing cities exhibit

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faster rising rents, while rent burden increases at a very similar rate in both groups. We also use a fixed effects regression model to test for differences between growing and shrinking cities in sensitivity of rent burden to changes in income and rent. Rent burden has considerably increased across US cities since 1980, yet growing and shrinking cities exhibit clearly different pathways toward that end. Shrinking cities are more sensitive to identical changes in income and rent, likely because a greater share of their residents live near the edge of affordability.

Introduction

Housing affordability crises in destination cities like New York, Los Angeles and San Francisco have commanded national attention as an influx of skilled workers has dramatically increased demand, pushing rent increases beyond wage growth for incumbent residents (Kaysen, 2017; Metcalf, 2018; Zraick, 2018). One rental listing platform reported the median monthly rent for a one-bedroom apartment in San Francisco at US$3,690 for March 2019, the highest in the United States (US) (Chen, 2019b). The ten cities with the highest median rents are all located in high-growth coastal regions: five are in California and three are in the Northeast corridor. Momentum is gathering behind policy responses to localized housing crises, including hotly debated California Senate Bill 50, which would require local governments to allow higher-density development and calls to expand rent control, intensifying debates over its effectiveness (Dougherty, 2018).

Shrinking cities, conversely, are popularly characterized as replete with low-cost housing, providing an affordable alternative to superstar cities and their astronomically priced units (Conlin, 2015). As cities lose population, they also lose demand for housing, lowering home prices, in some instances to as low as US$100 (Barlow, 2009). In shrinking cities, municipal leaders are often more concerned with removing vacant properties than adding new units

(Rosenman and Walker, 2016; Saulny, 2010). Median rents in Rustbelt cities like Detroit, Cleveland and St. Louis remain well below those of coastal cities. Median rent for a one-bedroom apartment in Detroit is US$610, just 17% of the comparable cost in San Francisco (Chen, 2019a). Selective out-migration, however, means shrinking cities retain a large share of low-income households (Franklin, 2019; Galster, 2019; Martinez-Fernandez et al., 2012), for whom even low-cost housing can prove unaffordable (Desmond, 2018). Further, rent cannot fall below a certain threshold, as landlords have fixed costs, including insurance, debt payments and taxes. Inadequate demand in shrinking cities typically leads to abandonment, not ever-less-costly housing (Galster and Rothenberg, 1991; White, 1986).

This paper examines the distinct mechanisms through which rent burden is produced in both growing and shrinking cities. Household rent burden, defined as paying 30% or more of income toward rent, has become a national problem, impacting nearly 21 million households in the US (Joint Center for Housing Studies, 2017). But the specific pathways through which this burden is produced are likely different in growing cities—where we might expect rents to rise faster than income—and shrinking cities, where incomes may fall faster than rent. Through these two different pathways, rent burden is likely to increase across a range of urban environments, from San Jose to St. Louis. By better understanding the underlying processes involved in generating rent burden in different urban housing markets, policy responses can be tailored to local conditions.

In this paper, we investigate these pathways by studying changes in income, rent and cost burden for renter households in US cities between 1980 and 2017, using multiple lines of evidence. First, we examine trends in growing and shrinking cities to assess their correspondence with our hypothesized framework (Figure 1). Then, we use matching to assess whether exposure to population loss leads to different income and rent trajectories for otherwise similarly situated cities. Lastly, we develop a fixed-effects panel model to test our hypothesis that rent burden is more sensitive to changes in income or rent in shrinking cities given their socioeconomic composition, specifically, their concentration of households living on the edge of affordability.

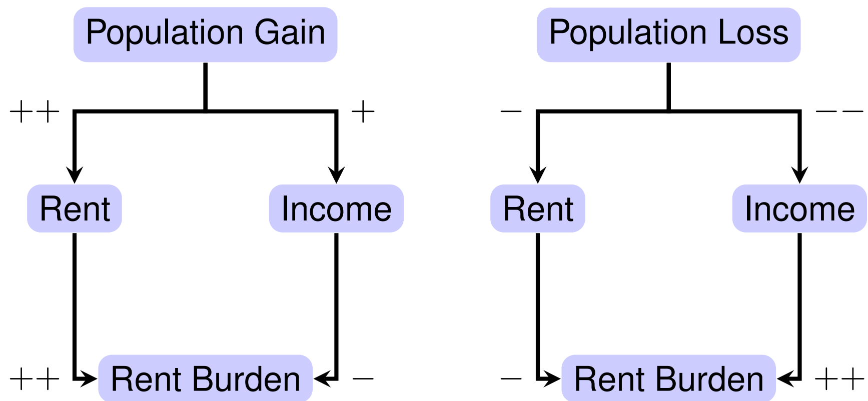

Figure 1: Conceptual diagram of rent burden pathways for growing cities (at left) and shrinking cities (at right). $+/-$ indicates positive or negative impacts on a particular pathway. The number of $+/-$ symbols indicates strength of influence.

Background

Though there is little research on rent burden in growing versus shrinking cities, much has been written on the factors influencing housing costs. Prior research suggests that in places experiencing rapid growth, particularly where geographic constraints and the regulatory environment limit density and new construction, housing costs are higher (Glaeser and Gyourko, 2003; Glaeser et al., 2005; Gyourko et al., 2013; Ihlanfeldt, 2007; Quigley and Raphael, 2005; Saiz, 2010). This work confirms the intuition that where demand exceeds supply—for whatever reason—housing prices will grow and be higher than in otherwise identical areas with greater supply. Gyourko et al. (2013) refer to these cities, specifically those featuring high growth in price relative to supply, as "superstars." Rising home prices are not only found in superstar cities like San Francisco and Seattle, however. Even in growing cities adding supply, production trails demand and rents increase, albeit more slowly than in superstar cities.

Whether or not it is a superstar, rent burden in a growing city worsens as rents rise faster than wages. Since the Great Recession, the number of cost-burdened renters has increased nationwide (Colburn and Allen, 2018), impacting even moderate-income households (Dewan, 2014; Zraick, 2018). Demand for rental housing soared after 2010 for several reasons, including tightened mortgage lending and the increasing number of young, higher-income households. In markets where these households bid up rent, costs have risen considerably, exacerbating affordability problems. Between 51% and 54% of renter households in California, Colorado, Florida, Hawaii and New York paid more than 30% of their income toward housing in 2016 (Joint Center for Housing Studies, 2017). Though new units have been added, they are increasingly concentrated in the luxury market, offering little relief. The share of newly built units renting for US$1,500 or more rose from 15% in 2001 to 40% in 2016. Nationally, low-cost rental stock has been disappearing since 2000, in part due to rising prices in high-demand housing markets (Immergluck et al., 2018; Joint Center for Housing Studies, 2017).

In shrinking cities, conversely, prices have plummeted due to persistent net out-migration and reduced demand for housing. Shrinking cities are generally characterized by poor housing conditions and high levels of housing vacancy (Accordino and Johnson, 2000; Dewar, 2015; Ganning and Tighe, 2015), problems further aggravated by the foreclosure crisis (Deng et al., 2018; Immergluck, 2011). While home prices and rents have since fallen with demand, so too have incomes. Through selective in- and out-migration, shrinking cities have rising shares of low-income and under- or un-employed households. Post-war suburbanization drove early waves of White middle-class out-migration (Freund, 2010; Jackson, 1987). Exclusionary housing markets and de facto segregation made it difficult for low-income and minority households to exit increasingly low-opportunity places, creating patterns of concentrated poverty and disadvantage (Massey and Denton, 1993; Wilson, 2012). The loss of manufacturing jobs, a common issue in shrinking cities, made it difficult for remaining unskilled workers to find or retain employment guaranteeing a living wage (Bluestone and Harrison, 1982; Wilson, 1992).

Aggregate income loss over time in shrinking cities often appears as a given in the literature based on the confluence of these and other historical circumstances contributing to the selective out-migration of higher-income or upwardly mobile households and the concomitant concentration of poverty (Galster, 2019; Martinez-Fernandez et al., 2012). Empirical research also finds that shrinking cities tend to exhibit falling aggregate incomes over time, though economic decline appears more cyclic than population loss (Hartt, 2019, 2018). While Hartt (2019) addresses the question of whether shrinking cities can be prosperous, as measured by higher per capita income relative to regional baselines, the author reports that 73% of the 886 shrinking cities in their sample fail to meet their definition of a "prosperous city." Among shrinking cities exhibiting absolute population loss between 1980 and 2010, 78% are non-prosperous, and among cities that lost population in each decade between 1980 and 2010, 84% were classified as non-prosperous. Similarly, Hartt (2019) found that among the 19 large US cities exhibiting population loss in each decade between 1980 and 2010, 10 exhibited falling per capita income in each decade between 1980 and 2010 and 8 more exhibited fluctuating patterns of aggregate income loss and growth. Although the analysis of decline found in Weaver et al. (2016) is focused on census tracts, this research similarly finds a close correspondence between population loss and economic decline, with income being one component of their index of changing economic conditions.

In short, though home prices and, by extension, rents, have fallen or remained flat in many places losing population, household incomes may have fallen even further, creating or exacerbating rent burden for low-income households in these cities. There is abundant documentation that low-income renters are disproportionately rent-burdened (Collinson, 2011; Joint Center for Housing Studies, 2017; McConnell, 2013). The geographic distribution has also been documented and indicates a rise in rent burden across US metropolitan areas, most substantially in coastal areas (Joint Center for Housing Studies, 2017). But less attention has been paid to the underlying relationships between income and rent and to how they jointly structure localized patterns of rent burden, particularly in the context of shrinking cities, where the problem of surplus low-cost housing is often prioritized over adequate *affordable* housing. Recent research on evictions and the housing problems of low-income renters in distressed housing markets highlights the need to understand these particular dynamics (Desmond, 2016). Despite the popular perception of shrinking cities containing ample low-cost housing, rents in these places remain sticky given fixed costs for landlords (e.g. property taxes) and the frequent need for maintenance in older units. But landlords often keep rents up in depressed housing markets beyond levels necessary to secure adequate rates of return, either due to the outsized perception of risk or exploitative business practices (Desmond and Wilmers, 2019). Under these conditions, incomes likely have far more room to fall than rent, contributing to widespread rent burden.

This paper examines the joint dynamics of income and rent in growing and shrinking cities, testing our basic proposition concerning differential dynamics in these two types of cities. For cities experiencing secular population growth, we look to see whether rents have indeed grown at a faster rate than than income, leading to rising rent burden over time. For shrinking cities, on the other hand, we look to see whether incomes have been falling faster than rents, leading to similar levels of overall rent burden calculated at the city-level. Further, we test to see whether rent burden in shrinking cities is more sensitive to identical changes in rent and income given differences in aggregate socioeconomic conditions.

Data and Methods

We construct a panel of US cities drawing on the National Historical Geographic Information System (NHGIS), which provides access to historical tables from the decennial US Census and the American Community Survey (ACS) (Ruggles et al., 2019). In this study, we examine cities in each of the decennial census years 1980, 1990, 2000, and 2010 and include the 2013–2017 American Community Survey (ACS), a 5-year summary, and denote this sample by the middle year, 2015. For 1980, 1990, and 2000 we use short and long-form decennial census tables for demographic and detailed socioeconomic data, respectively; for 2010, we draw on demographic and basic housing data from the 2010 decennial census and socioeconomic data from the 2008–2012 ACS, which replaced the long-form after the 2000 census. We restrict our sample to census places that have: 1) the same NHGIS integrated geographic unit code in each survey year from 1970 to 2010; 2) a population of at least 10,000 in 1970; and 3) at least 1,000 renter households in 1970.[1] We also excluded Census Designated Places (CDPs) as these are not cities *per se*, i.e. they are not legally incorporated areas. Two cities with incomplete panels were also excluded. This left us with a panel of 1,952 cities across the contiguous US and Alaska (Figure 2) each observed at five periods.

We define rent burden as paying 30% or more of income toward rent and utilities. Since 1981 this has been the federal benchmark for classifying households as rent-burdened (Schwartz and Wilson, 2008). Though this metric is imperfect, it has been found to be a reliable indicator of overall levels of housing affordability (Herbert et al., 2018). Consistent tabulations of the rent-burdened population are available from the NHGIS from 1980 forward, which defines the temporal extent of our panel.[2]

[1]NHGIS units codes correspond to Federal Information Processing Standards (FIPS) codes from 1970 forward. To ascertain whether a place had the same NHGIS geographic unit code, we examined each survey year for a valid population value. Surveys include 1970, 1980, 1990, 2000, 2010 decennial censuses and the 2013–2017 ACS as retrieved from NHGIS table AV0.

[2]Tabulations from 1970 cannot be harmonized with subsequent years because of differences in the categories used in publicly available tables.

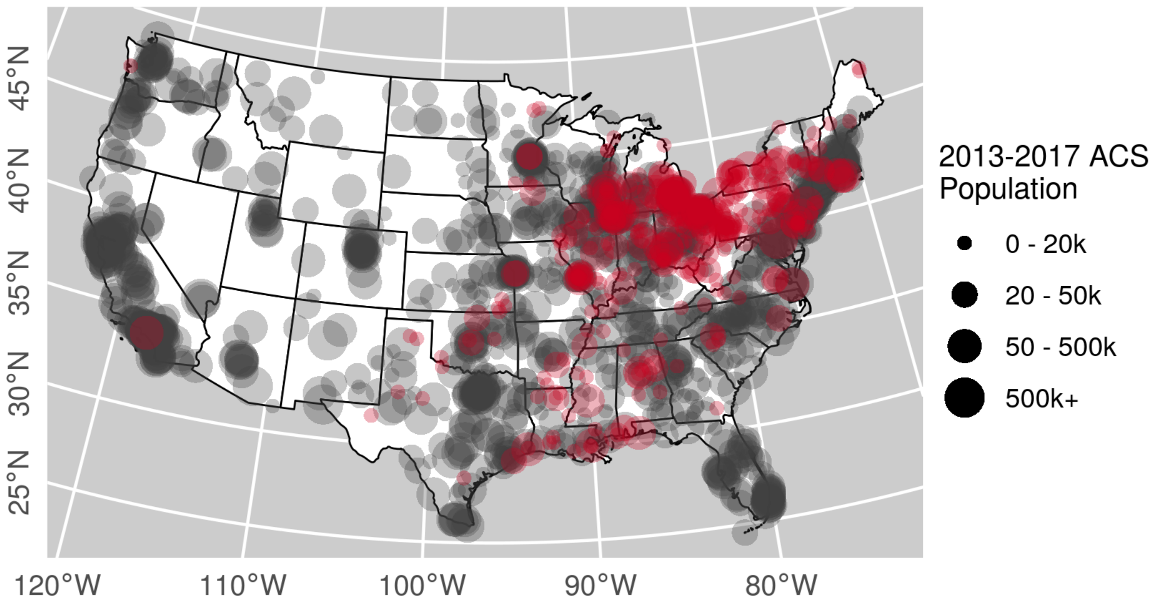

Figure 2: Map of shrinking (in red) and non-shrinking cities (in black) in this study's sample. Two cities in Alaska are not shown.

Examining Rates of Population, Income, and Rent Change

We define "shrinking cities" as cities with a significant ($\alpha = 0.05$), negative, linear trend in population over our study period (1980–2015), assigning total population estimates from the 2013–2017 ACS to the year 2015. This operational definition is consistent with studies emphasizing the persistence of population loss as a central criterion for identifying shrinking cities (Ganning and Tighe, 2018; Großmann et al., 2013; Hartt, 2018). Non-shrinking cities include those with growth in population as well as those that have no significant change over this period (i.e. stable). By this definition, our sample of cities includes 415 shrinking cities and 1,537 other cities.

We also examine linear trends in median renter income and median gross rent so as to explore the relationship between these two variables and determine if that relationship differs between shrinking and non-shrinking cities. To that end, we fit linear trends and normalized the rates of change by the corresponding value in the starting year (1980) to obtain percentage change, which is comparable across different cities and between different variables. We can then compare both the direction and the relative magnitudes of income and rent change.[3]

Robustness of Population Change Estimates

There are multiple approaches to classifying shrinking cities in the literature (Ganning and Tighe, 2018; Haase et al., 2014; Hartt, 2019; Weaver et al., 2016). Alves et al. (2016) presents a typology based on the drivers of population loss and a reference time span, which helps to inform studies developing policy interventions but does not help distinguish shrinking cities as a class. Linking both population and economic decline is central to some definitions of shrinkage (Wiechmann, 2008), yet it presents a problem of endogeneity for studies that intend to assess the effect of shrinking on economic conditions. Emphasizing that population loss is the key element, the "past peak" definition proposes that shrinking cities include any city with a peak population prior to the most recent estimate during the study period (Hartt, 2019). The ontological problem of shrinkage also begs the question as to *how much* population loss constitutes shrinkage. Schilling and Logan (2008) employed a stringent threshold of 25% loss between 1970 and 2010, which was subsequently adopted by Weaver et al. (2016).

Requiring a critical threshold for population loss is appropriate for studies of extreme shrinkage or right-sizing cities, but those are not our aims. Relative to our chosen definition (described above), we find that requiring a 20% threshold for population loss over 30+ years would omit 244 cities with significant, negative population trends but add only 2 cities that do not exhibit such a trend, as they experienced single-year spikes in population or single-year declines within an otherwise stable population. We conclude that while a threshold-based approach is not conceptually dissimilar from our chosen definition, it is arbitrary and does not significantly improve the precision or recall of our shrinking cities classification. We have also found that the past-peak definition captures many rebounding cities, cities with a

[3]We adjust all variables expressed as dollars to 2017 US$ using the Consumer Price Index research series using current methods (CPI-U-RS).

single-year spike in population, and a number of actually growing cities. As we discuss in the Results, adding information on the magnitude of population loss to our current binary classification of shrinking cities does not significantly improve our model of the differential drivers of rent burden. Furthermore, as we discuss, below, regarding Census district boundary changes, we have reason to believe that our cities panel and shrinking cities definition would lead us to under-estimate, rather than over-estimate, any effects particular to shrinking cities.

We use ordinary least squares (OLS) for trend tests; while the sample size is quite small (5 periods per city), they are spaced as evenly possible across a 37-year period. Our approach thus echoes textbook applications of OLS for extrapolating future population estimates based on past Census data (Klosterman, 1990), although we confine our task to fitting a linear trend to observed datapoints. Ostensibly more robust tests of trend do not improve results, and there is no alternative to infrequent Census estimates for this kind of study. Theil-Sen robust trends converge to OLS trend estimates when no outliers are present, which is almost assuredly the case for Census population figures. Another alternative, the Mann-Kendall trend test, is far too conservative, missing many cities with population panels that we believe would be deemed shrinking by a broad consensus.

Whereas the decennial total population counts (i.e., in 1980, 1990, 2000, and 2010) are based on a census, the 2013–2017 ACS population totals, which are used for the year 2015, are based on a sample of the population. We used the ACS margin of error for a 90% symmetric confidence interval to test the robustness of our OLS-based shrinking cities population trends. We simulated the 2015 population total for each city using the 2013–2017 ACS estimated total as the mean and the standard error derived from the margin of error based on a 90% confidence interval for a normally distributed random variable; this was used in place of the reported total in simulations. We performed 100 simulations and compared the results to our baseline, i.e., using the 2013–2017 ACS total population estimate. While our baseline sample of shrinking cities contains 415 cities, the total number of shrinking cities across simulations varied from 411 to 418. Cities either missed (14 total) or added (10 total) by the simulations have similar population trajectories: they all experienced net population loss over the study period; generally, their populations stabilized in the middle (and then declined further) or at the end. The 14 cities our sample includes would likely be considered shrinking by any observer, based on their population trajectories. The same could be said for all but one of the 10 we are missing (relative to the ensemble of simulations). The effect of excluding *actually shrinking* cities from our shrinking cities sample would be to reduce the differences between our shrinking and non-shrinking city groups and therefore make our model estimates conservative. But overall, our chosen definition of shrinking cities seems to be largely insensitive to the 2013–2017 ACS margin of error.

In addition to problems of definition, prior research has wrestled with measuring population change amidst changing geographic boundaries. We use nominally integrated place-level data for several reasons. Available boundary-consistent census data are normalized to 2010 geographies, meaning that places with population gains through annexation rather than in-migration will have inflated population values for past years. Consequently, these data would obscure municipal population loss. Though population data normalized backward do not exist, some have approximated these values by aggregating present block-level data within past boundaries (Ganning and Tighe, 2018). This approach could potentially identify cities that *would* have lost population over time but for annexation. This distinction, however, is not central to our research.[4] Further, including these "averted-loss" cities among non-shrinking cities can only make our comparisons more conservative by limiting the differences between observations in our shrinking and non-shrinking categories. In terms of misidentifying a growing city as a shrinking city, this could only occur through a limited set of rare or un-

[4]While many cities have gained population through annexation, this is distinct from concerns about measuring loss under the counterfactual scenario of annexation not having occurred. Furthermore, annexation is now difficult in parts of the Northeast and Midwest, where shrinking cities are concentrated. In the South and West, conversely, annexations are more common (Edwards, 2008). As noted above, we do, however, account for substantial additions through boundary changes by removing cities that were part of city-county consolidations post 1970.

likely circumstances, such as de-annexation or net growth in the unsheltered population (who would not be counted) exceeding net loss of sheltered persons.

Propensity Score Matching

Propensity score matching allows us to compare shrinking cities to their most similar non-shrinking cities (Dehejia and Walhba, 2002), matched on baseline social and economic conditions that potentially confound the effects of local economic changes that are hypothesized to distinguish shrinking cities. We selected covariates based on theory and intuition concerning the types of variables that either operate through income and rent on rent burden or which likely provide additional information about income and rent distributions. For instance, cities with increasing unemployment and poverty rates may exhibit increasing rent-burden rates, net of change in median household income, given the concentration of renter households at low income levels (Lens, 2018). We also include the percent of the population that is foreign born, to account for increased demand through immigration (Collinson, 2011; Greulich et al., 2004), as well as overcrowding, which might indicate individuals and families "doubling up" to make rent more affordable. Following prior research, we measure overcrowding as the share of renter-occupied housing units with more than one person per room (Blake et al., 2007). The share of housing units built before 1950 indicates the degree of new development, with higher values indicating less redevelopment. Greater concentrations of older housing may be linked with both lower income and higher rent, net of central tendency (Desmond and Wilmers, 2019).

We apply a genetic matching approach with an estimated propensity score, as this approach has been shown to produce better results than other matching techniques regardless of whether or not the covariates are normally distributed (Sekhon, 2011). The propensity score—or the probability a given city will shrink sufficiently enough to be designated a "shrinking" city in our sample—is estimated through logistic regression, with shrinking city status (1 or 0) regressed on the covariates listed in Table 1 for 1980. In searching for optimal balance in the covariates between the treatment (shrinking) and control (non-shrinking) city populations, a control city might match more than one treatment city. We allowed such ties to take place, producing a matched dataset of control cities that are assigned to one or more treatment cities (as in 1-to-1 matching) or weighted across multiple treatment cities to produce the optimal balance (as in 2-to-1 matching). In 2-to-1 matching, weights are not necessarily equal to 0.5 but are assigned so as to maximize covariate balance.

After matching, we have three groups of cities: actually shrinking cities (based on population trends), pseudo-control cities that are not shrinking but are otherwise similar to shrinking cities in 1980, and all other cities ("discarded" in the matching). We fit linear trends in median renter income and in median gross rent for each city in each group. Subsequently, to test the hypothesis that shrinking cities and the most-similar non-shrinking cities have different income and rent trajectories forward from 1980, we then used pairwise *t*-tests to assess differences in the income and rent trends between treatment and control city pairs. We stress that we use the language of "control" and "treatment" in a loose and strictly analogical sense, as we borrow from the pseudo-experimental approach of propensity-score matching solely for the purposes of identifying those non-shrinking cities most closely resembling those that would exhibit secular population loss 1980 to 2017. We do not mean that "shrinking" is a treatment in the clinical sense; rather, we retain occasional usage of these terms to communicate which groups specifically are under discussion. Below, we use "matched non-shrinking cities" and "shrinking cities" interchangeably with "control" and "treatment" cities, respectively.

Fixed-Effects Panel Regression Model

Separate from the matching analysis, we employed a fixed-effects (FE) panel regression model to account for the unobserved heterogeneity of sample units (Allison, 2009; Halaby,

Table 1: Baseline (1980) values for each of the covariates used in the logistic regression, for estimating the propensity score and/ or in the fixed effects panel model.

	Other Cities	Shrinking Cities
Median (annual) gross rent (2017 US$)	9,724	8,374
Median renter income (2017 US$)	38,428	33,707
Median home value (2017 US$)	177,259	118,915
Bachelor's degree attainment (% of pop. 25 and older)	18.8	12.9
Percent of housing built before 1950	43.5	65.6
Foreign-born residents (% of pop.)	6.6	3.8
Residents living alone† (% of pop.)	36.5	40.3
Overcrowding (% of rentals with >1 person per room)	5.9	4.2
Unemployment rate (% of pop. 16 and older in labor force)	5.9	8.4
Vacancy rate (% of units)	6.0	5.6
Poverty rate (% of pop.)	11.3	12.4
Renter occupancy rate (% of units)	38.5	36.1
Non-Hispanic Black† (% of pop.)	8.4	13.2
Hispanic/Latino† (% of pop.)	7.3	2.1
Total (N)	1,537	415

† Denotes a variable not included in calculating the propensity score nor for the matching analysis.

Note: Statistics shown are the mean in 1980 within each city group, which represents the baseline conditions for the matching analysis. Pop. = population.

2004). We use this model to test the hypotheses that different dynamics driving rent burden operate between shrinking and non-shrinking cities and that shrinking cities are more sensitive to these changes than other cities. Our model regresses the share of rent-burdened households on the covariates listed in Table 1 and includes an interaction term allowing the slope to vary between shrinking and non-shrinking cities for each covariate. In contrast to the matching analysis, we included covariates measuring the share of the Black and Hispanic population and the share of renter households constituted by persons living alone. While Black and Hispanic households are more likely to experience rent burden than their White counterparts, we expect this difference is largely explained by income (Colburn and Allen, 2018). However, since Black renters are over-represented in shrinking cities, we included these variables to assess the effect of income net of race and ethnicity (Franklin, 2019). Similarly, given the direct relationship between household size and income as well as the possibility that changes in household composition over time might create mismatches in the housing stock (exacerbating affordability problems), we also accounted for the share of individuals living alone. Thus, we included race, ethnicity and renters living alone in the FE model as robustness checks.

Equation 1 describes this model, where i indexes cities and t indexes time periods (years); α_i indicates the fixed city-level intercept and δ_i is a dummy variable for shrinking cities; ε_{it} is the stochastic Gaussian error term. We estimate two types of effects on rent burden: the effect of changes in social and economic conditions in *any* city regardless of shrinking status (β) and the *additional* effect of such changes in shrinking cities (γ). The model is fit in the R statistical computing environment using the `plm` package (Croissant and Millo, 2008), which corrects for serial correlation between observations from the same city. Time (the year of the survey) is included in the model as a continuous variable to measure any secular trend in citywide rent-burden over time not accounted for by changes in the other covariates. The sample size in our panel data set is the number of sample units (cities) multiplied by the number of time points (years). 5 cities in our original set of 1,952 cities do not have complete covariate data in the 2013-2017 ACS; this is not a problem for the prior analyses, but these cities cannot be included in a balanced panel analysis. Thus, our panel includes 1,947 cities and 5 time periods, yielding 9,735 total observations.

$$[\text{Pct. Rent-Burdened}]_{it} = \alpha_i + X_{it}\beta + \delta_i X_{it}\gamma + \varepsilon_{it}$$
$$\delta_i = \begin{cases} 1, & \text{Shrinking} \\ 0, & \text{Non-shrinking} \end{cases} \tag{1}$$

Results

Comparing Rates of Change

Our prediction that incomes fall more often and more steeply in shrinking cities while rents rise more often and more steeply in other cities is initially confirmed by exploratory analysis; Figure 3 shows median (annual) gross rents, median renter incomes and the rent-burdened population over time for all cities. These apparently different dynamics lead to strikingly similar outcomes in the rent-burdened population. It is also apparent that while rents have risen between 1980 and 2015 in both shrinking and other cities, incomes for renter households have fallen sharply in shrinking cities, while remaining stagnant in other cities. Though the rent-burdened population has increased steadily over those 35 years, the sharpest increase, between 2000 and 2010, appears related to the sharp decline in median renter incomes between these years caused by the Great Recession (Colburn and Allen, 2018).

To further establish whether shrinking cities have different rent and income dynamics and to compare rates of change between shrinking and non-shrinking cities, we fit linear trends to each city's rent and income panels. We classified cities by the direction of change in in-

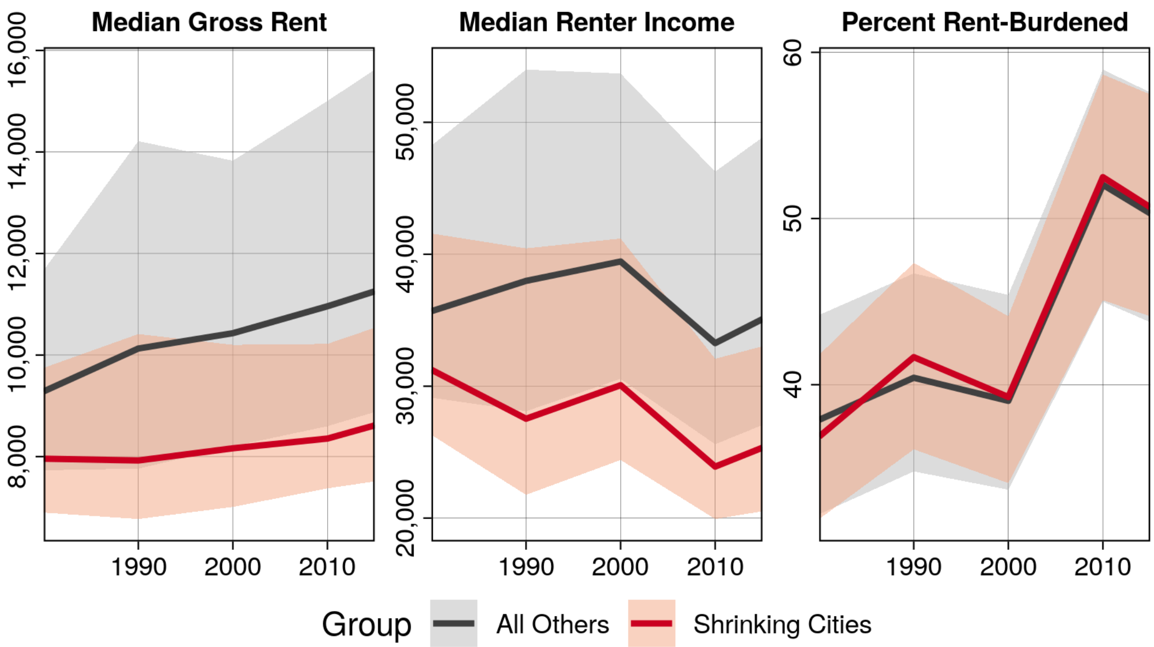

Figure 3: Median (annual) gross rent, median renter income and the percentage of the city population that is rent-burdened for shrinking cities and all others. *Note*: The solid line shows the median city's value (in 1980, 1990, 2000, 2010 and 2015) while the shaded area shows the 20th and 80th percentiles.

comes and rents and tallied the number of cities in each category (Table 2). The categories represent the four quadrants of a two-by-two matrix divided into rising and falling median renter income on one axis and rising and falling rent on the other axis. Table 2 shows the vast majority of shrinking cities experienced falling renter incomes (Q2 and Q3) and that 9 in 10 non-shrinking cities are characterized by rising rents (Q1 and Q2). A greater share of shrinking cities than non-shrinking cities fall into the doubly challenged category of both falling incomes and rising rents (Q2), though the majority of all cities fall within this quadrant.

Table 2: Share of cities in each category by type of city

Category	Other Cities	Shrinking Cities
Q1: Rising renter incomes, Rising rents	37.2%	11.6%
Q2: Falling renter incomes, Rising rents	51.9%	59.8%
Q3: Falling renter incomes, Falling rents	10.7%	27.7%
Q4: Rising renter incomes, Falling rents	0.3%	1.0%
Total (N)	1,537	415

We also examined the relative magnitudes of these rates to assess whether incomes change faster than rents, or vice-versa, within each category. Figure 4 shows the ratios of trends in rent against trends in income for each category. Except for where renter household incomes are rising along with rents (Q1), a considerable share of cities in each category are experiencing incomes that fall faster than rents, in percentage terms. In particular, even where rents are falling (cities in Q3, 27.7% of shrinking cities and 10.7% of others), incomes are generally falling faster. In 89% of cities where both are rising (Q1), rents have risen faster than incomes, whereas in 97% of cities with both falling incomes and rents (Q3), incomes have fallen faster than rents. In the worst-case scenario where incomes are falling and rents are rising (Q2), we see that most shrinking cities experience renter incomes falling faster than the rate of increase in rent.

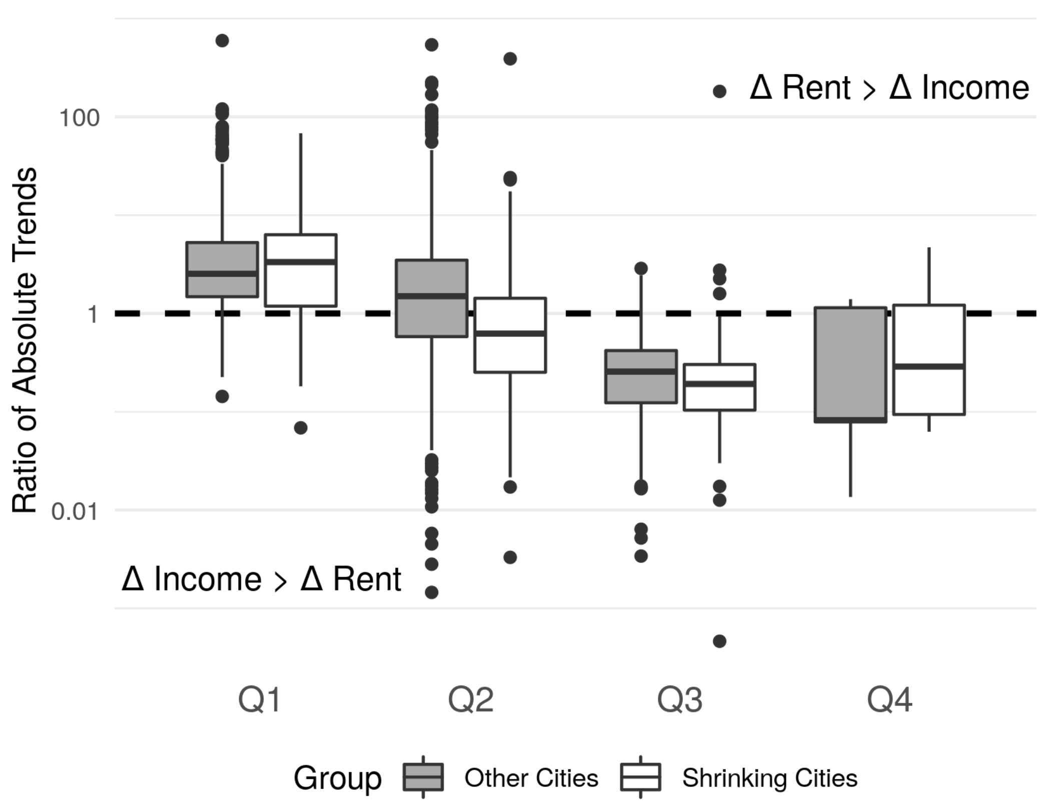

Figure 4: Plot of the ratios of the absolute trends in median gross rent versus median renter income for each city, within each category. *Note*: See Table 2 for a description of categories. The dashed line indicates a ratio of 1, i.e. the rates of change in income and rent are equal.

Matching on 1980 Baselines

When we force 1-to-1 matching or 2-to-1 matching by breaking ties randomly, we obtain 234 and 376 unique control (matched non-shrinking) cities, respectively. The 1-to-1 matching produces better covariate balance, yet the 2-to-1 matching produces similar numbers of matched non-shrinking cities as shrinking cities. Thus, we compared the 1-to-1 and 2-to-1 control populations to ensure the robustness of our results. After matching, two-sided t-tests of the baseline (1980) differences between shrinking and matched non-shrinking cities reveal no significant difference in any covariate for both the 1-to-1 and 2-to-1 matched populations.

Kolmogorov-Smirnov (KS) bootstrapped p-values are more robust than the two-sided t-test (Sekhon, 2011), however, and these indicate that baseline differences could not be entirely eliminated between shrinking and non-shrinking cities in either matched populations. In the 1-to-1 matching, the percentage foreign-born (p-value $<< 0.001$), the bachelor's degree attainment rate (p-value $= 0.001$), the vacancy rate (p-value $= 0.004$), the percentage of units built prior to 1950 (p-value $= 0.014$), and the percent overcrowded (p-value $<< 0.001$) are statistically significantly different between shrinking and matched non-shrinking cities. Some of these differences, significant under the KS test, are actually quite small (a difference in the percentage of units built prior to 1950 of only 0.6% after 2-to-1 matching, or 0.2% after 1-to-1 matching, compared to 22% prior to matching), and the test might therefore be regarded as too conservative. If we take the KS test results at face value, then we could not find a set of pseudo-control cities that perfectly matched our set of shrinking cities. However, the pseudo-control set is much more similar to our shrinking cities overall and the two populations' income and rent trajectories have a very similar baseline compared to the unmatched, non-shrinking cities. Figure 5 illustrates the different trajectories shrinking and matched non-shrinking cities follow after 1980. The trend lines span all city-year observations in each group, with each city reporting exactly once in each year, showing the average trend of the group. What this suggests is that the non-shrinking cities *most similar* to shrink-

Table 3: Mean trends in total population, median renter income, and median gross rent, in terms of percentage change per decade, between the shrinking cities and matched non-shrinking cities.

	Total Population	Median Renter Income	Median Gross Rent
Trend, Shrinking cities (N=415)	−5.5%	−5.0%	2.8%
Trend, Matched control cities (N=234)	4.6%	−3.3%	5.3%
All Non-shrinking cities (N=1,537)	13.6%	−0.8%	7.2%

Note: Third row shows the trends for all non-shrinking cities (both matched and unmatched), which is relevant to the fixed-effects panel model.

ing cities have a higher rate of increase in median gross rent and a slower rate of decline in median renter income.

While Figure 5 shows the aggregate trends in each group, we formally tested for differences between each shrinking city's own income and rent trend and that of its matched non-shrinking city. Paired, one-sided *t*-tests using matched shrinking and non-shrinking city pairs indicate that individual trends in median renter income and median gross rent from 1980 to 2017 are significantly different between shrinking cities and the most similar non-shrinking cities. Income declines in both the shrinking and matched non-shrinking cities, but income declines faster, on average, in shrinking cities by 1.7 more percentage points per decade (p-value $<< 0.00001$). Conversely, rent rises more slowly in shrinking cities than in matched control cities, on average, by 2.5 fewer percentage points per decade (p-value $<< 0.00001$). Although the sample size for each city's OLS trend in income or rent is small (5 periods) owing to the nature of the data, these pairwise *t*-tests are applied to large samples (415 shrinking and 234 pseudo-control cities) with wide, regular intervals between observation periods. The average trends in population, income, and rent over the period 1980–2017 for shrinking and matched non-shrinking cities are shown in Table 3.

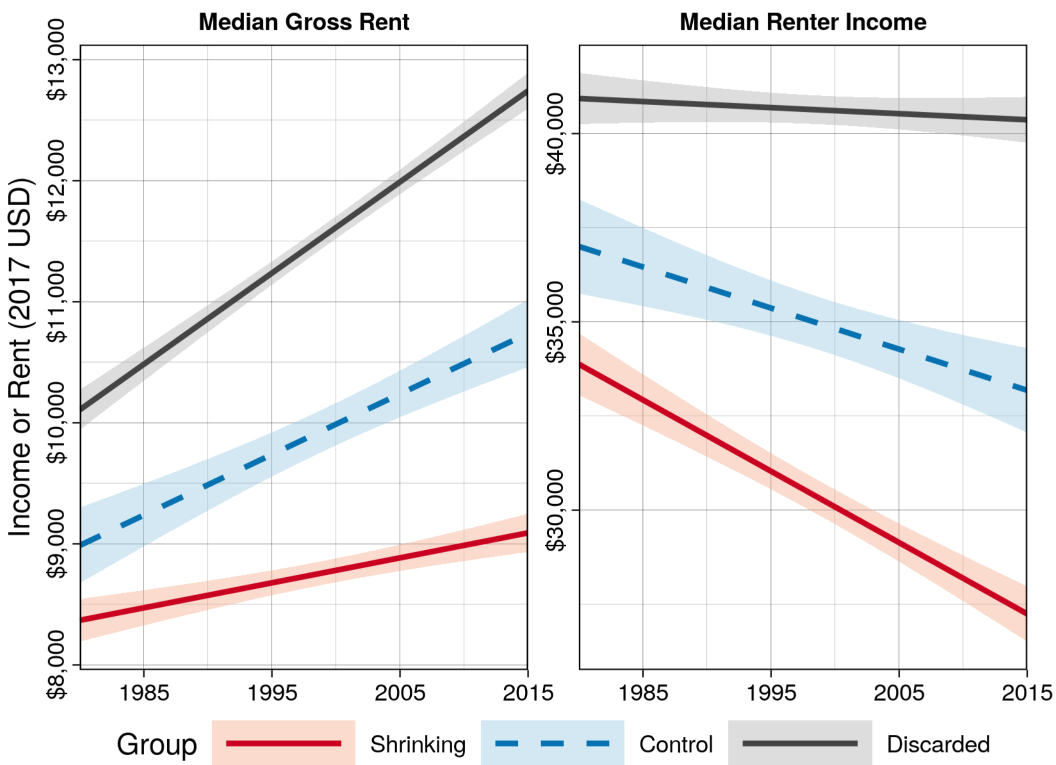

Figure 5: Based on the matched groups, linear trends in the shrinking (N=415), matched non-shrinking (N=234), and discarded (N=1,303) cities' median renter income and median gross rent. Trend lines and shaded 95% confidence intervals are based on each group's observed Census estimates in 1980, 1990, 2000, 2010, and 2015. *Note*: 1-to-1 matching is used. Shrinking and matched non-shrinking cities start at a similar baseline, by virtue of the matching.

Modeling Rent and Income Changes

We regressed the percentage of residents rent-burdened in each city in each year on the covariates listed in Table 1 and the year of observation. After removing cities with missing data in the 2013-2017 ACS (5 such cities), a balanced panel of 1,947 cities was obtained with observations in each of 5 periods: 1980, 1990, 2000, 2010 and 2015.[5] Within this sample, 415 observations (roughly 21%) are shrinking cities. Overall, the model fits the data well (overall $R^2 = 0.90$). The within R^2, or the proportion of variance explained by the within effects, is 0.82 (adjusted $R^2 = 0.77$). The FE model confirms what is evident in the raw data, alone, about the trajectory of rent burden over time. The percentage of renter households paying 30% or more for housing is increasing over time, on average by 1.6 percentage points per decade in non-shrinking cities, net of the change in covariates. This rate of increase is not significantly different in shrinking cities.[6]

In dollar terms, rising rents appear to be the strongest driver of an increase in the rent burden rate (Table 4). A US$1,000 increase in (annual) median gross rent corresponds to a simultaneous increase in the percentage of rent-burdened households by 2.5 percentage points in non-shrinking cities; shrinking cities experience an even greater increase in the rent burden (3.6 percentage points) for an equivalent increase in median gross rent (adjusted p-value ≈ 0.006). Declining renter incomes are the second strongest driver in dollar terms and the strongest driver based on a comparison of t-statistics. A US$1,000 decline in median renter income corresponds with a simultaneous increase of 0.71 percentage points in the percentage of residents rent-burdened in non-shrinking cities but an increase of 0.95 percentage points

[5]As noted above, our data for 2010 draw on demographic tables from the 2010 decennial census and economic tables from the 2008–2012 ACS and our data for 2015 draw from the 2013–2017 ACS.

[6]We computed heteroscedastic-consistent (HC4) standard errors using clustering to mitigate serial correlation. In assessing multicollinearity, we calculated variance inflation factors (VIFs) of 11.1 and 13.2 for the year term and its interaction with the shrinking city indicator, respectively. The terms are retained in the model, but their standard errors should be interpreted with caution. In addition, we investigated whether model results were patterned between population size or the magnitude of change, but found evidence for neither based on diagnostic plots of studentized residuals.

in shrinking cities (adjusted p-value = 0.0007).

In addition to the main effects of income and rent, we find statistically significant main effects for several covariates, including the Bachelor's degree attainment rate, overcrowding, unemployment, vacancy, poverty, and rentership. Several of these variables capture additional variation in the shape of the income distribution, for instance, households with higher educational attainment typically have higher incomes. Intuitively, rising unemployment and poverty drives a rising share of rent-burdened households. Overcrowding is negatively associated with change in rent burden, likely reflecting the compensatory effects of larger household size and total household income, though it may reflect an inadequate supply of affordable housing that necessitates doubling-up.

Change in the vacancy rate is also positively associated with change in rent burden. While we included this variable because it could drive changes in multiple predictor variables as well as in rent burden, the intuition for this association is not immediately clear. Some vacant housing stock, particularly in the steeply shrinking cities of the Rust Belt, may not be fit for occupancy (i.e. derelict or otherwise structurally unsound); vacancy would therefore represent a further constraint on housing supply. Lastly, an increase in the percentage of the population that is Non-Hispanic Black is negatively associated with changes in rent burden in shrinking cities alone.

Discussion and Conclusion

This paper addresses the different pathways through which rent burden is produced in shrinking and growing cities in the US. We draw upon multiple lines of evidence (exploratory data analysis, propensity score matching, and fixed effects regression) to both formally and informally test our hypothesis that shrinking cities exhibit fundamentally different dynamics in income and rent than non-shrinking cities. Our conceptual framework describes how rent

Table 4: Fixed-effects regression results for the panel of 1,947 cities observed in each of 5 periods: a balanced panel of 9,735 city-year observations ($N = 9,735$).

Variable	Main Effect	Difference in Shrinking Cities
Year	0.1575	-0.0533
	(0.0134)***	(0.0277)
Median Renter Income (2017 US$, thousands)	-0.7084	-0.2391
	(0.0411)***	(0.0707)***
Median Gross Rent (2017 US$, thousands)	2.4786	1.0911
	(0.1667)***	(0.3968)**
Poverty Rate (%)	0.3494	0.0214
	(0.0333)***	(0.0587)
Percent Overcrowded	-0.1837	0.0551
	(0.0186)***	(0.0603)
Percent Unemployed	0.2742	-0.0135
	(0.0350)***	(0.0590)
Percent Vacant Units	0.1253	-0.0228
	(0.0271)***	(0.0587)
Renter-Occupied Rate (%)	-0.0695	0.0567
	(0.0201)***	(0.0464)
Bachelor's Attainment Rate (%)	-0.0736	0.0019
	(0.0224)**	(0.0388)
Non-Hispanic Black Population Share (%)	0.0080	-0.0563
	(0.0139)	(0.0268)*
Pct. Built Prior to 1950	0.0171	0.0294
	(0.0089)	(0.0169)
Hispanic/Latino Population Share (%)	0.0175	-0.0964
	(0.0162)	(0.0524)
Percent Live Alone	-0.0262	0.0313
	(0.0205)	(0.0443)
Median Home Value (2017 US$, thousands)	-0.0007	0.0065
	(0.0015)	(0.0062)
Percent Foreign Born	-0.0148	0.0450
	(0.0209)	(0.0701)

Note: Heteroscedastic-consistent standard errors are shown in parentheses, below point estimates. The response variable is the percent of the population rent-burdened. The far-right column corresponds to the shrinking-city indicator's interaction term. p-values denoted: *** p-value < 0.001; ** p-value < 0.01; * p-value < 0.05.

burden is exacerbated in growing cities (i.e. faster increases in rent than income) as well as the less-explored relationship between income and rent in shrinking cities, where we hypothesized incomes fall faster than rent. Few cities regulate rent levels and these controls are often limited (e.g. Gilderbloom and Ye, 2007). Thus, in growing cities, there are few mechanisms preventing rents from rising in a context of increasing demand. For renters in shrinking cities, conversely, rent likely falls only so far given fixed housing costs and the abandonment of no-longer-profitable units. Incomes, however, have declined in shrinking cities for decades due to economic contraction and selective out-migration. Under both scenarios, rent burden is likely to grow.

As selective out-migration leads to concentrated poverty in shrinking cities, we hypothesized these cities may respond differently to similar shocks in income and rent. Because there is a greater concentration of lower-income households in shrinking cities, an identical increase in rent dollars is likely to capture a greater percentage of renter household income, pushing more households above the 30% threshold. A negative income shock is similarly likely to have an outsized effect in shrinking cities, particularly given the sticky nature of rent in declining markets. Simply put, a greater share of residents experience poverty in shrinking cities compared with growing cities (mean of 21% versus 16%, respectively, in 2015), so more of a shrinking city's residents are impacted by rising rents or falling incomes.

Our study indicates shrinking and non-shrinking cities do, in fact, exhibit different trajectories of income and rent and that the joint operation of these two dynamics increases the share of rent-burdened households. Gross rents, in constant dollars, have risen steadily since 1980 in both shrinking and non-shrinking cities but the median renter household income in most cities has fallen below 1980 levels. While renter incomes fell sharply between 2000 and 2010, they have generally recovered in non-shrinking cities; no such recovery occurred in shrinking cities. We also observe a modest increase in rents over time in shrinking cities, not the steep plummet in prices one might expect from popular accounts. By matching shrinking cities to their most similar non-shrinking cities in 1980, we continue to observe distinctly different trends in income and rent as these cities change over time.

Does growth in the rent-burdened population respond similarly to rising rents or falling incomes in both shrinking and non-shrinking cities? Our panel model indicates that shrinking cities are more sensitive to changes in either rent or income. In addition to the expected, powerful main effects of income and rent, we find that an identical rent increase or income decline produces a greater increase in the rent-burdened population in shrinking cities. These findings are consistent with the intuition that shrinking cities have higher percentages of low-income renter households for whom rising rents or falling incomes are more likely to lead to their paying at least 30% of their household income toward rent. Though a negative income shock should increase rent as a percentage of household income for many renter households in non-shrinking cities, it may not be sufficient to exceed the 30% threshold.

With regard to our control variable for the percentage of the population that identifies as Black, one plausible explanation for our finding of a negative association between between this variable and our interaction term for shrinking cities is the historical conjuncture between racial residential segregation; the concentration of low-income Black populations in inner-city neighborhoods, including in many of the nation's older industrial cities; and the location of publicly assisted housing, including public housing, tax-credit financed housing with affordable units, and privately owned units accepting vouchers. While housing advocates are often critical of the tendency of these programs to reinforce segregation (McClure, 2019; Metzger, 2014), assisted housing reduces aggregate rent burden net of area median income and poverty (Lens, 2018). This finding is congruent with the intuitive understanding that assisted housing provides a crucial bulwark against housing precarity and should be increased in cities with rental affordability problems regardless of population dynamics.

Since declining incomes exacerbate rental affordability across *all* cities (and in in shrinking cities in particular), the policy implications of this research are clear. While policies like rent control might address the problem of sky-rocketing rents in growing cities, it is not clear that laws limiting rent increases would mitigate rent-burden rates in shrinking cities, where rents rise more slowly. The central problem in shrinking cities, rather, is the alarming decline in income, which renders unaffordable what most would consider to be low-cost housing. Also, given the sticky levels of rent we observe in shrinking cities, we find these cities are clearly *not* replete with low-cost rental housing, as might be expected in a context of depopulation, vacancy and abandonment (Schilling and Logan, 2008). The expansion of housing vouchers (which cover the difference between 30% of renter households' income and contract rent up to a certain payment standard), would close the affordability gap for many rent-burdened households (Desmond and Perkins, 2016). Universal basic income (UBI) or some minimum direct cash transfer to low-income households might also decrease rent burden by rendering rent a smaller share of income (Glaeser and Gyourko, 2008). Discussions around these types of policies have entered the mainstream, though they remain controversial. This paper, however, offers additional evidence for the need for a floor on incomes, particularly in places with large numbers of households dislocated from the economy. An increase in the minimum wage would offer relief to a large number of cost-burdened households living in growing and shrinking cities alike. At present, full-time minimum-wage employment is inadequate to afford even a one-bedroom apartment in many states and nowhere can such income allow a household to afford a two-bedroom apartment (Aurand et al., 2019).

Though we do not directly observe these behaviours, our results are also consistent with recent research on landlord exploitation. Due to their perception of greater risk involved in renting to low-income tenants, or simply because they can get away with it, landlords charge relatively high rents in low-income areas (Desmond, 2016; Desmond and Wilmers, 2019). We find rents are on the rise even in shrinking cities, despite the erosion of demand through depopulation and poor property conditions. Old and aging housing has higher maintenance costs, but work by Desmond and Wilmers (2019) and others suggest this does not sufficiently account for rents charged in low-income areas. In the absence of adequate assisted housing or UBI, low-income renters are often consigned to search for housing in the private rental market and contract with exploitative landlords charging rents not far below city-wide averages while deliberately withholding maintenance to inflate profits (Garboden and Rosen, Forthcoming; Greif, 2018; Seymour and Akers, 2019).

Although this paper has focused on housing affordability challenges in the United States, this is a problem of global dimensions (Wetzstein, 2017). Housing affordability has increasingly become a problem across the developed world where the private market is the principle provider of housing, as demonstrated by research focused on Australia (Baker et al., 2016), Canada (Bunting et al., 2004), and the United Kingdom (Fingleton, 2008; Hilber and Schöni, 2016). Urban population loss is a phenomenon also common across the developed world (Martinez-Fernandez et al., 2012). Given substantial differences in national contexts between the US and other nations facing problems of both urban decline and housing affordability, our findings may have limited generalizability, though future research may take up these important relationships between problems of affordability and local population and housing market dynamics.

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