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# The Push of Big City Prices and the Pull of Small Town Amenities

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## Abstract

As house prices continue to rise in large, supply-constrained cities, what are the implications for other places that have room to grow? Recent literature suggests that amenities that improve quality of life are becoming increasingly important in location decisions. In this paper, we explore how location amenities have differentially driven population and price dynamics in small towns versus big cities, with a focus on the role of housing supply. We provide theory and evidence that demand for high-amenity locations has increased in recent decades. High-amenity counties in large metropolitan areas have experienced relatively higher price increases, while high-amenity counties in small metros and rural areas have absorbed increased demand through population growth. This divergence in population dynamics between big cities and small towns was driven by domestic migration, with high-amenity small towns and rural areas experiencing significant domestic in-migration.

*Keywords:* housing supply, amenities, population dynamics, domestic migration

*JEL classification:* R11, R31, R23

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# 1 Introduction

Housing costs in large cities have been rising rapidly for decades, driven in part by limited housing supply in the face of high demand. This phenomenon has generated substantial discourse in both the economics literature and the public sphere.<sup>1</sup> Housing costs in the largest metropolitan areas of the U.S. have soared relative to less populated areas over the last 40 years. Population growth has displayed different patterns over the same time frame; it is highest in mid-sized metropolitan areas, while both large cities and rural areas have exhibited slow population growth. These trends obscure the substantial variation that exists within each of these size categories. For example, the mean population growth in rural counties was 25 percent between 1980 and 2019, compared to 45 percent growth in the entire U.S. However, 16 percent of rural counties have exceeded the U.S. growth rate and 5 percent have more than doubled in population. What drives these differences in growth? We examine the characteristics and outcomes of locations across the country to understand the underlying mechanisms of both the big-city housing crunch and rural decline, and how these two phenomena interact.

In this paper, we explore how location amenities have not only driven variation in population and price dynamics, but have done so differently in big cities and small towns, focusing on the role of housing supply. Some location consumption amenities are derived from natural resources, such as coastlines, while others are derived from durable institutions, such as universities. Others may arise endogenously through cultural opportunities or access to consumption variety in large cities. We build on the literature that suggests consumption amenities have become increasingly important in people's location decisions (e.g. Glaeser et al., 2001; Rappaport, 2009; Diamond, 2016; and Carlino and Saiz, 2019). Increasing preferences for location amenities will interact with housing supply and lead to different population and price dynamics in different locations.

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<sup>1</sup>Gyourko and Molloy (2015) and Been et al. (2019) provide extensive reviews of the literature on housing supply and affordability. Schuetz (2022) provides a comprehensive assessment of affordable housing policies.

There is large variation in the price elasticity of housing supply across locations. Supply elasticities can be driven by geographic constraints (Saiz, 2010) or regulation (Glaeser et al., 2005; Gyourko and Molloy, 2015). Importantly, the price elasticity of housing supply also decreases with city size. This relationship has been both predicted by theory (Capozza and Helsley, 1989; Mayer and Somerville, 2000) and measured empirically (Green et al., 2005; Paciorek, 2013; and Oikarinen et al., 2015). The intuition behind the relationship between city size and price elasticity is that as cities grow, there is a decline in the quantity and quality of land that is still available for development. This increases the marginal cost of additional housing. Housing supply is constrained in the very largest cities, but most other locations have room to grow.

We provide a simple model to illustrate the interaction between housing supply and preferences for amenities. In our model, demand for housing increases with the utility delivered by the location, which is dependent on wages, local prices, and consumption amenities. Housing supply increases with rent; however, the price elasticity in a location is not constant. Instead the price elasticity of housing decreases with city size.<sup>2</sup> We then consider the effect of an increase in preferences for location amenities. With an increase in demand for amenities, both population and prices would be expected to rise relatively faster in high amenity locations. However, the relative size of the population and price changes depend on initial population. In large cities, increased demand will be realized through increased prices, while in small towns high-amenity locations will experience relatively higher increases in population.

We use county-level data from the U.S. to illustrate basic population and price patterns between 1980 and 2019. We first group counties into categories based on the overall population of the metropolitan area in which the counties are located and then compare changes in housing rents and population across the different categories. Overall, the largest rent increases are in the counties located in the largest metropolitan areas, while the largest population gains are in counties located in mid-sized metropolitan areas. Counties in rural

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<sup>2</sup>We also include a location-specific housing productivity shifter as in Albouy and Stuart (2020) to explain differences in city size for locations with like prices.

(non-metropolitan) areas have exhibited the slowest growth in both prices and population. Nonetheless, there is large variation in both price and population changes within the metro size categories.

To test predictions of the theory, we start by estimating implied amenities in 1980 and 1990 for U.S. counties. We use an established method, similar to Roback (1982), Chen and Rosenthal (2008), Albouy (2016), and Albouy and Stuart (2020), among others, to calculate amenities using local rents and wages. The underlying idea of this method is that in equilibrium, geographically mobile households must be compensated for differences in location-specific amenities through changes in consumption. We use hedonic regression methods to adjust income and rents to account for differences in population and household characteristics using sub-county data.

The estimated amenities are correlated with several exogenous or persistent characteristics of locations. Proximity to coastlines, mountainous terrain, good weather, and universities are all positively correlated with our amenity estimates. In addition, the amenity value of innate location characteristics is similar across size categories. The correlation between amenities and population density is negative for the overall sample, but it is positive for counties in the largest metros.

Using these amenity estimates, we then analyze how housing rents and population have changed between 1980 and 2019 with respect to initial amenity levels. The patterns are different for counties in large metropolitan areas relative to smaller metro areas and rural locations. We find that the relationship between initial-period amenities and price growth is stronger for counties located in large metros, while the relationship between amenities and population growth is strongest in small metros and rural areas. These results are robust to modeling assumptions, weighting, controls, and size category definitions.

Finally, we employ Census data from 2000 to 2019 that decompose the source of county population change into core components: natural increase (from births and deaths), interna-

tional immigration, and domestic migration.<sup>3</sup> Natural increase is somewhat larger in large cities, but does not appear to be correlated with amenities. International migration is higher in both larger cities and in high-amenity locations across all population size categories.<sup>4</sup> The diverging patterns for counties in high-amenity rural versus high-amenity large cities are driven by domestic migration. Counties in large metro areas had negative net domestic migration, and high-amenity counties lost more population to migration than did low-amenity counties. On the other hand, in small towns and rural areas, high-amenity counties had positive net domestic migration.

Overall, these results suggest that rural areas and small towns may provide a release valve for housing demand pressure in the form of out-migration from housing-constrained large cities. In addition, if households continue to increase their valuation of location amenities, high-amenity rural places will grow relatively faster than low-amenity rural places. The welfare implications of these trends are unclear. Large cities continue to provide significant production advantages, which suggests that easing housing supply constraints may still be an important public policy concern.<sup>5</sup> Finally, as the nature of in-person work and residential location choices change in the wake of the COVID-19 pandemic, these results may help guide predictions about future growth patterns in different locations.

## 2 Summary of population and price dynamics

To summarize aggregate patterns, we obtain data from the U.S. Census on housing costs and population at the county level between 1980 and 2019. For 1980, 1990, and 2000, we use the Decennial Census of Population and Housing, and for 2010 and 2019 we rely on the American

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<sup>3</sup>Our analysis complements work by Rupasingha et al. (2015) and others who have documented domestic migration patterns from metros to non-metro counties.

<sup>4</sup>This is consistent with results by Albert and Monras (2018), who provide theory and evidence that immigrants are more likely to locate in expensive cities.

<sup>5</sup>Hsieh and Moretti (2019) and Duranton and Puga (2019) find large productivity and growth losses from misallocation of population across cities.

Community Survey.<sup>6</sup> Our goal is to understand how price and population dynamics have diverged for different city sizes. Therefore, we divide counties into four groups based on the total size of their associated Metropolitan Statistical Area (metro) in 1980. Non-metro counties are included with the smallest metro areas.

The groups were constructed so that each category has a roughly equal total population of 55 million. The first group includes only counties in the 10 largest metropolitan areas, the next group contains the remainder of the largest 45 metros, then the remainder of the largest 210, and the last group contains the smallest metropolitan areas and non-metro counties.<sup>7</sup> For perspective, in 1980 the 10th largest metropolitan area had a total population of 3,012,412 (Dallas-Fort Worth-Arlington, TX), the 45th had a population of 807,143, (Bridgeport-Stamford-Norwalk, CT), and the 210th had a population of 147,295 (Barnstable Town, MA). Therefore the smallest category generally includes small towns and rural areas. We refer to these groups as “large,” “mid-sized,” “small,” and “rural” areas, respectively. In rural areas, 82 percent of counties are either single-county metros or non-metro counties.

Figure 1a shows the percent change in median rent for counties in each group relative to 1980.<sup>8</sup> Growth rates over the sample period were monotonically associated with metro size: nominal rents in the 10 largest metros grew the most, increasing by 420.5 percent. Rents in the smallest metros and rural counties grew the least, at only 343.5 percent over the time period.

Figure 1b shows the change in population for the different metro size categories. Unlike rent changes, population growth in individual counties is not correlated with the size of the associated metro population. Mid-sized metros showed the greatest population growth. Rural areas showed the least, followed by large metro areas. Average population growth was 36.9 percent in large-metro counties and 24.6 percent in rural counties. Counties in mid-sized

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<sup>6</sup>The data were obtained from IPUMS National Historical Geographic Information System (Manson et al., 2021).

<sup>7</sup>The groups contain 113, 279, 498, and 2,218 counties respectively.

<sup>8</sup>Given that we do not use microdata, median rent is constructed as a population weighted average of the median rent for each county. Other measures of housing costs exhibit similar qualitative patterns.

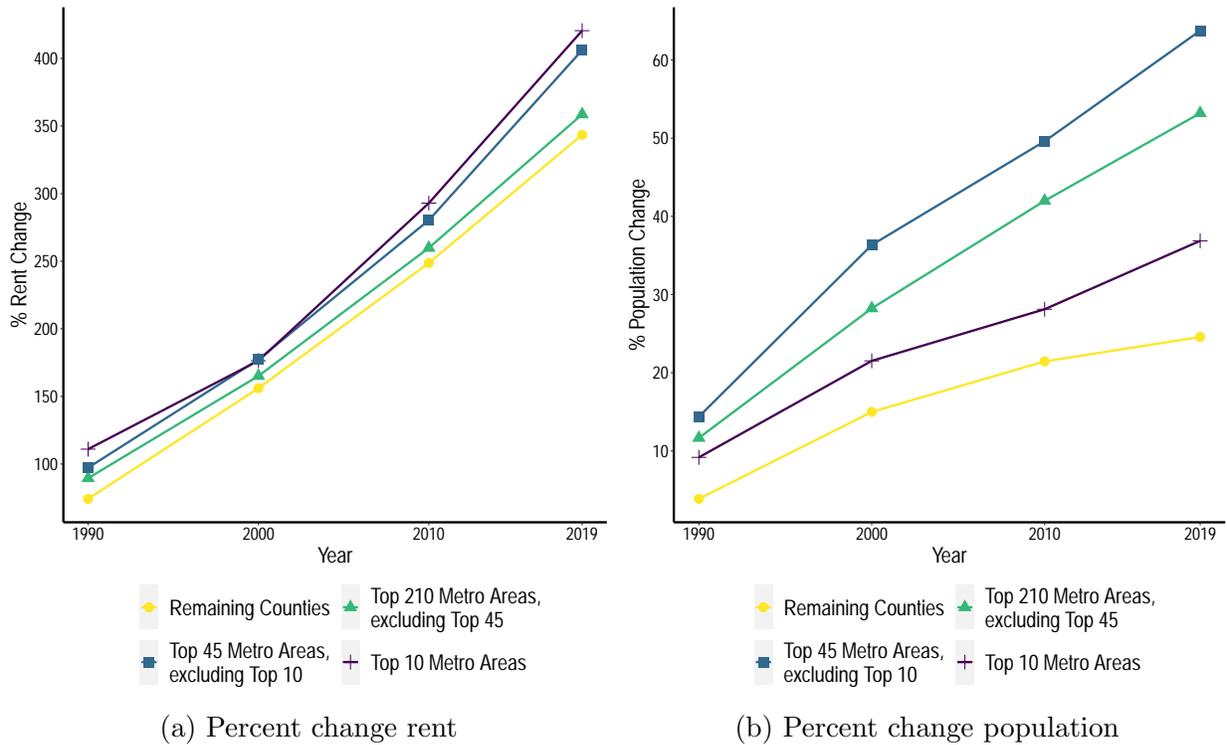


Figure 1: Rent and population changes by initial population categories

This figure shows the percent change in median rents (Panel (a)) and the percent change in total population (Panel (b)) relative to 1980 for counties grouped by the population of their containing metropolitan area. Median rent is a population-weighted average of county median rent for each category.

metros grew 63.8 percent on average. Rent growth and population growth show diverging patterns. This is particularly true in large metros, which grew more in rent than any other category but less in population than all but rural counties, illustrating the constraints in housing supply noted in previous studies.

These broad patterns mask significant variation in growth rates within size categories. Figure 2 shows the distribution of growth rates for counties in the four categories. The left panel shows the distribution of the percent change in median rents between 1980 and 2019, while the right panel shows the percent change in prices over the same time period. The different categories experienced different average growth rates, but there is considerable overlap in the distributions. This is particularly notable in the smallest category, where counties are largely rural or contain small urban areas. In this category, both prices and

population grew slowly on average, but a portion of these counties experienced significant growth.

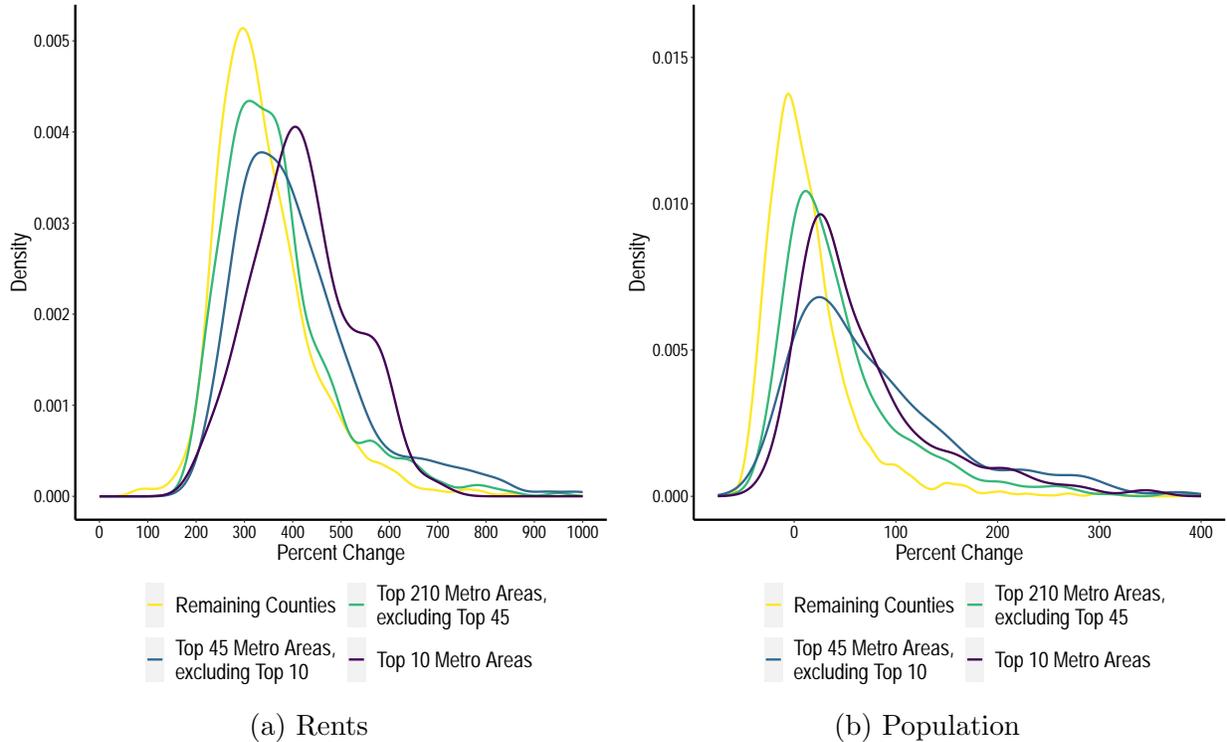


Figure 2: Distribution of rent and population changes for each category

This figure shows the distribution of the percent change in median rents (Panel (a)) and population Panel (b)) for U.S. counties between 1980 and 2019. The counties are grouped by the size of the containing Metropolitan Statistical Area.

In this paper, we explore the mechanisms and underlying characteristics of locations that led to differences in growth rates, and how these mechanisms differed for large cities versus small towns in terms of price and population growth. As an example, consider the graphs in Figure 3. The left panel shows the change in the natural logarithm of population versus initial median housing rents in 1980. In the largest metro areas, initially high rents are associated with slower population growth, exhibited by the downward-sloping linear fit line. In all other categories, the upward-sloping line indicates that higher initial prices are associated with higher population growth rates. The right panel shows the change in the natural log of rents versus initial median housing rents in 1980. In this case, the lines are all downward sloping,

meaning that higher initial rents are correlated with slower price growth. However, the slope is much more shallow for counties located in the largest metro areas.

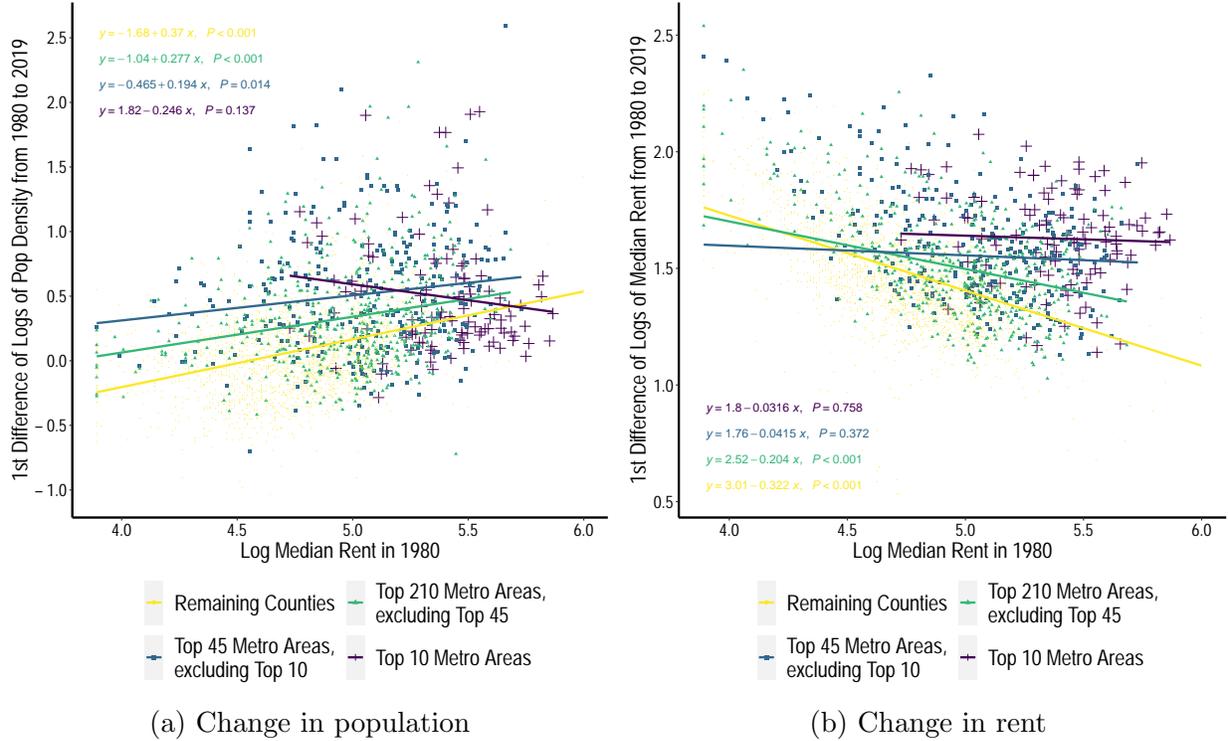


Figure 3: Changes in log population and log rent versus initial housing rents

This figure shows the change in the natural log of population (Panel (a)) and median rents (Panel (b)) between 1980 and 2019 for U.S. counties plotted against the natural log of median rents in 1980. Different colors and symbols are used to group counties based on the size of their containing metro areas. Lines and equations represent best linear fit for each group.

These raw correlations provide initial evidence that location characteristics have driven variation in both the amount and type of growth in recent decades. Initially large places with the conditions for growth displayed increased prices, while initially small places responded with increased population. In subsequent sections, we provide theory and evidence on how amenities have driven growth in large cities and small towns and explore the underlying mechanisms of this growth.

### 3 An illustrative model of housing and amenities

We present a simple model to illustrate how increasing preferences for amenities will affect prices and population differently in large cities versus small towns. The purpose of the model is to fix ideas and guide empirical analysis. In the model, housing demand increases with location amenities and wages and decreases with prices in a location. Housing supply increases with prices, but the price elasticity of housing decreases with the population of a location. We show that in this environment, increasing preferences for amenities will lead to higher prices and population in high-amenity locations. However, price changes will be relatively larger in high-population locations, while population changes will be relatively larger in low-population locations. Details of the model follow.

**Housing Demand.** Each location in the economy is endowed with a consumption amenity  $B_j$  and a wage  $w_j$ . We assume that both the amenity and wage are exogenous.<sup>9</sup> Households have increasing preferences over traded consumption goods  $c$ , local goods  $l$ , and location amenities  $B_j$ . Utility is given by:

$$\ln U_j = \rho \ln B_j + (1 - \beta) \ln c + \beta \ln l, \quad (1)$$

where  $\beta$  is the consumption share of local goods, and  $\rho$  is a parameter that determines the relative importance of the amenity for utility. People maximize utility subject to  $w_j = c - lr_j$ , where  $r_j$  is the price of local goods, and  $w_j$  is the local wage. The price of the traded consumption good is fixed and normalized to 1. Solving the agent's maximization, indirect utility in a given location is:

$$\ln V_j = \rho \ln B_j + \ln w_j - \beta \ln r_j. \quad (2)$$

Demand for housing is increasing with the utility delivered by a location according to the

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<sup>9</sup>We make this assumption for simplicity. It is established in the literature that wages and amenities depend on both the size and/or composition of locations.

following:

$$\ln N_j = \frac{1}{\lambda} \ln V_j, \quad (3)$$

where  $\lambda$  is a parameter that defines the price elasticity of housing demand and could reflect moving frictions or individual attachment to locations. This is somewhat different than the amenity measurement literature that assumes perfect mobility. However, this formulation is consistent with the recent quantitative urban literature summarized by Redding and Rossi-Hansberg (2017). Later, we discuss the implications of this assumption in the context of our empirical exercise. Combining equations 2 and 3 gives the following expression for inverse housing demand:

$$\ln r_j = \frac{1}{\beta} (\rho \ln B_j + \ln w_j - \lambda \ln N_j). \quad (4)$$

**Housing Supply.** Housing supply increases with local prices. In addition, the price elasticity of housing supply decreases with population. This relationship is both predicted by theory (e.g. Capozza and Helsley, 1989) and has been measured in the data (e.g. Green et al., 2005). We assume the following form for inverse housing supply where the natural logarithm of rent is related to the level of population as opposed to the natural logarithm of population:<sup>10</sup>

$$\ln r_j = \eta N_j - A_j, \quad (5)$$

where  $\eta$  is the elasticity parameter, and  $A_j$  is a shifter that represents productivity in housing production.<sup>11</sup> The housing productivity term could reflect differences in supply constraints like geography or regulation, or could represent differences in general local productivity. Albouy and Stuart (2020), for example, find a strong correlation between housing productivity and goods productivity as reflected in local wages.

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<sup>10</sup>This functional form lends itself to analytic simplicity, but other forms where the elasticity is decreasing with  $N$  can be used to illustrate the same relationships.

<sup>11</sup>Albouy and Stuart (2020) use housing productivity to pin down equilibrium city size. This is often ignored in the quality-of-life literature, which generally focuses on prices. For our application, this formulation is useful to rationalize the variation in prices and city size in the data.

**Equilibrium and changing preferences.** Combining the supply and demand equations above, we can derive the following expression that can be used to find the equilibrium population:

$$\eta N_j = \frac{1}{\beta} (\rho B_j + \ln w_j - \lambda \ln N_j) + A_j. \quad (6)$$

It can be shown that the solution for  $N_j$  is strictly increasing in  $w_j$ ,  $B_j$ , and  $A_j$  in accordance with intuition.<sup>12</sup>

How do population and prices react if there is an increase in preferences for amenities? Specifically we want to understand the change in  $\ln N_j$  and  $\ln r_j$  as the preference parameter  $\rho$  increases. For simplicity, we assume there is some positive shock to the preference parameter  $\rho$ . However, a shock to the value of amenities could also be rationalized by increasing incomes leading to a shift toward consumption of local amenities, a pattern documented for central cities by Baum-Snow and Hartley (2020) and Couture and Handbury (2020).

The change in population with respect to the amenity parameter is given by:

$$\frac{d \ln N_j}{d \rho} = \frac{B_j}{\beta \eta N_j + \lambda}. \quad (7)$$

As would be expected, the change in population will be larger for locations that have higher amenity values  $B_j$ , all else equal. In addition, the increase will be larger for locations that have initially lower populations  $N_j$ . Thus, high-amenity small towns will experience a larger population response than high-amenity large cities for the same change in preferences for amenities.

The change in local prices with respect to changes in the amenity parameter is given by:

$$\frac{d \ln r_j}{d \rho} = \frac{B_j}{\beta + \frac{\lambda}{\eta N_j}}. \quad (8)$$

Like population, the change in local prices will be larger for places with higher amenity

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<sup>12</sup>Define  $a \equiv \frac{\rho}{\eta \beta} B_j + \frac{1}{\eta \beta} \ln w_j - \frac{A_j}{\eta}$  and  $b \equiv \frac{\lambda}{\eta \beta}$ , then  $N_j = bW(\frac{1}{b} \exp(\frac{a}{b}))$ , where  $W(z)$  is the product log function, which is strictly increasing for positive  $z$ .

$B_j$ . However, price increases will be larger for locations that have higher population  $N_j$ . Therefore, high-amenity large cities will have a larger price response than high-amenity small towns. An important feature to note is that if the economy exhibits perfect mobility, then we will not see differences in price changes for locations with different supply elasticities. In this case utility is equalized everywhere and housing demand is perfectly elastic, corresponding to  $\lambda = 0$ . In other words, with perfect mobility, amenities are perfectly capitalized in prices and differences in supply elasticities are only reflected in population change.<sup>13</sup> Our modeling choice is driven by empirical results that suggest that there is a significant difference in the price response of locations with different initial populations.

This simple model provides predictions for how prices and population will change for locations with different populations and amenities if there is an increase in the preference for amenities. Specifically, we would expect that high-amenity locations in large cities will experience a relatively larger increase in prices, while high-amenity locations in small towns and rural areas will see a larger increase in population. In what follows, we test these predictions by estimating initial amenity levels of locations and examining changes in population and prices for locations in different population categories.

## 4 Measuring amenities

To measure amenities, we employ standard methods from the quality-of-life literature that have been used by numerous researchers following Roback (1982). This literature relies on the assumption that with perfect mobility, amenities will be capitalized into local prices net of wages. We use data on demographics and housing from the U.S. Census to control for differences in housing quality and workforce composition to properly compare prices and wages across locations.

With perfect mobility ( $\lambda = 0$ ), households receive the same utility in every location. In

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<sup>13</sup>Other modeling choices that place population in the housing demand function may break this link even with the perfect mobility assumption. Our formulation can be interpreted as a reduced form version of more complex models.

this case, rearranging equation 4, we get the following expression for the amenity in a given location:

$$\rho \ln B_j = \beta \ln r_j - \ln w_j. \quad (9)$$

We use this expression to estimate amenities for each location as is standard in the literature. Note that this formulation ignores the effects of demand frictions (i.e. when  $\lambda \neq 0$ ), which may be important for population and price dynamics. However, conditioning on population, this expression still holds. In our empirical exercise, we stratify our sample into narrow population categories to account for the potential that population is informative of amenities.<sup>14</sup>

We use median household income and median housing rents from the U.S. Census at the county level as our primary measures of local wages and prices, respectively.<sup>15</sup> Given that locations vary in housing quality and workforce composition, it is important to account for these differences to get proper estimates of wages and prices across locations. To do so, we follow methods similar to Chen and Rosenthal (2008) and others who use hedonic regression methods and data on housing and demographics to estimate equivalent prices across locations. Ideally, we would use individual level data, however, this is not available at the county level. Therefore we use tract-level data in our price regressions which provides some sub-county variation.

To calculate adjusted rents, we first estimate the following regression equation:

$$\ln r_{ij} = \theta_0^R + \theta_1^R Z_{ij}^R + d_j^R + \epsilon_{ij} \quad (10)$$

where  $r_{ij}$  are the median housing rents in tract  $i$  and county  $j$  and  $Z_{ij}^R$  is a vector of housing characteristics that includes number of rooms, number of units in building, and year built.

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<sup>14</sup>We also include controls for population density within our narrow population categories in robustness checks. Note that the literature is mixed on the endogenous effect of population on amenity levels. We have found that there is not a strong correlation with amenities and population.

<sup>15</sup>We experimented with other measures of prices and found qualitatively similar results.

The term  $d_j^R$  represents a county-level fixed effect. The adjusted county-level rents  $\hat{r}_j$  can then be calculated by the following,

$$\hat{r}_j = \exp(\hat{\theta}_0^R + \hat{\theta}_1^R \bar{Z}^R + \hat{d}_j^R), \quad (11)$$

where  $\bar{Z}^R$  is the vector of average housing characteristics in the sample. Likewise, to calculate adjusted wages, we first estimate the following regression equation:

$$\ln w_{ij} = \theta_0^W + \theta_1^W Z_{ij}^W + d_j^W + \epsilon_{ij}, \quad (12)$$

where  $w_{ij}$  are the median household incomes in tract  $i$  and county  $j$  and  $Z_{ij}^W$  is a vector of demographic characteristics that includes education and age. The term  $d_j^W$  represents a county-level fixed effect. The adjusted county-level wages  $\hat{w}_j$  can then be calculated by the following:

$$\hat{w}_j = \exp(\hat{\theta}_0^W + \hat{\theta}_1^W \bar{Z}^W + \hat{d}_j^W), \quad (13)$$

where  $\bar{Z}^W$  is the vector of average demographic characteristics in the sample.

Using these adjusted rents and wages, we calculate amenities using equation 9 for both 1980 and 1990. We use both years because, in 1980, many counties were not completely partitioned into Census tracts, and missing tracts are largely concentrated in rural areas.<sup>16</sup> We calibrate the local consumption parameter  $\beta$  to equal 0.65, which captures the share of total expenditures on local goods. This value is an effective expenditure share suggested by Albouy (2016), who notes that this share includes housing and other local goods, but also should account for differences in tax burden due to progressive federal taxes and the fact that a significant share of income comes from non-local sources.<sup>17</sup> We standardize the amenity values by subtracting the mean and dividing by the standard deviation. A map

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<sup>16</sup>In addition, in our empirical analysis, we provide results using both adjusted wages and rents as well as the unadjusted prices.

<sup>17</sup>Earlier studies used smaller values, therefore we discuss the sensitivity of this calibration in our main analysis in Section 5 with results shown in Appendix Table A.1

of the resulting amenity estimates using 1990 adjusted prices is shown in Figure 4, and the highest- and lowest-amenity counties in each size category are shown in Appendix tables A.5 and A.6. These amenity estimates are constructed from wages and rents, so outliers and sampling error in these variables result in a few unexpected amenity values, particularly in counties with small populations. However, it is clear that there are underlying location characteristics and geographic patterns captured in the amenity estimates.

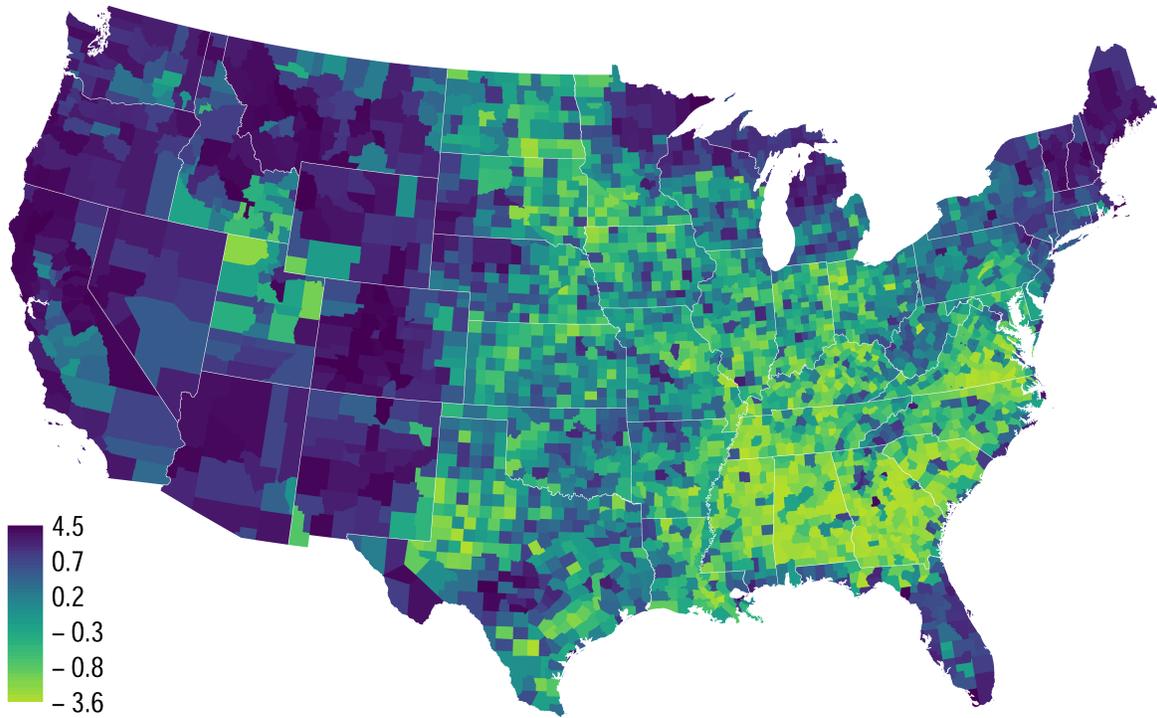


Figure 4: 1990 Amenity estimates

This map shows amenity estimates using 1990 adjusted prices for each county. The amenity values are standardized by subtracting the mean and dividing by the standard deviation.

Next, we formally explore the determinants of these amenities by collecting data on various exogenous characteristics of locations. Using Census Bureau data on coastline counties, we construct an indicator for whether or not a county is on the coast. We use a 100-meter resolution elevation map from the U.S. Geological Survey's National Elevation Dataset to

calculate the average slope (in degrees) of each county. We also include indicators for the four Census regions (West, South, Midwest, and Northeast). We include various county-level weather characteristics data from National Oceanic and Atmospheric Administration's National Centers for Environmental Information. We use maximum temperature (in degrees Fahrenheit) for July, minimum temperature (in degrees Fahrenheit) for January, and precipitation totals (in inches) for both months in 1980. Using data on colleges from the 1994 vintage of the Carnegie Classification of Institutions of Higher Education, we construct two indicators for the presence of higher education institutions within a given county. The first indicator is for whether or not a county contains at least one or more institutions classified as baccalaureate, master's, or doctoral universities or colleges. The second indicator is for whether or not a county contains at least one or more institutions classified as research universities. There are only 125 institutions that receive this highest classification. Finally, we include the percent of the population with a college degree and the population density, which are endogenous characteristics.

Table 1 shows the results of an OLS regression of 1990 amenity values using adjusted prices on the various location characteristics. The first column shows the results for all counties in the U.S., while columns 2 through 5 stratify the sample into different size categories. Many of the results are intuitive. Counties near coasts and with good weather have higher measured amenities. For example, for the entire sample, coastal counties have an average amenity value that is 0.81 standard deviations above the overall average. More mountainous counties, that is counties with a higher average slope, have higher average amenities. In addition, counties that have colleges or research universities also have higher average amenities. Counties in the West, which is the omitted regional category, have the highest average amenity. In terms of endogenous characteristics, a higher share of college graduates is associated with a higher amenity level, while population density is associated with a lower amenity level.<sup>18</sup>

While the results are fairly consistent across size categories, there are some notable dif-

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<sup>18</sup>We also ran the regressions using each independent variable separately for each population category. The correlations were qualitatively similar.

Table 1: Determinants of location amenities

	<i>Dependent variable:</i>				
	Adjusted Amenity 1990				
	Country	Top 10	Top 45	Top 210	Remaining
	(1)	(2)	(3)	(4)	(5)
Coastline	0.811*** (0.061)	-0.116 (0.161)	0.551*** (0.144)	0.968*** (0.121)	0.900*** (0.093)
Slope	3.793*** (0.334)	-0.395 (3.177)	2.202 (1.517)	2.861*** (0.812)	4.281*** (0.386)
Northeast	-0.578*** (0.077)	-0.453 (0.645)	-1.228*** (0.265)	-0.715*** (0.176)	-0.380*** (0.101)
Midwest	-0.758*** (0.065)	-1.058 (0.759)	-1.202*** (0.259)	-0.884*** (0.185)	-0.658*** (0.075)
South	-1.073*** (0.063)	-0.624 (0.646)	-1.391*** (0.225)	-1.012*** (0.153)	-1.050*** (0.075)
Precipitation Jan	-0.074*** (0.010)	-0.113 (0.084)	-0.082*** (0.028)	-0.105*** (0.022)	-0.067*** (0.012)
Precipitation Jul	-0.049*** (0.009)	-0.099 (0.074)	-0.057* (0.030)	0.019 (0.020)	-0.064*** (0.012)
Max Temp Jul	-0.016*** (0.004)	-0.066*** (0.022)	-0.022 (0.014)	0.006 (0.010)	-0.017*** (0.005)
Min Temp Jan	0.003 (0.003)	0.032 (0.021)	0.010 (0.009)	-0.005 (0.007)	0.003 (0.003)
College Present	0.178*** (0.039)	-0.008 (0.144)	0.340*** (0.106)	0.161** (0.074)	0.134** (0.058)
Research University	0.306*** (0.087)	0.058 (0.179)	0.302* (0.168)	-0.060 (0.151)	0.441** (0.208)
Pct Pop College	3.232*** (0.420)	5.708*** (2.130)	2.387 (1.480)	7.866*** (1.264)	2.797*** (0.580)
Log Pop Density (1980)	-0.035*** (0.010)	0.072* (0.039)	-0.008 (0.031)	-0.026 (0.024)	-0.067*** (0.014)
Constant	2.136*** (0.345)	5.880*** (1.691)	2.904** (1.229)	0.103 (0.883)	2.173*** (0.417)
Observations	3,099	112	277	489	2,221
R <sup>2</sup>	0.422	0.550	0.459	0.465	0.432
Adjusted R <sup>2</sup>	0.419	0.491	0.432	0.450	0.428

This table shows the results of a regression of estimated amenities on various location characteristics. The first column contains the results using all U.S. counties. Columns 2 through 5 include only counties within a given metro size category. \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

ferences. The correlation between natural features and amenities is generally stronger for counties in rural areas and small metros. Both coastlines and average slope are uncorrelated with amenities in large metros but have large significant positive coefficients for small metros and rural areas. The presence of colleges is also more important for the amenity value of small towns compared to that of the largest metros. Note that this is true even controlling for income and education, suggesting that universities may provide some spillovers in terms of quality of life beyond jobs and peer effects. Finally, population density is a positive amenity

for big cities but a disamenity for small towns. This result may suggest that the relationship between density and amenities is not monotonic. To speculate, very large cities may provide increased variety with increased density, while in small towns, additional density may have a pure congestion effect through traffic or losses in open space.

## 5 Amenities and location dynamics

In this section we estimate the effects of initial amenity levels on population and price changes in recent decades. Consistent with theory, if preferences for location amenities have increased, we would expect that small towns with high amenities would experience relatively larger increases in population, while large cities with high amenity levels would experience relatively larger price increases. As in section 2, we group counties based on the total population of the containing metro area into four bins with roughly equal total population.

Figure 5 shows plots of the change in the natural logarithm of median rents and population versus estimated amenities for all U.S. counties between 1980 and 2019. For this graph we use unadjusted rents and incomes to calculate amenities. In 1980 many counties were not completely partitioned into Census tracts, so sub-county data is not available for all counties. Later in our regression analysis, we show results for changes since 1980 and 1990 using both adjusted and unadjusted prices. The population size categories are denoted by different colors and symbols. The lines and equations represent population weighted linear best fit lines.

In Figure 5a it can be seen that the relationship between the change in population and amenities decreases with metropolitan size, as indicated by the slope of the linear fit lines. For small metros and rural areas, the relationship was the most positive, while in the 10 largest metros, the relationship was actually slightly negative. The relationship between rent changes and amenities, shown in Figure 5b, exhibits the opposite pattern. Large metropolitan areas had the most positive correlation between rent changes and initial amenities, while for

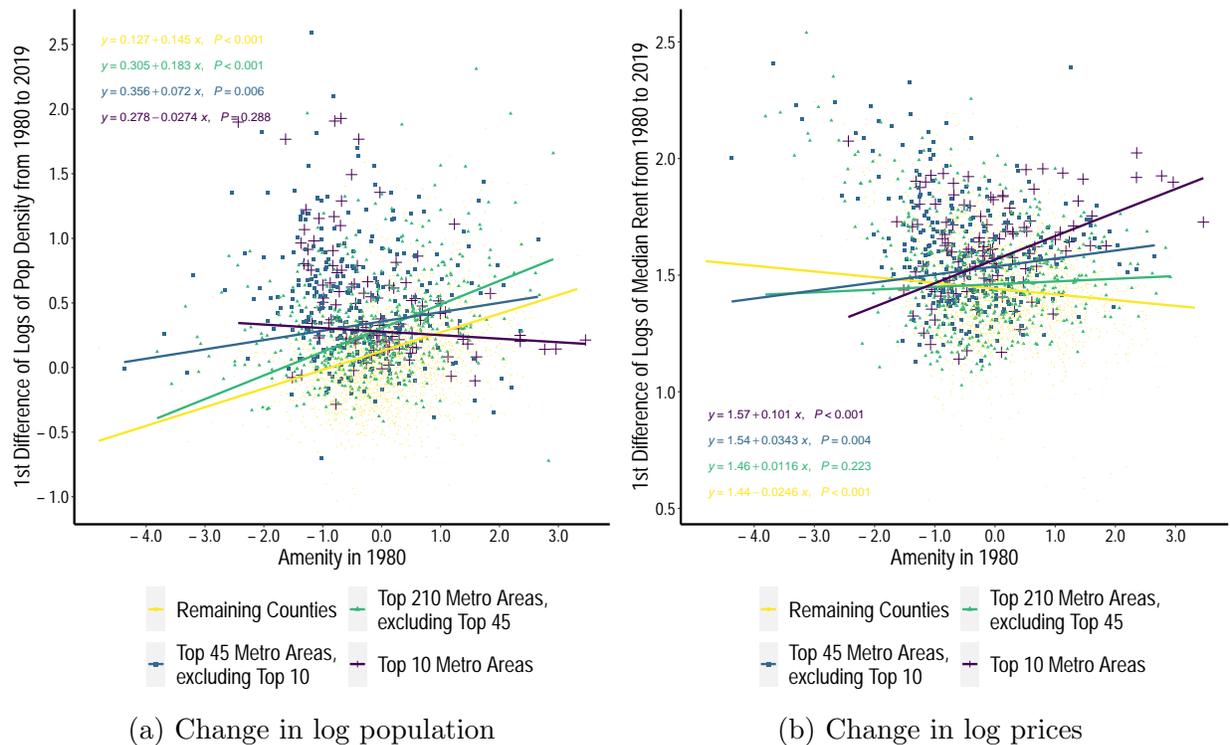


Figure 5: Changes in log population and log rent versus initial amenity level

This figure shows the change in the natural log of population (panel (a)) and median rents (panel (b)) between 1980 and 2019 for U.S. counties plotted against amenity level in 1980. Different colors and symbols are used to group counties based on the size of their containing metro areas. Lines and equations represent best linear fit for each group.

small towns the relationship was slightly negative. These relationships are consistent with increasing preferences for amenities and supply constraints in large cities.

To more formally test these relationships, we estimate the following equations, by regressing changes in the natural logarithm of rents and population on initial amenities interacted with population size categories:

$$\Delta \ln N_j = \beta_0 + \beta_1 B_j + \beta_2 D_j + \beta_3 B_j * D_j + \epsilon_j \quad (14)$$

$$\Delta \ln r_j = \beta_0 + \beta_1 B_j + \beta_2 D_j + \beta_3 B_j * D_j + \epsilon_j, \quad (15)$$

where  $\Delta \ln N_j$  and  $\Delta \ln r_j$  are changes in the natural logarithm of population and median

rents in each county respectively,  $B_j$  is the estimated amenity in the initial year, and  $D_j$  is vector of dummy variables for the different population size categories. In the regressions, we use the same size categories as before, with rural areas as the omitted category. For both the rent and population regressions, we present results using both raw and hedonic regression-adjusted wages and rents. We also show results for both 1980 to 2019 and 1990 to 2019.

Table 2 shows the results of the population regressions described above (equation 14). Amenities are standardized, so coefficients can be interpreted as the increase in the change in log population or rent for a one standard deviation change in amenity. The first column shows the results for changes in population from 1980 to 2019 using unadjusted wages and rents. The first row contains the coefficient on amenity. This is the effect of amenities on population changes for the omitted category that includes counties in the smallest metros and rural areas. The coefficient of 0.145 implies that a one standard deviation change in the amenity level was associated with a roughly 15.6 percent increase in population growth. Rows 2 through 4 are the interaction terms for the other size categories, so these should be added to the first row to get the total effect in each category. For the 10 largest metro areas, the total effect is -0.027, suggesting that the effect of initial amenities on county population growth was small. This is consistent with housing supply constraints in the largest metros preventing substantial population growth.

The other columns show the results for different specifications. The second column shows the results for changes from 1990 to 2019. The third and fourth columns then repeat the same regression but use adjusted wages and rents. Note that in 1980 not all counties were partitioned by census tracts, resulting in a smaller sample. All specifications exhibit the same qualitative patterns. However, the effects tend to be smaller for the 1990 to 2019 time period, and using adjusted wages and rents also shrinks the magnitude and spread of the coefficients.

Table 3 shows the results of the regression of changes in the natural logarithm of median

Table 2: The relationship between amenities and increases in population was stronger in small towns and rural areas

	<i>Dependent variable:</i>			
	1st Difference Density			
	1980-2019	1990-2019	1980-2019	1990-2019
	(1)	(2)	(3)	(4)
Amenity	0.145*** (0.013)	0.062*** (0.009)	0.095*** (0.021)	0.066*** (0.010)
Amenity*Top 210 Metro Areas, excluding Top 45	0.038** (0.019)	0.001 (0.014)	0.034 (0.033)	-0.031* (0.016)
Amenity*Top 45 Metro Areas, excluding Top 10	-0.073*** (0.018)	-0.081*** (0.014)	0.006 (0.033)	-0.066*** (0.016)
Amenity*Top 10 Metro Areas	-0.172*** (0.017)	-0.126*** (0.013)	-0.149*** (0.032)	-0.133*** (0.017)
Top 210 Metro Areas, excluding Top 45	0.178*** (0.018)	0.131*** (0.013)	0.130*** (0.027)	0.123*** (0.014)
Top 45 Metro Areas, excluding Top 10	0.229*** (0.018)	0.186*** (0.013)	0.145*** (0.028)	0.172*** (0.015)
Top 10 Metro Areas	0.151*** (0.018)	0.100*** (0.013)	0.130*** (0.032)	0.122*** (0.017)
Constant	0.127*** (0.012)	0.125*** (0.009)	0.177*** (0.019)	0.133*** (0.009)
Observations	3,103	3,105	1,775	3,105
R <sup>2</sup>	0.147	0.102	0.073	0.084
Adjusted R <sup>2</sup>	0.145	0.100	0.069	0.082

This table shows the results of a regression of the change in the natural log of population on estimated amenities interacted with size categories. The first and second columns show the results using unadjusted wages and rents for 1980 and 1990, respectively. The second and third columns show the results using adjusted wages and rents for 1980 and 1990, respectively. \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

rent on amenities interacted with size categories (equation 15). The first and second columns show the results using unadjusted prices for the change from 1980 and 1990, respectively. The third and fourth columns show the same results but use adjusted prices. The first row shows the effect of amenities on rent growth for the smallest population category (the omitted category). The coefficient of -0.025 for the first column means that a one standard deviation increase in the amenity value is associated with slightly slower rent growth of 2.5 percent over the 40-year period. For counties in the top 10 metro areas, adding -0.025 plus 0.126 means that a one standard deviation difference in amenity value is associated with a 10.6 percent increase in rents over the period. The effect is stronger for the period starting in 1980 compared to 1990. In addition, regressions using adjusted prices (columns 3 and 4) exhibit

stronger effects.

Table 3: The relationship between amenities and increases in rents was stronger in large cities

	<i>Dependent variable:</i>			
	1st Difference Rents			
	1980-2019	1990-2019	1980-2019	1990-2019
	(1)	(2)	(3)	(4)
Amenity	-0.025*** (0.007)	-0.013*** (0.005)	-0.077*** (0.011)	-0.028*** (0.005)
Amenity*Top 210 Metro Areas, excluding Top 45	0.036*** (0.010)	0.018** (0.008)	0.051*** (0.016)	0.004 (0.008)
Amenity*Top 45 Metro Areas, excluding Top 10	0.059*** (0.010)	0.044*** (0.007)	0.092*** (0.016)	0.080*** (0.008)
Amenity*Top 10 Metro Areas	0.126*** (0.009)	0.065*** (0.007)	0.289*** (0.016)	0.123*** (0.009)
Top 210 Metro Areas, excluding Top 45	0.019** (0.010)	-0.042*** (0.007)	0.026** (0.013)	-0.028*** (0.007)
Top 45 Metro Areas, excluding Top 10	0.095*** (0.010)	-0.011 (0.007)	0.093*** (0.014)	-0.037*** (0.008)
Top 10 Metro Areas	0.125*** (0.010)	-0.021*** (0.007)	0.002 (0.016)	-0.079*** (0.009)
Constant	1.442*** (0.007)	0.900*** (0.005)	1.444*** (0.009)	0.900*** (0.005)
Observations	3,099	3,101	1,775	3,101
R <sup>2</sup>	0.221	0.069	0.302	0.099
Adjusted R <sup>2</sup>	0.219	0.067	0.300	0.097

This table shows the results of a regression of the change in the natural log of rent on estimated amenities interacted with size categories. The first and second columns show the results using unadjusted wages and rents for 1980 and 1990, respectively. The second and third columns show the results using adjusted wages and rents for 1980 and 1990, respectively. \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

These results are robust to the definition of size categories. Figure 6 shows the coefficients on the interaction term of amenities and category indicators when the sample is split by metro size into 10 categories of roughly equal population rather than four. For these results, we use unadjusted 1980 amenity estimates. The left panel shows the coefficients on the interaction term for each category for the change in log population. The points represent the coefficient estimates and the lines represent 95 percent confidence intervals. The regressions use population weights and control for county-level density. Even with these finer categories, the coefficients on the interaction terms are decreasing with metro size. The right panel shows the same results with the change in rents as the dependent variable. In this case,

the coefficients increase with metro size categories. The high-amenity counties in the top quantile have the largest price gains.

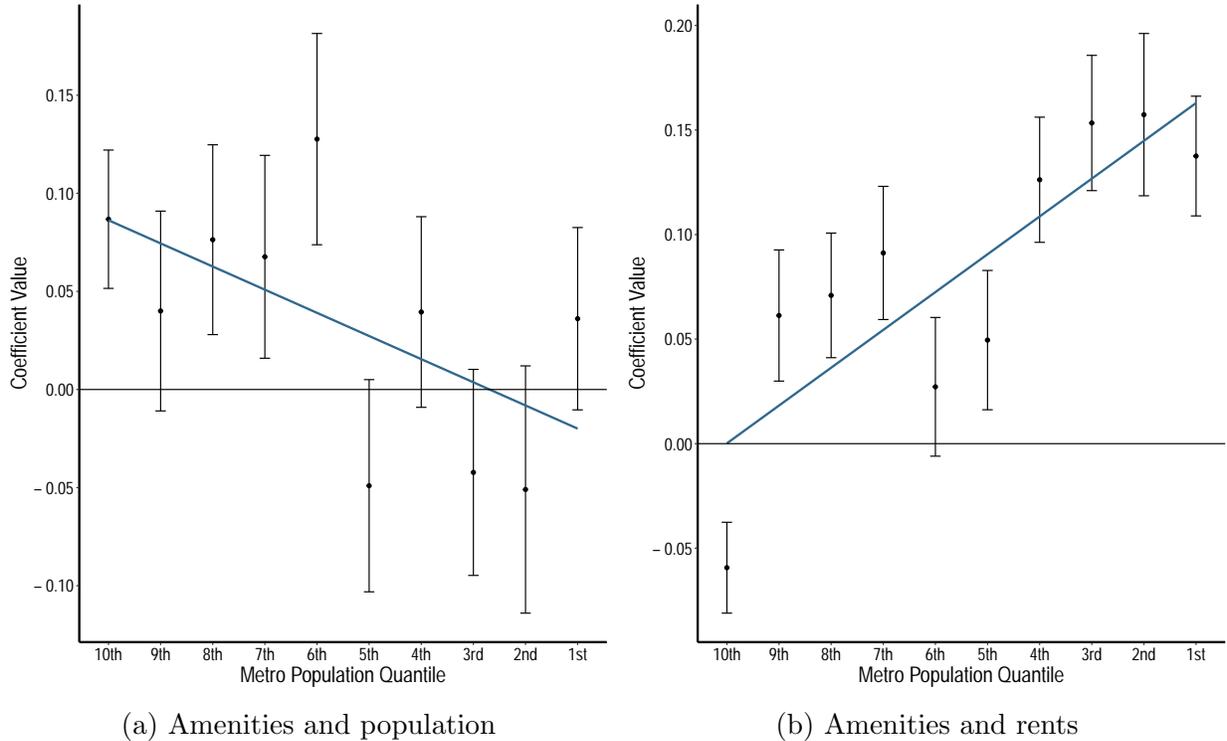


Figure 6: The effects of amenities on population and rents by fine metro size categories.

This figure shows estimates of the coefficient on the interaction term between amenities and population category indicators for each quantile. Counties are separated into 10 categories based on the size of their containing metro. Each category has roughly equal population. The left panel shows the coefficients using changes in population as the dependent variables, while the right panel uses rents. Points represent coefficient estimates on the interaction term for each quantile, and lines through the points represent 95 percent confidence intervals. The blue line is a linear fit through the coefficient estimates.

In the Appendix tables A.1 and A.2, we show the results of several additional robustness checks. First, we may be concerned that differences in density are driving population change even within metro size classifications and that density may be correlated with amenities, so we run regressions that control for population density. Second, our income measure does not account for the fact that there is variation in commuting costs that affect realized income. We run regressions where we adjust wages by subtracting commuting costs, assuming that the value of commuting time equals the wage rate. Third, the results may be sensitive to

our calibration of local expenditure shares. In our baseline results we use 0.65 as suggested by Albouy (2016); however, other studies have used a smaller local expenditure share, so we include results using 0.35. Finally, in our baseline regressions, we use rents as our measure of housing costs, which excludes owner-occupied units. This may bias our results given that home ownership rates vary across locations. As a check, we run the regressions using median house values instead of rents.

These additional checks provide broad support for our baseline estimates both qualitatively and quantitatively. The only discrepancy is when we substitute house values for rents. The results for population changes remain consistent; however, for changes in housing costs, the coefficient estimates on the interaction of amenities and metro size categories no longer strictly increase with metro size. One potential explanation for why population results are robust to using house values but price results are not is the fact that house values are partially driven by expectations about future price growth. We suspect that rents are a better measure for contemporary housing costs.

Finally, in Appendix tables A.3 and A.4 we include results that show the estimates by individual decades. In all four decades between 1980 and 2019, the same patterns persist and are statistically significant. The correlation of amenities and population growth is higher for small towns, while the correlation of amenities and rents is higher for large cities, as in the baseline results. The relationships weaken slightly over time; the strongest relationships are found in the 1980s and 1990s. Note that the estimates for 2010 to 2019 do not capture an entire decade as the 2019 value is based on a 5-year lagged average, and therefore we would expect smaller coefficients relative to other decades.

The results in this section are consistent with increasing preferences for amenities. In large cities, high-amenity counties have increased relatively more in price, while in high-amenity small towns populations have grown. In the next section, we consider how domestic migration flows have contributed to this population gain.

## 6 Decomposition of Population Changes

In this section, we examine the source of population changes for locations in different size categories and with different amenity levels. In our analysis, we use Census-calculated decompositions of population change to explore the contributions of natural increase (births and deaths), domestic migration, and international migration to county population changes. Data are available yearly between 2000 and 2019.<sup>19</sup>

We aggregate the data into eight categories. We keep the same four size categories based on metro size as in previous sections (top 10, 11 through 45, 46 through 210, and remaining counties), which have roughly equal population. We also separate each of the four population categories into high and low amenity counties of roughly equal total population using adjusted 1990 amenity values.<sup>20</sup> The result is eight bins all with roughly equal population.

Table 4 shows the total contributions to population change for each size and amenity category over the entire sample period from 2000-2019. The last row shows total population change. Consistent with Figure 1b, the largest total population gains are in the mid-sized metro areas, while slower population growth occurred in both the top 10 metros and in the remaining category, which represents small metros and rural areas. Notably the effect of amenities on population growth varies by size category. For small towns, population growth was significantly higher in high-amenity locations, while the relationship is reversed for the largest metros.

The other rows of Table 4 show the contribution of each component of population growth. Natural increase, which captures population growth from births and deaths, was higher in larger cities but appears to have little relationship to amenities of locations. Natural increase is related to demographic characteristics, and larger cities, on average, have younger

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<sup>19</sup>These data were obtained from the Census Bureau's Annual Population Estimates and Estimated Components of Resident Population Change.

<sup>20</sup>The cutoff amenity values are not the same in each population category given different population distributions and average amenity levels. However, maintaining equal populations in each bin allows for easy comparison of flows. The cutoff amenity level for the top 10, top 45, top 210, and remaining counties are at the 70th, 80th, 70th, and 60th percentiles, respectively.

Table 4: Population growth decomposition across county types

	Remaining		Top 210		Top 45		Top 10	
	High	Low	High	Low	High	Low	High	Low
<b>Natural Increase</b>	1,538	1,305	3,060	3,678	4,144	3,745	4,710	4,687
<b>International Migration</b>	867	567	1,686	1,260	3,048	1,456	4,131	2,876
<b>Domestic Migration</b>	1,097	-945	2,181	1,646	1,230	2,768	-5,697	-1,502
<b>Residual</b>	-102	-143	-72	-23	263	12	419	296
<b>Net Population Change</b>	<b>3,399</b>	<b>785</b>	<b>6,855</b>	<b>6,561</b>	<b>8,685</b>	<b>7,981</b>	<b>3,563</b>	<b>6,357</b>

This table shows a decomposition of population changes for U.S. counties between 2000 and 2019 by size and amenity categories. All numbers are in thousands of people. Amenity categories use 1990 amenity estimates adjusted for housing and worker characteristics.

populations. International migration also is strongly related to city size, with large cities receiving a disproportionate share of immigrants. In addition, immigrants tend to locate in high-amenity locations regardless of population size. A large literature has documented and studied the location choices of immigrants, including papers by Albert and Monras (2018), Card (2001), and Munshi (2003). The residual component represents population growth that the Census is unable to attribute to the other categories.

Unlike the other components of growth, the importance of amenities for domestic migration depends on metro size. For small towns, in-migration is significantly higher in high-amenity counties. However, for large metros, high-amenity counties saw significantly more out-migration. The difference in population dynamics for large versus small places with respect to amenities is entirely due to the domestic migration component of population change.<sup>21</sup> These results may have significant implications for understanding the prospects of small towns facing depopulation. High-amenity counties in the smallest metro category have increased by over 1 million residents from domestic migration, while low-amenity counties

<sup>21</sup>There are potentially interesting correlations between amenities, housing supply, and gross migration that may have implications for declining gross migration observed in the U.S. over the study period, as explored by Molloy et al. (2011) and Coate and Mangum (2019).

have lost almost a million residents to out-migration.

Figure 7 shows the components of growth for each year from 2000 to 2019. The left panel shows the contributions to population changes for the 10 largest metros, while the right panel shows the same graph for counties in the smallest population size category. The line color denotes population change component, while the line type signifies high-amenity (solid) or low-amenity (dotted) counties.

Population dynamics over this time period clearly were affected by macroeconomic trends, notably the housing boom and bust cycle associated with the Great Recession. Population growth in high-amenity small towns was the largest during the housing boom of the early 2000s. The growth in these locations then slowed before picking up considerably around 2015. Population dynamics exhibited the opposite pattern for high-amenity counties in large metros. During expansions these counties had slower growth, but tended to grow more during and after the housing market crash.

The time-series patterns were largely driven by domestic migration. International migration and natural increase were relatively stable within population and amenity categories over the business cycle. Domestic migration, on the other hand, varied significantly and drove changes in net population growth over the time period. Overall, these patterns are consistent with a push from high prices in big cities as well as available supply capacity in less populated high-amenity counties.

## 7 Conclusion

In this paper, we have documented a divergence in the growth dynamics of American cities. Rising incomes have increased American consumers' demands for local goods in the form of housing in high-amenity areas. In most of the country, this demand produces an increase in the population of high-amenity areas. However, the country's largest and most expensive cities are experiencing a housing supply crunch, which creates twin pressures: high and

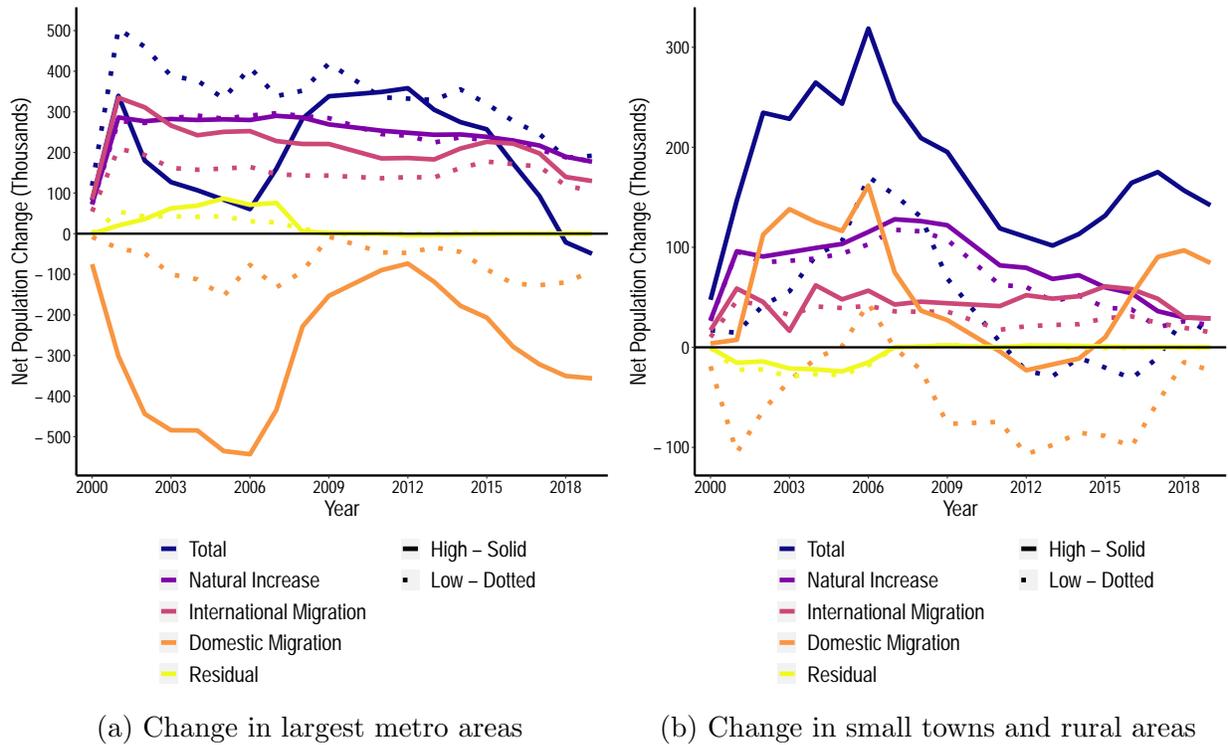


Figure 7: Net population change decomposition over time

This figure shows the decomposition of population growth for U.S. counties for each year between 2000 and 2019. Different colors represent different components of population growth. Solid lines are high-amenity locations, while dotted lines represent low-amenity locations. Amenity categories use 1990 amenity estimates adjusted for housing and worker characteristics. Note that the y-axis scale is different for the two plots to improve clarity. The 2010 points are an interpolation using the trend between 2009 and 2011; in the data, the 2010 points are estimates for a 3-month period and are dropped.

rising rents, and net population loss to other, less expensive locations. We use a simple model to explain the relationship between these phenomena. Smaller metro areas are gaining population without increasing in (relative) price, and this change is largely driven by people moving away from expensive big cities. While large cities continue to grow slightly on net, their population growth is driven by natural increase and new international arrivals.

The lack of housing supply in America’s largest cities affects more than just local rents. Population dynamics throughout the country are altered by the combination of high demand for amenities and constraints on supply. The welfare implications are ambiguous; the productive agglomerative forces of big cities may cause large welfare losses as populations realign

to smaller areas. The research here thus demonstrates that solutions to the housing crunch in big cities must consider the entire American metropolitan network.

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# A Appendix

Table A.1: Robustness: Population results

	<i>Dependent variable:</i>			
	1st Difference Density			
	(1)	(2)	(3)	(4)
Amenity	0.058*** (0.009)	0.071*** (0.010)	0.030*** (0.010)	0.083*** (0.010)
Amenity*Top 210 Metro Areas, excluding Top 45	-0.008 (0.015)	-0.027* (0.016)	-0.014 (0.016)	-0.065*** (0.014)
Amenity*Top 45 Metro Areas, excluding Top 10	-0.022 (0.015)	-0.044*** (0.017)	-0.076*** (0.017)	-0.076*** (0.014)
Amenity*Top 10 Metro Areas	-0.056*** (0.016)	-0.114*** (0.017)	-0.069*** (0.018)	-0.109*** (0.012)
Top 210 Metro Areas, excluding Top 45	0.238*** (0.015)	0.119*** (0.014)	0.134*** (0.013)	0.132*** (0.013)
Top 45 Metro Areas, excluding Top 10	0.340*** (0.017)	0.176*** (0.017)	0.165*** (0.013)	0.167*** (0.014)
Top 10 Metro Areas	0.363*** (0.020)	0.102*** (0.018)	0.046*** (0.014)	0.097*** (0.015)
Log Pop Density	-0.076*** (0.004)			
Constant	0.364*** (0.015)	0.136*** (0.009)	0.139*** (0.009)	0.134*** (0.009)
Observations	3,105	2,963	3,105	3,105
R <sup>2</sup>	0.186	0.102	0.070	0.088
Adjusted R <sup>2</sup>	0.184	0.100	0.068	0.086

This table shows results that demonstrate the robustness of the baseline estimates on population change. Each column shows the results of a regression of the change in the natural log of population on estimated amenities interacted with size categories. The first column shows the results using the natural log of population density as a control. The second column shows the results using commute-adjusted wages. The third column shows the results using a lower value, 0.35, of the local consumption parameter. The fourth column shows the results using median housing value in place of median rents. All columns show the results using adjusted wages and rents (values in the case of column four) for 1990. The time period for the change in the natural log of population is 1990 to 2019. \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Table A.2: Robustness: Rent results

	<i>Dependent variable:</i>			
	1st Difference Rents			
	(1)	(2)	(3)	(4)
Amenity	−0.030*** (0.005)	−0.027*** (0.005)	−0.008 (0.005)	0.029*** (0.008)
Amenity*Top 210 Metro Areas, excluding Top 45	0.009 (0.008)	0.015* (0.008)	0.026*** (0.008)	−0.046*** (0.012)
Amenity*Top 45 Metro Areas, excluding Top 10	0.089*** (0.008)	0.090*** (0.009)	0.060*** (0.008)	0.036*** (0.012)
Amenity*Top 10 Metro Areas	0.139*** (0.009)	0.106*** (0.009)	0.128*** (0.009)	0.002 (0.010)
Top 210 Metro Areas, excluding Top 45	−0.004 (0.008)	−0.037*** (0.007)	−0.038*** (0.006)	−0.047*** (0.011)
Top 45 Metro Areas, excluding Top 10	−0.001 (0.009)	−0.048*** (0.009)	0.002 (0.007)	−0.015 (0.012)
Top 10 Metro Areas	−0.028** (0.011)	−0.067*** (0.009)	0.047*** (0.007)	−0.091*** (0.012)
Log Pop Density	−0.016*** (0.002)			
Constant	0.949*** (0.008)	0.897*** (0.005)	0.897*** (0.005)	0.988*** (0.008)
Observations	3,101	2,959	3,101	3,104
R <sup>2</sup>	0.115	0.092	0.112	0.058
Adjusted R <sup>2</sup>	0.113	0.090	0.110	0.056

This table shows results that demonstrate the robustness of the baseline estimates on population change. Each column shows the results of a regression of the change in the natural log of rents on estimated amenities interacted with size categories. The first column shows the results using the natural log of population density as a control. The second column shows the results using commute-adjusted wages. The third column shows the results using a lower value, 0.35, of the local consumption parameter. The fourth column shows the results using median housing value in place of median rents. All columns show the results using adjusted wages and rents (values in the case of column four) for 1990. The time period for the change in the natural log of rents is 1990 to 2019. \*p<0.1; \*\*p<0.05; \*\*\*p<0.01 \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Table A.3: Population results by decade

	<i>Dependent variable:</i>			
	1st Difference Density			
	1980-1990	1990-2000	2000-2010	2010-2019
	(1)	(2)	(3)	(4)
Amenity	0.061*** (0.005)	0.029*** (0.004)	0.026*** (0.004)	0.004*** (0.0005)
Amenity*Top 210 Metro Areas, excluding Top 45	0.017** (0.007)	0.002 (0.007)	-0.005 (0.006)	0.001 (0.001)
Amenity*Top 45 Metro Areas, excluding Top 10	-0.018*** (0.007)	-0.050*** (0.006)	-0.053*** (0.005)	-0.002*** (0.001)
Amenity*Top 10 Metro Areas	-0.064*** (0.006)	-0.061*** (0.006)	-0.053*** (0.005)	-0.005*** (0.001)
Top 210 Metro Areas, excluding Top 45	0.066*** (0.007)	0.035*** (0.006)	0.048*** (0.005)	0.016 (0.027)
Top 45 Metro Areas, excluding Top 10	0.093*** (0.007)	0.057*** (0.006)	0.058*** (0.005)	0.136*** (0.026)
Top 10 Metro Areas	0.068*** (0.007)	0.029*** (0.006)	0.022*** (0.005)	0.255*** (0.025)
Constant	0.015*** (0.005)	0.086*** (0.004)	0.041*** (0.004)	-0.158*** (0.019)
Observations	3,103	3,105	3,106	3,103
R <sup>2</sup>	0.174	0.078	0.120	0.169
Adjusted R <sup>2</sup>	0.172	0.076	0.119	0.167

This table shows the results of a regression of the change in the natural log of population on estimated amenities interacted with size categories. The four columns show the results of the change in the natural log of population for 1980-1990, 1990-2000, 2000-2010, and 2010-2019, respectively. The regression uses unadjusted rents and wages. \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Table A.4: Rent results by decade

	<i>Dependent variable:</i>			
	1st Difference Value			
	1980-1990	1990-2000	2000-2010	2010-2019
	(1)	(2)	(3)	(4)
Amenity	-0.007 (0.006)	-0.035*** (0.004)	0.014*** (0.004)	-0.001 (0.001)
Amenity*Top 210 Metro Areas, excluding Top 45	0.011 (0.009)	0.003 (0.006)	0.010* (0.005)	0.001 (0.001)
Amenity*Top 45 Metro Areas, excluding Top 10	-0.004 (0.008)	0.002 (0.006)	0.033*** (0.005)	0.002** (0.001)
Amenity*Top 10 Metro Areas	0.044*** (0.008)	0.021*** (0.005)	0.013*** (0.004)	0.005*** (0.001)
Top 210 Metro Areas, excluding Top 45	0.069*** (0.008)	-0.044*** (0.005)	-0.001 (0.005)	-0.022 (0.032)
Top 45 Metro Areas, excluding Top 10	0.115*** (0.008)	-0.049*** (0.005)	0.005 (0.005)	-0.030 (0.030)
Top 10 Metro Areas	0.166*** (0.008)	-0.106*** (0.005)	0.048*** (0.005)	-0.157*** (0.030)
Constant	0.538*** (0.006)	0.390*** (0.004)	0.284*** (0.004)	0.255*** (0.023)
Observations	3,103	3,105	3,105	3,099
R <sup>2</sup>	0.190	0.173	0.161	0.088
Adjusted R <sup>2</sup>	0.188	0.171	0.160	0.086

This table shows the results of a regression of the change in the natural log of rents on estimated amenities interacted with size categories. The four columns show the results of the change in the natural log of rent for 1980-1990, 1990-2000, 2000-2010, and 2010-2019, respectively. The regression uses unadjusted rents and wages. \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Table A.5: Highest amenity counties by population category

Group	County	Metro Area	Amenity	Med Rent	Med Income	Population
<b>Country</b>	Pitkin County, Colorado	Glenwood Springs	4.55	663	39,991	12,661
	Hinsdale County, Colorado		4.55	275	26,250	467
	Gilpin County, Colorado	Denver-Aurora-Lakewood	3.82	351	31,898	3,070
	San Miguel County, Colorado		3.77	447	30,578	3,653
	Dixie County, Florida		3.68	160	15,380	10,585
	Mineral County, Colorado		3.59	231	19,830	558
	Park County, Colorado	Denver-Aurora-Lakewood	3.48	366	32,102	7,174
	Monroe County, Florida	Key West	3.37	523	29,351	78,024
	Blaine County, Idaho	Hailey	3.32	410	31,199	13,552
Dukes County, Massachusetts	Vineyard Haven	3.23	521	31,994	11,639	
<b>Top 10</b>	Marin County, California	San Francisco-Oakland-Berkeley	3.05	763	48,544	230,096
	San Francisco County, California	San Francisco-Oakland-Berkeley	3.03	613	33,414	723,959
	New York County, New York	New York-Newark-Jersey City	2.43	478	32,262	1,487,536
	Falls Church City, Virginia	Washington-Arlington-Alexandria	2.19	769	51,011	9,578
	Alameda County, California	San Francisco-Oakland-Berkeley	2.01	570	37,544	1,279,182
	San Mateo County, California	San Francisco-Oakland-Berkeley	1.88	711	46,437	649,623
	Contra Costa County, California	San Francisco-Oakland-Berkeley	1.69	613	45,087	803,732
	Suffolk County, Massachusetts	Boston-Cambridge-Newton	1.65	546	29,399	663,906
	Pike County, Pennsylvania	New York-Newark-Jersey City	1.60	445	30,314	27,966
Alexandria City, Virginia	Washington-Arlington-Alexandria	1.58	667	41,472	111,183	
<b>Top 45</b>	Gilpin County, Colorado	Denver-Aurora-Lakewood	3.82	351	31,898	3,070
	Park County, Colorado	Denver-Aurora-Lakewood	3.48	366	32,102	7,174
	Clear Creek County, Colorado	Denver-Aurora-Lakewood	3.17	335	33,149	7,619
	El Dorado County, California	Sacramento-Roseville-Folsom	2.44	478	35,058	125,995
	Bandera County, Texas	San Antonio-New Braunfels	2.10	256	24,671	10,562
	Orleans Parish, Louisiana	New Orleans-Metairie	1.91	277	18,477	496,938
	Placer County, California	Sacramento-Roseville-Folsom	1.88	496	37,601	172,796
	Multnomah County, Oregon	Portland-Vancouver-Hillsboro	1.86	347	26,928	583,887
	Denver County, Colorado	Denver-Aurora-Lakewood	1.79	339	25,106	467,610
King County, Washington	Seattle-Tacoma-Bellevue	1.76	457	36,179	1,507,319	
<b>Top 210</b>	Teller County, Colorado	Colorado Springs	3.08	387	32,209	12,468
	Santa Cruz County, California	Santa Cruz-Watsonville	2.51	651	37,112	229,734
	Barnstable County, Massachusetts	Barnstable Town	2.40	547	31,766	186,605
	Sonoma County, California	Santa Rosa-Petaluma	2.23	576	36,299	388,222
	Lane County, Oregon	Eugene-Springfield	2.18	360	25,268	282,912
	Storey County, Nevada	Reno	2.15	343	32,457	2,526
	Monroe County, Georgia	Macon-Bibb County	2.15	208	27,770	17,113
	Boulder County, Colorado	Boulder	1.96	449	35,322	225,339
	San Luis Obispo County, California	San Luis Obispo-Paso Robles	1.96	510	31,164	217,162
Cumberland County, Maine	Portland-South Portland	1.95	458	32,286	243,135	
<b>Remaining</b>	Pitkin County, Colorado	Glenwood Springs	4.55	663	39,991	12,661
	Hinsdale County, Colorado		4.55	275	26,250	467
	San Miguel County, Colorado		3.77	447	30,578	3,653
	Dixie County, Florida		3.68	160	15,380	10,585
	Mineral County, Colorado		3.59	231	19,830	558
	Monroe County, Florida	Key West	3.37	523	29,351	78,024
	Blaine County, Idaho	Hailey, ID	3.32	410	31,199	13,552
	Dukes County, Massachusetts	Vineyard Haven	3.23	521	31,994	11,639
	Custer County, Colorado		3.23	223	20,000	1,926
Nevada County, California	Truckee-Grass Valley	3.21	489	32,200	78,510	

Table A.6: Lowest amenity counties by population category

Group	County	Metro Area	Amenity	Med Rent	Med Income	Population
<b>Country</b>	Glasscock County, Texas		-3.55	100	29,306	1,447
	Clinch County, Georgia		-3.14	115	18,098	6,160
	Webster County, Georgia		-3.08	99	19,028	2,263
	Glascoc County, Georgia		-3.07	111	21,806	2,357
	Powhatan County, Virginia	Richmond	-2.91	331	37,394	15,328
	Robertson County, Kentucky		-2.86	99	19,756	2,124
	Lamar County, Alabama		-2.81	110	20,618	15,715
	Jenkins County, Georgia		-2.67	111	16,967	8,247
	Johnson County, Georgia	Dublin	-2.61	105	18,064	8,329
Clay County, Alabama		-2.61	116	19,252	13,252	
<b>Top 10</b>	Newton County, Indiana	Chicago-Naperville-Elgin	-1.11	207	28,624	13,551
	Waller County, Texas	Houston-The Woodlands-Sugar Land	-0.99	237	22,334	23,390
	Lapeer County, Michigan	Detroit-Warren-Dearborn	-0.87	335	35,874	74,768
	Warren County, Virginia	Washington-Arlington-Alexandria	-0.87	328	31,062	26,142
	Charles County, Maryland	Washington-Arlington-Alexandria	-0.85	603	46,415	101,154
	Jasper County, Indiana	Chicago-Naperville-Elgin	-0.80	228	28,546	24,960
	Calvert County, Maryland	Washington-Arlington-Alexandria	-0.77	519	47,608	51,372
	Manassas Park City, Virginia	Washington-Arlington-Alexandria	-0.74	602	39,076	6,734
	Jefferson County, West Virginia	Washington-Arlington-Alexandria	-0.73	294	30,941	35,926
Culpeper County, Virginia	Washington-Arlington-Alexandria	-0.69	402	33,523	27,791	
<b>Top 45</b>	Fayette County, Tennessee	Memphis	-2.58	137	22,199	25,559
	Southampton County, Virginia	Virginia Beach-Norfolk-Newport News	-2.43	140	26,376	17,550
	Gates County, North Carolina	Virginia Beach-Norfolk-Newport News	-2.39	135	23,408	9,305
	St. James Parish, Louisiana	New Orleans-Metairie	-2.38	114	23,105	20,879
	Smith County, Tennessee	Nashville-Davidson-Murfreesboro-Franklin	-2.05	175	23,255	14,143
	Meriwether County, Georgia	Atlanta-Sandy Springs-Alpharetta	-1.93	172	20,212	22,411
	Tate County, Mississippi	Memphis	-1.92	185	22,207	21,432
	Chester County, South Carolina	Charlotte-Concord-Gastonia	-1.73	169	23,054	32,170
	Jasper County, Georgia	Atlanta-Sandy Springs-Alpharetta	-1.66	170	25,736	8,453
Heard County, Georgia	Atlanta-Sandy Springs-Alpharetta	-1.63	179	21,513	8,628	
<b>Top 210</b>	Powhatan County, Virginia	Richmond	-2.91	331	37,394	15,328
	Talbot County, Georgia	Columbus	-2.49	99	20,489	6,524
	Calhoun County, South Carolina	Columbia	-2.38	127	23,750	12,753
	Pickens County, Alabama	Tuscaloosa	-2.32	99	17,879	20,699
	Goochland County, Virginia	Richmond	-2.28	282	36,239	14,163
	Crawford County, Georgia	Macon-Bibb County	-2.26	155	25,799	8,991
	Lynchburg City, Virginia	Lynchburg	-2.22	272	23,726	66,049
	Fairfield County, South Carolina	Columbia	-2.21	151	21,484	22,295
	Twiggs County, Georgia	Macon-Bibb County	-2.18	145	19,213	9,806
Lowndes County, Alabama	Montgomery	-2.15	99	15,584	12,658	
<b>Remaining</b>	Glasscock County, Texas		-3.55	100	29,306	1,447
	Clinch County, Georgia		-3.14	115	18,098	6,160
	Webster County, Georgia		-3.08	99	19,028	2,263
	Glascoc County, Georgia		-3.07	111	21,806	2,357
	Robertson County, Kentucky		-2.86	99	19,756	2,124
	Lamar County, Alabama		-2.81	110	20,618	15,715
	Jenkins County, Georgia		-2.67	111	16,967	8,247
	Johnson County, Georgia	Dublin	-2.61	105	18,064	8,329
	Clay County, Alabama		-2.61	116	19,252	13,252
Irwin County, Georgia		-2.60	125	20,169	8,649	