Title: The Changing Landscape of Affordable Housing in the Rural and Urban United States, 1990-2016

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Abstract

Affordable housing has declined in recent decades, yet limited research has examined the demographic and economic changes influencing place-level affordability—especially outside of large metros. In this study I examine the effects of county-level population growth and decline, population aging, and natural amenity development on rates of affordable housing, income, and housing costs across four types of counties. While declines in affordability from 1990-2016 were universal between rural and urban counties, population growth is associated with decreases in affordability in rural counties but increased affordability in large metros counties due to estimated decreases in housing costs. Population aging is estimated to improve affordability in large and small metro counties, despite the associated decrease in income and housing costs across all county types. The effects of aging vary greatly between owners and renters. Natural amenity development, despite its theoretical importance, is not associated with changes in affordability for rural counties.

Keywords: Affordable Housing, Demographic Change, Rural, Urban

Introduction

Affordable housing has been on a decades-long decline in the United States (Harvard JCHS 2018a; Stone 2004). In 1990, 26.6 percent of households had housing costs deemed unaffordable, but this increased to 32.0 percent by 2016 despite increases in income over the period (Bernstein 2016; Harvard JCHS 2018a, 2018b; Wilmers 2018). Rates of unaffordable housing in 2016 were especially high among socioeconomically vulnerable groups such as renters (47.4 percent) and households making less than \$30,000 per year (73.1 percent) (Harvard JCHS 2018a). Adding on to these trends were significant spikes in unaffordable housing and general housing instability during the Great Recession (Colburn and Allen 2018; Harvard JCHS 2018a; Lens 2018). These housing trends are important because those without affordable living arrangements are at heightened risk of joblessness, forced moves, and mental stress, among other things (Desmond and Gershenson 2016; Lee and Evans 2020; Mason et al. 2013; Zavisca and Gerber 2016). Accompanying this general decline in affordability is growing inequality in affordability between groups. Most studies regarding changes in the attainment of affordable housing have focused on what characteristics—e.g. race, tenure—influence individuals' risk of housing instability (Colburn and Allen 2018; Cook et al. 1994; Desmond and Gershenson 2016; McConnell and Akresh 2010), but housing inequality can also be viewed as a place-based, spatially-aggregated process. Research on place-level affordability has focused primarily on disparities between neighborhoods within or between metropolitan areas (Flippen 2010; McConnell 2013); generally overlooking housing in rural areas and how county-level affordability across the nation has been impacted by demographic and economic change.

This study addresses these knowledge gaps via two objectives. First, I test hypotheses regarding the socioeconomic determinants of change in affordable housing from 1990 to 2016 in U.S. counties. Of all the potential determinates of change, I focus on three that have a strong theoretical link to place-level affordability: population growth, population aging, and natural amenity development (NAD). These forces have been documented to affect local housing costs and other spatial socioeconomic outcomes (e.g., income, poverty) and are thus likely produce changes in affordability (Deller 2010; Glasgow and Brown 2012; Lichter and Brown 2011). Particular emphasis is given to understanding how these determinates vary between urban (metropolitan) and rural (nonmetropolitan) counties, which I expect to differ in housing affordability dynamics given how related spatial inequalities have played out across the rural-

urban continuum.¹ A second objective is to tease apart these effects on affordability into county-level changes in household income and housing costs, respectively. As subsequently explained, it is necessary to study changes in affordability, income, and housing costs together to fully understand the changing the landscape of affordable housing.

Conceptual Framework

Place-level rates of affordable housing—regardless of geographic scale—are determined by the relationship between the financial resources available to residents and the housing costs paid by those residents. Although there are multiple ways to measure the relationship between financial resources and housing costs to determine affordability, the most straightforward way is to measure the percentage of households that live in affordable housing. The affordable housing rate is typically defined as the proportion of households that spend 30 percent or less of their income on housing costs (Herbert et al. 2018). The main limitation of measuring affordability in this way is that when examining longitudinal changes in affordability it masks why a place is becoming more or less affordable for its residents.

This limitation arises from the issue that changes in affordability are a direct reflection of unequal changes in average income and average housing costs. A place can maintain the same relative affordability if there are relatively equal shifts—positive or negative—in income and housing costs. Changes in income and housing costs affect resident’s lived experiences and thus must be considered when estimating changes in place-level affordability. Furthermore, different combinations of income and housing cost change can produce the similar changes in affordable housing. A county that has become more affordable over time could have, for example, experienced a significant rise in income with minor growth in housing costs or, alternatively, experienced a decrease in housing costs with no change in income. These scenarios reflect very different socioeconomic realities that must be accounted for and have distinct implications for the long-term wellbeing of residents.

Incorporating income and housing costs also helps understand the process through which multiple socioeconomic forces produce changes in place-level affordability. The demographic

¹ In this study, I use the terms urban and metropolitan and rural and nonmetropolitan interchangeable. While I acknowledge that these terms are not direct synonyms and differ technically within U.S. federal statistics (Isserman 2005), I use both sets of terms in order to make key substantive or technical points.

and economic forces of interest to this study—population growth, population aging, and NAD—theoretically affect the subcomponents of affordability in different ways with sometimes ambiguous implications for overall rates of affordable housing. For example, while population growth may put pressure on available housing stock within a county (E. Glaeser and Gyourko 2018; Mulder 2006), it may at the same time be driven by the in-migration of affluent individuals that can afford to live in a tighter housing market (Nelson et al. 2010; Nelson and Hines 2018). Alternatively, in the case of a NAD community, those permanently migrating in are often those seeking working-class jobs. These migrants may be poorer than current residents resulting in decreases in average incomes—compounding the increases in housing cost—thus decreasing affordability (Cooke 2010; Nelson et al. 2009).

The other element of this study’s conceptual framework is the need to explore how affordability and its determinants vary between rural and urban areas. While rates of unaffordable housing in 2016 were at 25 percent in nonmetro counties, 26 percent in small metros, and 40 percent in large metros (Harvard JCHS 2018a), differences in overall cost of living relative to income are much smaller between county types (Nord 2009). One study found that while central cities tend to be more costly there is little difference in costs of living between suburban and rural areas (Loveridge and Paredes 2018). For housing costs specifically, in the ten largest metro areas the median monthly housing costs exceeded \$1,300, while costs in all other metros was around \$700 and \$650 for nonmetro counties (Harvard JCHS 2018a). However, research on cross-sectional rural-urban disparities cannot fully explain how and why rural and urban places become more or less affordable over time.

Rural-urban status is likely a key modifier of affordability for a number of reasons. First, county socioeconomic heterogeneity likely means that changes in population or employment result in different impacts on housing in different types of rural and urban counties. Population growth is unequal among U.S. counties: many rural counties having experienced decline (Johnson and Lichter 2019) while many metropolitan areas experienced unprecedented growth (Shearer et al. 2018). Urban governments tend to have a larger relative tax-base, stronger zoning ordinances, and provide more services than rural governments (Frank and Reiss 2014; Lobao and Kraybill 2005), all of which could make urban places less susceptible to drastic shifts in affordability. As a counterpoint, homeownership—generally the more affordable option than renting—is dominant in rural areas, while renting is much more common in urban areas (Barcus

2010; Brooks and Mueller 2020; Scally et al. 2018).

Rural places also can have specialized—or dependent—economies and thus relatively small shifts in employment could produce significant housing change (Gundersen 2006; Thiede and Slack 2017). Urban places also tend to have greater availability of newly-built housing (Harvard JCHS 2018a), which can help growing populations find affordable housing (Hall 2013; Lichter et al. 2010). Income growth has generally been more stagnant over time in rural areas and rural poverty is significantly higher than urban poverty (Weber and Miller 2017). These rural disadvantages suggest that shifts in income and housing costs are more likely to be unequal in rural areas—resulting in significant changes in affordability—and that the potential effects of demographic and economic change may be smaller in urban areas than in rural areas.

The second reason why rural-urban status is important is that certain types of counties may benefit—become more affordable—from a given socioeconomic change while other nearby counties may become worse off. Rural America continues to be exploited by urban America for its cheaper land and labor in ways that affect housing (Lichter and Brown 2011; Lichter and Ziliak 2017). Exurban housing developments are often built in nonmetro counties that border metro counties—with developments sometimes just across the county line. While these developments increase the available housing stock for the nearby suburban population, they may have the unintended effect of increasing the nonmetro county’s housing costs (Clark et al. 2009; Esparza 2010; Lichter et al. 2020; Lichter and Ziliak 2017). Population change may make urban places more affordable at the expense of rural places. Furthermore, employment changes in one county can spill-over to another, which is particularly true for NAD (Hunter et al. 2005). The potential for uneven effects on housing within a multi-county area—containing both rural and urban places—suggests a need to incorporate spatial processes into this study’s analysis.

The final reason to include rural-urban status into this framework is a practical one. Rural-urban status can help identify the on-the-ground changes that may have occurred as a result of socioeconomic changes. Rural-urban status is needed to understand the potential effects of NAD, as the occupations associated with NAD—hospitality, real estate, and recreation—mean different things in rural and urban areas (Deller 2010; Winkler et al. 2012). For example, it is unlikely that growth in tourism-related occupations will create universal changes in affordability across rural-urban counties. How population growth translates to housing change is also affected by rural-urban status. Growth in rural areas may potentially lead to the building of expensive

suburban-style housing developments (Clark et al. 2009; Marx 2010; Roskey 2010), but urban growth may increase rental prices in large metros (Colburn and Allen 2018). Overall, rural-urban status is needed to fully understand why some places in the United States are becoming more or less affordable.

Past Research on Housing, Demographic, and Economic Change

This study views changes in housing affordability as a form of spatial inequality in that a social advantage—the attainment of affordable housing—is unequally distributed among places in the United States (Lobao et al. 2008). To theorize and understand how population growth, aging, and NAD affect affordability it is necessary to assess past research regarding how these processes have impacted communities and have produced related spatial inequalities.

Population growth is unequal across the United States with growth favoring urban counties and significant decline present in rural remote counties (Johnson and Lichter 2019). However, even within rural areas there is not a consistent pattern with many “micropolitan” counties and metropolitan fringe areas experiencing growth (Johnson and Lichter 2019; Lichter et al. 2020; Tong and Plane 2014). Population growth and decline are associated with a number of key socioeconomic changes that are relevant to this study. Counties that have been consistently classified as nonmetropolitan since 1960—and thus have had limited population growth—had poverty rates in 1970 that were 3.1 percent higher than consistently metropolitan counties (15.9% vs. 12.8%), while high-growth, rural-to-urban counties had a poverty rate of 14.0 percent (Johnson and Lichter 2020). Interestingly, poverty change over time is also affected by county growth type, with declines from 1970 of 5.4 percentage points for consistently nonmetropolitan counties, -1.8 points (indicating an increase) for nonmetro-to-metro counties, and 5.1 points for consistently metropolitan counties. Population growth is also related to income inequality. Butler and colleagues (2020) found that high growth nonmetropolitan counties experienced a decline in income inequality relative to stable growth counties, while population decline counties became more unequal over time. Similar trends may cross over to inequality in affordability, where growing populations create more equitable housing markets and it is easier for households of all income groups to find suitable housing. Alternatively, population decline should theoretically lead to excess housing stock resulting in decreased housing prices for those who remain in these places (Mulder 2006). The vast majority of counties that have experienced

population decline in these studies are also classified as rural (Butler et al. 2020; Johnson and Lichter 2019), which for this study may mean that population change may also be associated with larger relative changes in affordability in rural counties compared to urban counties.

While research on population change and affordability specifically is limited, several empirical studies document the effects of growth on housing costs and home values. In general, population growth increases housing prices within the area (Füss and Zietz 2016; Mulder 2006). A study of change between 1984 and 1998 found that a one percent increase in population was associated with a 1.1 percent increase in housing prices (Jud and Winkler 2002). Fuss and Zietz (2016) find that while rising housing costs often accompanies population growth, the relationship is moderated by availability of land and federal funds. However, both studies only focused on changes within metropolitan areas. State-level population growth has also been shown to affect housing prices (Holly et al. 2010). Population growth is a well-documented driver of housing supply. If an increase in population is not matched by a reasonable increase in housing supply then housing prices can rise dramatically, resulting in decreased affordability (E. L. Glaeser et al. 2006).

The United States is aging (Lichter and Johnson 2020; Thiede et al. 2017), and this is particularly true for many rural areas. In 2010, for example, approximately 15 percent of the rural population was over 65 years old compared to only 12 percent of the urban population (Glasgow and Brown 2012). The growth of the elderly population can be driven by two trends: aging in place and the emergence of rural retirement destinations. Aging in place communities are categorized by increases in median age due to the aging of long-term residents and the outmigration of young adults (Glasgow and Brown 2012; Johnson and Lichter 2019). In many nonmetro counties the number of deaths each year outnumber the number of birth, which likely has an effect on the availability of housing in those communities (Johnson 2020). Aging places can suffer economically due to decreased relative size of the working-age population and increased stress that seniors often put on local health and social services (Erickson et al. 2012). However certain types of elderly individuals have very stable income due to governmental transfers, pensions, and other sources of retirement incomes (Cooper and Pugh 2020). Modest levels of population aging is also associated with an increase in community services in many rural counties (Thiede et al. 2017), which may help keep housing costs stable over time. However, counties with initially very large proportions of elderly residents see declines in

services, meaning that the relationship between aging and affordability may be nonlinear. Aging in place is also a function of population loss at the bottom of the age pyramid, with many places in the rural United States experiencing brain drain and general youth out-migration (Jacquet et al. 2017; von Reichert et al. 2014). While no research has looked at the relationship between housing affordability and youth outmigration directly, there are strong conceptual reasons to believe that as a county shifts from significant portions of population having a high risk of housing instability (i.e., young adults) to a population with a lower risk (i.e., elderly), local rates of housing affordability should increase.

The other major driver of local population aging is the emergence of rural retirement destinations (Brown et al. 2011; Glasgow and Brown 2012), in which wealthy retired individuals migrate to select amenity-rich communities. Rural retirement destination communities can greatly benefit from such migration streams as many retirees have high incomes and help support local civic and social organizations (Brown et al. 2011; Sherman 2018). In general, elderly individuals who migrate to rural areas tend to do so to micropolitan counties (Johnson and Winkler 2015; Plane et al. 2005).

Although there are reasons to expect older individuals to be more housing-stable, affordable housing is a growing concern for the elderly population (Vega and Wallace 2016). One study found that in 2017, 30.9 percent of people aged 65-79 lived in unaffordable housing compared to 28.2 percent in 2001—likely driven by increases in renting among the elderly (Harvard JCHS 2019a). Despite this increase in renting, homeownership is the modal tenure for those aged 65+, and the majority (54%) have paid off their mortgage (Harvard JCHS 2019a). Homeownership is even more prevalent among the rural elderly (Barcus 2010; Nelson 2014). Elderly households in recent decades have also seen significant increases in household wealth compared to other types of households, with significant portions of that wealth gain coming from housing assets (Gibson-Davis and Percheski 2018). One of the main potential “benefits” of population aging on place-level affordability is that population aging indirectly reduces the prevalence of young families with children, who experience very high rates of housing burden and instability (Desmond 2012; Stone 2004). Young adults are significantly more likely to rent compared to older adults (Harvard JCHS 2019b), which again is associated with unaffordable housing. Finally, poverty rates among the elderly also differ by county type: those in metro areas have a poverty rate of 9.3 percent, 10.8 for micropolitan counties, and 13.1 for other nonmetro

counties (Glasgow and Brown 2012). Overall, it is unlikely that the effects of population aging on rates of affordable housing are consistent across counties.

NAD is the third phenomenon of interest for this study, and the link between it and housing has been studied quite extensively. Most counties that have experienced NAD are located in the Mountain-West region (Beale and Johnson 1998; Hines 2010), but are also present in the Sunbelt and Northeast (with many of those counties being on the metropolitan fringe) (Nelson et al. 2010; Winkler et al. 2012). NAD is a key driver of county-level population growth—particularly for rural counties (Chi and Marcouiller 2013; McGranahan 2008), but the evidence regarding impacts of NAD on economic well-being is mixed. One study found that income growth over time in nonmetro NAD counties was not significantly different than nonmetro counties that did not experience NAD (Hunter et al. 2005), while others have found that high amenity counties can experience significant economic growth under the right circumstances (Deller 2010; Deller et al. 2008). There is a linked migration of two groups—wealthy outsiders and Hispanic immigrants—to NAD communities, with the latter population moving there to take advantage of the new jobs in tourism, hospitality, and construction (Nelson et al. 2009, 2010). These two different income migration streams complicate the effects of NAD on income and housing costs.

Two case studies demonstrate the potential effects of NAD on housing. In coastal North Carolina, NAD was shown to lead to new housing developments with the largest developments having occurred in metropolitan fringe areas, and much of this new housing was targeted towards “later-life in-migrants,” (Crawford et al. 2013). In another example, NAD in Jackson Hole, Wyoming also had a significant impact on the building of new high-price housing as well as increasing land values throughout the area (Nelson and Hines 2018). Importantly, the effects of NAD on income and costs of living likely spill-over to nearby counties. Thus, even though a specific place may not have been experiencing the associated employment and gentrification shifts of NAD directly, there may potentially be an impact on housing (Hunter et al. 2005). Finally, an important characteristic of NAD is the purchase of second homes in these areas by wealthy outsiders and the transition of existing housing to vacation or seasonal housing (Beale and Johnson 1998; Glasgow and Brown 2012; Ulrich-Schad and Qin 2018). While the community and housing changes have been studied as point of conflict between long-term residents and newcomers, the direct impact on affordable housing has not yet been tested.

Hypotheses

I test three hypotheses regarding the impact of population growth, aging, and NAD on housing affordability, and these impacts vary across county types.

1. Population growth has a significant impact on county-level rates of affordable housing. As counties grow in population, they will experience decreases in affordability due to pressure on the supply of housing. The effects of population growth are unequal across different types of counties, with growth having a larger effect in nonmetro counties due to significant increases in housing costs outweighing potential increases in income.

2. Changes in county age structure impact rates of affordable housing. As counties have proportionately larger elderly populations, they will experience increases in affordability due to decreases in housing costs. The effects of population aging are larger in nonmetro counties due to the prevalence of homeownership.

3. Natural amenity development (NAD) has a significant impact on county-level rates of affordable housing, with increases in NAD-related employment being associated with decreases in affordability. The effects of NAD are larger in nonmetro counties due to the over-specialized nature of many nonmetro labor markets.

Current Study

To test these hypotheses, and in general assess the changing landscape of affordable housing, I estimate a series of regression models in which the variables of interest are county-level rate of affordable housing, median household income, and median housing costs. These models include county fixed effects to estimate within-county variation over time in affordability as they relate to population growth, population aging, and NAD. By focusing on within county change over time, this study provides substantive lessons on why affordable housing for many areas is on the decline.

Data and Measures

The unit of analysis is county and county equivalents within the continental United States. Counties provide the smallest unit in which socioeconomic data are universally available for all time periods and for the entire country. Conceptually, they are an appropriate geographic

scale to test this study's hypotheses as they best capture mesoscale changes in demographics and employment (Isserman 2005). I account for significant county boundary changes by merging together select counties to create time consistent units (n=3070).²

Data for this analysis were obtained from a variety of sources to create a dataset of county-level variables across four time-periods—1990, 2000, 2010, and 2016. Using IPUMS-NHGIS, I obtain data for the three outcome variables from the 1990 and 2000 decennial censuses and the 2006-2010 and 2012-2016 American Community Survey (ACS) 5-year estimates (Manson et al. 2021). Rate of affordable housing is measured as the percentage of households within a county that spent 30 percent or less of their monthly income on housing cost. This variable on rate of affordable housing is pre-constructed within the ACS, but census data does not provide the median housing cost for all households directly, but instead the median costs for owner and renter households separately. To remedy this issue, I construct a variable of median housing costs for all households by calculating the weighted average of owner and renter housing costs based on the proportion of owner and renter households in the county. For example, in a county where renter households make up 30 percent of the population and have median costs of \$1200 per month, while owners are 70 percent of households and had median costs of \$1400 per month; I then estimate that for this county that the median housing cost overall is \$1340 per month. Median household income and housing costs are reported as monthly values and were adjusted to 2016 dollars to account for inflation. Census data also provided two independent variables: county total population and percent of residents aged 65+.

Although census data does provide employment estimates, it does not provide the detailed information needed to estimate the proportion of workers in occupations associated with NAD. To get the necessary estimates, I use the County Business Patterns for 1990, 2000, 2010, and 2016, obtained via the imputed County Business Patterns data created by Eckert and colleagues (Eckert et al. 2020).³ Imputed County Business Pattern data has the advantage of providing accurate estimates of detailed occupation groups that are harmonized to NAICS 2012 classifications. I categorize NAD related employment as those employed in accommodation and food services (NAICS=72); arts, entertainment, and recreation (NAICS=71); real estate and

² A table of specific county boundary changes is available in Appendix Table A.1.

³ County business patterns capture employment by place of work, not place of residence. This has the potential to be an issue when a large portion of workers live in one in county but work in another; however, this is partially mitigated by the inclusion of lagged employment variables (i.e. employment in neighboring counties).

rental and leasing (NAICS=531); and scenic sightseeing and transportation (NAICS=487) (Mueller 2020).

The analysis includes several control variables. First, percent of residents that are non-Hispanic Black and percent that are Hispanic (all races). These ethnoracial variables serve as controls to the effects of population growth and aging. It is important to assess whether changes in population size and aging in themselves have a significant relationship with affordability, and that the effects of these demographic changes are not just a reflection of the increase or decrease in the proportion of residents that are at high risk of living in unaffordable housing. The percentage of residents employed in manufacturing (NAICS=31-33) is used as a control for NAD employment. Manufacturing employment often provides stable and above-average income (Brady et al. 2013), opposed to NAD employment which is often seasonal and low wage (Hunter et al. 2005). Increases in NAD related employment may indicate a general larger economic shift away from stable income occupations which can affect affordability.

County rural-urban status—operationalized as metropolitan status—is included in the analysis as an interaction term. Metropolitan status is fixed at 1990 to account for the effects of county reclassification during the study period. I use the 1990 Rural-Urban Continuum Codes (RUCC) to create four groups (Economic Research Service 2004): counties in metro areas of one million or more people (large metros, RUCC=0-1; n=300), counties in metro areas of less than one million people (small metro, RUCC=2-3; n=512), nonmetro counties adjacent to a metro area (nonmetro adjacent, RUCC=4,6,8; n=987), and nonmetro counties not adjacent to a metro area (nonmetro remote, RUCC=5,7,9; n=1271).

Analytical Strategy

I employ a panel data approach via the inclusion of county and year fixed effects. This study's models are a variation of a spatial lag of X (SLX) model. A SLX model involves the inclusion of spatially lagged versions of all independent and control variables created through a spatial weights matrix (LeSage 2014). SLX models control for local spatial spillovers, which for this study means that there is an assumption that county affordability is affected by changes in neighbors' socioeconomic variables (X), but not neighboring affordability (LeSage 2014). The main advantage of SLX models for this study is that the size and significance of the effects of local—within-unit—changes in independent variables can be more accurately assessed. I create

the spatial weights matrix for these SLX models using a Queen's contiguity matrix. I produce three models that each use the same set of independent variables but use a different outcome variable: rate of affordable housing, median household income, and median housing costs. All three models are used in complement to test this study's hypotheses. From these models, I also produce tables of the average marginal effects of the three independent variables to better understand the significance and effect size of each variable by county type.⁴⁵

Results

County-level rates of affordable housing declined between 1990 and 2016 (Tables 1-2). On average, affordability declined by 3.6 percentage points over the study period. When disaggregating by county type, large metro counties experienced an average decline of 5.9 points, compared to 5.4 points for small metro, 3.6 points for nonmetro adjacent counties, and 2.4 for nonmetro remote counties. The Great Recession—captured by 2010 data—also had a significant impact on county-level affordability: county affordable housing rates declined by an average of 9.8 percentage points relative to their 1990 levels. Large and small metros were particularly impacted by the Great Recession, with decreases of 16.2 and 12.8 points, respectively. Despite the general decline, patterns were far from uniform: 660 counties became more affordable during the study period. Most of these counties were nonmetro, with 223 adjacent and 385 remote counties having higher rates of affordable housing in 2016 compared to 1990. Median housing costs also increased during the study period, with the largest increases being for large metros at \$207 and nonmetro adjacent counties at \$146.

⁴ Average marginal effects report the effect that a one unit change in an independent variable has on the outcome or dependent variable given a set of values for other independent variables in the model. These differ from the beta coefficients presented in a regular regression table that show interaction effects between two variables. For example, I report the average marginal effect of population change in metro adjacent counties instead of relying on beta coefficients of the effect of population change for the reference county type (large metro) and the interaction effect for metro adjacent. The choice to focus average marginal effects is done to compare the effects of population growth, aging, and NAD more easily across models and across county type.

⁵ Descriptive statistics of all variables by county type are available in Appendix Table A.2.

Table 1 Mean of rate of affordable housing, median household income, and median housing costs by metropolitan status and year

	Large metro	Small metro	Nonmetro adj.	Nonmetro remote	All counties
Rate of affordable housing					
1990	71.920 (6.058)	73.405 (5.402)	73.102 (5.843)	72.846 (6.578)	72.931 (6.121)
2000	71.313 (5.659)	72.250 (5.343)	72.507 (5.365)	72.335 (6.225)	72.276 (5.768)
2010	55.673 (6.659)	60.641 (6.168)	63.423 (6.226)	65.571 (6.639)	63.091 (7.093)
2016	66.044 (6.825)	68.066 (5.485)	69.503 (5.740)	70.465 (6.426)	69.323 (6.252)
Median household income					
1990	5288.212 (1,223.475)	4204.001 (746.115)	3462.948 (671.083)	3161.106 (629.367)	3639.937 (985.297)
2000	5870.357 (1,360.832)	4618.719 (845.801)	3957.221 (743.974)	3607.355 (675.472)	4109.647 (1,060.378)
2010	5778.840 (1,436.044)	4514.411 (900.475)	3966.265 (734.545)	3737.183 (704.964)	4139.965 (1,038.153)
2016	5595.097 (1,441.002)	4376.586 (923.360)	3824.891 (818.014)	3653.414 (844.941)	4018.892 (1,089.176)
Median housing costs					
1990	1042.729 (325.429)	762.770 (196.249)	542.473 (157.946)	479.248 (139.374)	601.922 (251.919)
2000	1211.861 (343.564)	877.182 (213.383)	667.862 (191.367)	575.805 (162.220)	717.819 (281.047)
2010	1405.526 (405.720)	982.936 (256.413)	751.038 (222.494)	638.340 (180.841)	807.012 (330.744)
2016	1250.388 (375.261)	890.886 (227.218)	688.673 (188.089)	607.519 (156.959)	743.690 (285.028)
Note: Standard deviations shown in parentheses					

Table 2 Rate of affordable housing county groups; by metropolitan status and year

	<u>Percent of residents living in affordable housing</u>			
	Less than 60%	60.1-70%	70.1-80%	More than 80%
Large metro				
1990	14	88	182	16
2000	13	89	194	4
2010	212	83	5	0
2016	58	143	99	0
Small metro				
1990	8	114	340	50
2000	8	151	331	22
2010	203	293	16	0
2016	49	262	199	2
Nonmetro adj.				
1990	17	274	577	119
2000	14	292	606	75
2010	275	580	129	3
2016	62	441	463	21
Nonmetro remote				
1990	50	325	747	149
2000	43	364	748	116
2010	247	692	316	16
2016	87	475	649	60
All counties				
1990	89	801	1,846	334
2000	78	896	1,879	217
2010	937	1,648	466	19
2016	256	1,321	1,410	83

Figure 1 County rates of affordable housing between 1990-2016

There is a pronounced spatial pattern of rates of affordable housing (Figure 1). In 1990, many counties in the Midwest were very affordable, with over 80 percent of households living in affordable housing in many places. Attainment of affordable housing was low in certain counties in California, the Mountain West, and the Mississippi Delta. The map of affordable housing changed significantly by 2016. While the Midwest still has many high affordability counties (rates greater than 80%), the number of counties declined significantly (from 334 to 83). Many more counties in California and the Mountain West had very low rates of affordability, and new clusters of low affordability emerged in the Southeast and Northeast. The number of very low affordability counties—less than 60 percent of residents living in affordable housing—increased from 89 to 256, with 136 (53.1%) of those counties in 2016 located in the South. These temporal and spatial trends provide evidence that there is a changing landscape of affordable housing and therefore insights as to why this is occurring must be produced.

Demographic and Economic Impacts on Affordability

Estimates of the effects of demographic and economic change on rates of affordable housing are shown in Table 3 and Appendix Table A3. These estimates reveal several insights into why place-level affordability has changed between 1990 and 2016. First, population growth has a significant association with affordability. I find that in both types of nonmetro counties, population growth is associated with a decline in affordability, but in large metro counties the opposite is true. The largest estimated effect is for nonmetro remote counties, where a population growth of 1000 people is associated with a .122 (average marginal effect) percentage point decline in the rate of affordable housing. While these estimates do support this study's hypothesis regarding population change, I did not anticipate the benefits—although small—of population growth large metro counties. To understand why this occurs, the analysis of income and housing cost change is needed.

Table 3 Average marginal effect of demographic and economic change on county rate of affordable housing by county type

	Marginal effect		S.E.	95% Conf. Interval	
Total population (1000s)					
Large metro	0.002	**	(0.001)	0.000	0.004
Small metro	-0.002		(0.002)	-0.006	0.002
Nonmetro adj.	-0.075	***	(0.015)	-0.104	-0.046
Nonmetro remote	-0.122	***	(0.019)	-0.158	-0.085
Natural amenities employment share					
Large metro	-0.063		(0.067)	-0.195	0.069
Small metro	-0.001		(0.053)	-0.104	0.103
Nonmetro adj.	0.013		(0.051)	-0.087	0.114
Nonmetro remote	0.015		(0.034)	-0.053	0.082
Elderly population share					
Large metro	0.190	*	(0.075)	0.042	0.337
Small metro	0.210	*	(0.086)	0.042	0.379
Nonmetro adj.	0.066		(0.070)	-0.070	0.203
Nonmetro remote	0.009		(0.111)	-0.208	0.226

Note: Sig: * <.05 ** <.01 *** < .01

I find that population aging also has a significant effect on affordability. However, these effects are opposite of what was originally hypothesized. Models indicated that an increase in elderly (e.g., 65+) population share is associated with increased affordability in large and small metro areas. The largest coefficient is for small metro counties, where a one percentage point increase in the share of elderly residents is associated with a .21-point increase in affordability; in large metros this coefficient is .19. While I originally hypothesized that the effects of population aging would be larger in nonmetro counties, these estimates suggest there is not a significant association between aging and affordability in nonmetro counties. Overall, population aging is associated with increased affordability in metro counties.

Finally, increases in employment related to NAD do not have a significant association with changes in affordability, despite what was hypothesized. Insignificance is universal across county types, even in nonmetro counties where NAD related employment should have the largest supposed impact. However, just because there is no effect on affordability directly, does not in itself indicate that NAD does not the livelihoods of residents. NAD could produce relatively equally sized changes in income and housing costs; whether this is a positive or negative change has yet to be determined within this study.

Income and Housing Cost Change

I continue the analysis with models that examine the effects of demographic and economic change on income and housing costs—the results of these models are shown in Table 4 and Appendix Table A4. Population growth has been shown to have a negative effect on affordability in nonmetro counties. Adding on this finding, I find that population growth increases median household income and median housing costs. In nonmetro adjacent counties, a population gain of 1000 individuals increases income by approximately \$4.95 (per month), and housing costs by \$2.26; in remote counties these effects are \$6.53 and \$2.64, respectively. While these effects are both positive, it is important to note that changes in rates of affordable housing are produced by unequal increases in income and housing costs. The ratio of the income and housing coefficients in nonmetro adjacent counties is 2.19 and 2.47 in remote counties.

These models suggest that while income has increased in these counties, this is seemingly outweighed—in regard to affordability—by increase in housing costs and thus growing nonmetro counties have become less affordable over time due to significant increases in housing costs. These seemingly irregular results on the relationship of affordability, income, and housing costs also reflect challenges associated with ecological inference. While these results support this study’s stated hypothesis, they also explain why population growth is associated with increased affordability in large metro counties. I find that population growth is associated with decreases in monthly housing costs—although the effect size is quite small—but has no association with income. Overall, population growth not only has opposite effects on affordability between metro and nonmetro counties, but housing costs as well

I find that population aging has a significant negative effect on both income and housing costs for all types of counties. The largest effect on income is for small metro counties, where a one percentage point increase in the elderly population share is associated with a decrease in median household income of \$35.32. Large metros and nonmetro remote counties have a very similar, but slightly smaller, coefficient. The largest effect size on housing costs is also observed in small metro counties, with a decrease of \$20.38. For housing costs there is a significant gap in coefficient size between metro and nonmetro counties, with the estimated effects in metro counties being more than twice that of nonmetro counties. As with population growth, the relationship between aging and affordability is influenced by unequal—but negative—shifts in income and housing. The ratios of income to housing cost change is 1.74, 1.73, 2.54, 5.93,

Table 4 Average marginal effect of demographic and economic change on county income and housing costs by county type

	Marginal effect		S.E.	95% Conf. Interval	
<u>Median household income</u>					
Total population (1000s)					
Large metro	0.097		(0.168)	-0.233	0.427
Small metro	0.673		(0.358)	-0.028	1.375
Nonmetro adj.	4.947	***	(1.295)	2.409	7.486
Nonmetro remote	6.532	***	(2.054)	2.506	10.557
Natural amenities employment share					
Large metro	5.991		(6.420)	-6.592	18.574
Small metro	4.710		(7.354)	-9.705	19.124
Nonmetro adj.	2.467		(2.300)	-2.040	6.975
Nonmetro remote	6.526	**	(2.210)	2.194	10.858
Elderly population share					
Large metro	-33.425	*	(13.687)	-60.252	-6.598
Small metro	-35.318	**	(11.510)	-57.877	-12.760
Nonmetro adj.	-23.307	**	(7.532)	-38.069	-8.544
Nonmetro remote	-34.091	***	(7.468)	-48.727	-19.455
<u>Median housing costs</u>					
Total population (1000s)					
Large metro	-0.136	*	(0.039)	-0.212	-0.060
Small metro	-0.011		(0.052)	-0.113	0.092
Nonmetro adj.	2.258	***	(0.373)	1.526	2.990
Nonmetro remote	2.641	***	(0.497)	1.667	3.615
Natural amenities employment share					
Large metro	0.786		(1.573)	-2.296	3.868
Small metro	2.905	*	(1.341)	0.277	5.532
Nonmetro adj.	2.271	**	(0.801)	0.700	3.841
Nonmetro remote	1.001		(0.826)	-0.617	2.619
Elderly population share					
Large metro	-19.189	***	(4.177)	-27.376	-11.002
Small metro	-20.377	***	(2.369)	-25.021	-15.734
Nonmetro adj.	-9.189	***	(1.442)	-12.015	-6.362
Nonmetro remote	-5.745	***	(0.851)	-7.412	-4.077

Note: Sig: * <.05 ** <.01 *** <.01

respectively across the four county types, all indicating that income is declining a greater rate than housing costs.

These ratios of income to housing costs change suggest that there is significant nuance into how these unequal shifts over time produce changes in affordability. Despite large and small metro counties having relatively smaller—or more equal—ratios there is corresponding significant increase in affordability related to population aging. Nonmetro counties have larger ratios—with very large decreases in income—but this does not translate into a significant effect on affordability. Importantly, the rate of affordable housing, median household income, and median housing costs are conceptually related, but they may move in seemingly conflicting

directions given differences in the underlying units of analysis (i.e., the share of households vs. a population mean). Relying on the ratio of coefficients of income and housing costs—while useful—does not provide mathematically precise insights as to why county-level affordability is changing. Overall, population aging decreases the average available financial resources in the county but at the same time decreases average housing costs.

A potential explanation for this divergence is growth in income inequality during the study period. Dong (2018) found that metropolitan counties with increasing levels of income inequality had higher proportions of residents living in unaffordable housing. It may be that longitudinal changes in income within a county are affecting different individuals than those that are experiencing changes in housing costs, and thus changes in income and housing costs are not as linked as originally theorized. Issues of ecological inference also complicate testing the relationship between affordable housing and its constituent components. As it relates to aging, for example, the decreases in housing costs may be experienced only by elderly individuals within the county, while the decreases in income may be felt by young and middle-aged individuals. In this potential scenario, one group is experiencing increased affordability while another is experiencing decreased affordability and thus overall county-level rates of affordable housing stay relatively the same. Alternatively, since population aging is the potential result of several age-specific processes (Glasgow and Brown 2012); it may be the phenomenon of youth out-migration is what drives declines in median income while separately the aging in place of older residents affects declines in housing costs. Future research must continue to disentangle the relationship between aging and affordability. By nature, these estimated effects are linear and approximate an average for all counties within a group. Alternative approaches that account for non-linearities in the effects of population, NAD, and elderly population share may help understand these changes.

In addition to these findings on the effects of population aging, I find that there is no estimated relationship between NAD and rates of affordable housing. There are some interesting estimated relationships between NAD, income, and housing costs that are worth reporting. In nonmetro remote counties, increases in NAD-related employment have a significant positive association with income. While in small metros and nonmetro adjacent counties, NAD-related employment is associated with increased housing costs.

Table 5 Average marginal effect of demographic and economic change on affordability by tenure and county type

	Marginal Effect		S.E.	95% Conf. Interval	
<u>Owner households</u>					
Total population (1000s)					
Large metro	0.004	***	(0.001)	0.001	0.006
Small metro	-0.003		(0.002)	-0.008	0.001
Nonmetro adj.	-0.098	***	(0.016)	-0.129	-0.068
Nonmetro remote	-0.147	***	(0.021)	-0.188	-0.106
Natural amenities employment share					
Large metro	-0.058		(0.082)	-0.218	0.103
Small metro	0.033		(0.058)	-0.080	0.146
Nonmetro adj.	-0.039		(0.045)	-0.128	0.050
Nonmetro remote	-0.002		(0.045)	-0.091	0.086
Elderly population share					
Large metro	0.314	***	(0.086)	0.146	0.481
Small metro	0.193	*	(0.090)	0.017	0.369
Nonmetro adj.	-0.086		(0.068)	-0.220	0.047
Nonmetro remote	-0.123		(0.096)	-0.312	0.066
<u>Renter households</u>					
Total population (1000s)					
Large metro	0.001		(0.001)	-0.002	0.003
Small metro	-0.002		(0.002)	-0.006	0.002
Nonmetro adj.	-0.015		(0.017)	-0.047	0.018
Nonmetro remote	-0.004		(0.023)	-0.050	0.041
Natural amenities employment share					
Large metro	0.007		(0.049)	-0.090	0.103
Small metro	0.021		(0.064)	-0.105	0.147
Nonmetro adj.	0.139		(0.042)	0.056	0.221
Nonmetro remote	0.045		(0.053)	-0.058	0.148
Elderly population share					
Large metro	-0.170	*	(0.083)	-0.333	-0.007
Small metro	-0.199		(0.111)	-0.416	0.018
Nonmetro adj.	-0.234	*	(0.104)	-0.438	-0.030
Nonmetro remote	-0.201		(0.124)	-0.444	0.042

Note: Sig: * <.05 ** <.01 *** < .01

Affordability Change by Tenure

I produce an additional set of models to help further understand impacts of demographic and economic change on affordability. These models examine county-level rates of affordable housing among owner and renter households separately (Table 5; Appendix Table A5). An immediate takeaway is that population growth has the same basic association with affordability for owners as it does for affordability among all households. However, it has no effect on renting affordability for any type of counties.

Unlike with population growth, the effects of aging differ between owner and renter households. In metropolitan areas, both large and small, aging is associated with increased affordability among owners. On the other hand, population aging is associated with decreased

affordability among renters. This is true in both large metros and nonmetro adjacent counties—with the effect being larger in adjacent counties. Finally, NAD-related employment is not associated with increased or decreased affordability for either type of household.

Nonlinear Effects on Affordability, Income, and Housing Costs

Although not originally hypothesized, the effects of population change and aging on affordable housing may be nonlinear, and thus producing supplemental models may help to disentangle the complex relationship between affordability, income, and housing costs (Appendix Tables A6 and A7). I produce three additional models that match the form of the original regressions but also include quadratic terms for population growth, aging, and NAD. These new models suggest that when looking at the nonlinear models of population change (Figure 2), the effect on rates of affordable housing remains significant across a plausible range of population for large metros and nonmetro counties. However, the magnitude of the effect in nonmetro is smaller at larger population sizes, meaning that growth is more impactful in smaller counties than in larger ones. While the established findings regarding housing costs hold in these new models, an important new takeaway is the decreasing magnitude of the effect for nonmetro counties. I estimate that estimated effect decreases in magnitude across the produced range by \$7.4 for nonmetro adjacent counties and by \$14.4 for remote counties. I also find that the originally estimated inverse relationship between population growth and housing costs for large metros is no longer present; affordability has increased due to gains in income without an accoupling change in housing costs.

Figure 2 Estimated marginal effect of population change on affordable housing, income, and housing incomes

As with the original models, there is no estimated effect of population aging on rates of affordable housing for nonmetro counties (Figure 3). However, I now find that the role of aging differs between types of metros. The effect for large metros is only significant for already high proportion elderly counties. For small metro counties the direction of the effect switches; a one percent increase in the elderly population increases affordability for counties with smaller original elderly populations, but for larger elderly population counties the same increase decreases affordability. The nonlinear models also help explain populations aging's initially complex relationship between affordability, income, and housing costs. For nonmetro counties, I originally found no effect on rates of affordable housing, but an estimated decrease in both income and housing costs. The nonlinear models indicate that for nonmetro counties with initial small elderly populations, population aging decreases income and housing costs, but for counties with larger elderly populations the effects are positive. However, the confidence intervals suggest that this latter positive effect may be nonsignificant.

In large metro counties, population aging only has the effect of lowering income and housing costs in counties with initially smaller elderly populations—and there is no estimated change in affordability for this subset of large metro counties. In small metros, the relationship between aging and affordability is complex in that aging in young counties increases affordability but affordability declines as already-old counties continue to age. The estimated switch in the effects on rates of affordable housing is explained by this inconstancy in the effect significance between income and housing costs. I estimate that household income only declines in already-older counties, while housing costs only decline in younger counties. Simply put, there appears to be initial benefits to population aging, but after a certain point increases in the elderly population hurt affordability. Finally, I find that the effects of NAD remain insignificant on overall rates of affordable housing, but I now find that for remote counties there is estimated increase income for at higher levels of NAD while housing costs increase for small metro and nonmetro adjacent counties (Figure 4).

Figure 3 Estimated marginal effect of population aging on affordable housing, income, and housing incomes

Figure 4 Estimated marginal effect of NAD on affordable housing, income, and housing incomes

Discussion and Conclusions

The purpose of this study was to estimate the changing landscape of affordable housing at the county level and understand how certain socioeconomic forces explain these changes. Indeed, the same forces that have created other types of spatial inequalities have also yielded significant changes in affordability. While a few past studies have shown that housing costs can be influenced by population size, age structure, and NAD (E. L. Glaeser et al. 2006; Vega and Wallace 2016); these findings have not yet been extended to housing affordability. This is an important gap since living in unaffordable housing has negative consequences for individuals and households (Zavisca and Gerber 2016). Like concentrated poverty and income inequality, there are likely to be long-lasting consequences for places where the majority of residents live in unaffordable housing.

In order to best understand changing local rates of housing affordability, it is necessary to decompose these changes into shifts in income and housing costs. While this study's analysis suggests that in most circumstances the direction of change in income and housing costs tends to be the same, the magnitude of these changes often varies considerably. Decreased affordability is often the result of housing costs outweighing any potential gains in place-level financial resources. Future research on housing change must not look at trends in housing costs, income, and affordability independently of each other; these trends are inherently linked and understanding the growing imbalance of income and housing costs over time is important as this directly and negatively effects the lives of residents.

The other motivation of this study was to understand how affordable housing is changing across places of all sizes in the United States. Despite the urban or metropolitan focus of past studies on place-level affordability, I find that affordability is on the decline in nonmetro counties—and particularly in regions, such as the Southeast, that were already socioeconomically disadvantaged (Baker 2020; Brooks 2019; Weber and Miller 2017). Overall, declining affordability is a problem shared between metros of all sizes and nonmetro areas both near and far from metro areas. This study builds upon past work that documents that cost-of-living varies less between urban and rural areas than what is generally perceived (Nord 2009). While the general decline in affordability is shared between different types of counties; the reasons as to why are not. For example, population growth is an important factor across the board, but the direction of effect differs by county type. Much of this study's findings on the

differential effects of population growth and aging add to the literature on the complex interplay between rural and urban places within the United States (Lichter and Brown 2011; Lichter and Ziliak 2017). A key takeaway from research on the rural-urban interface is that urban areas have taken advantage of available land in rural areas for exurban and suburban development (Esparza 2010; Marx 2010). While not directly tested, this study's findings can suggest that affordability in rural communities is on the decline due to demographic and economic forces originating in nearby metro areas.

This study's analyses provide several specific conclusions. *First*, county-level affordability declined by an average of 3.6 percentage points between 1990 and 2016; but there is significant variation between county types. While I find that the largest average declines were for large metro counties, both types of nonmetro counties became less affordable during the study period. Growing unaffordability—as with other key housing issues (York Cornwell and Hall 2017)—is not a problem exclusive to America's largest cities.

Second, population growth is associated with decreased affordability in nonmetro counties. I find that a one-thousand-person population increase is associated with a decrease in rate of affordable housing of .08 percentage points for nonmetro adjacent counties and .11 points for remote counties. This decline in affordability can be attributed to increases in median housing costs—reinforcing the findings of past studies on the matter. *Third*, while this decline in nonmetro affordability was hypothesized, past research would not have predicted that population growth would be beneficial for large metro counties. Population growth has opposite relationships with housing costs in metro and nonmetro counties, with housing costs going down in growing large metro counties in the initial linear models. This surprising finding is potentially explained by the building of suburban and exurban housing developments along the metro fringe, with these new housing developments theoretically relieving some pressure on urban housing markets while also transforming affected rural communities (Esparza 2010; Lichter and Ziliak 2017). However, the supplemental nonlinear models indicate that increased affordability in these counties is due to increases in median household income, which can also be explained by suburbanization and the in migration of higher-income groups.

Fourth, I find that population aging has a positive effect in metro counties—increasing affordability—and no effect in nonmetro counties net of other population changes. Aging has a similar effect of decreasing income and housing costs across all county types, but only results in

affordability change in metro counties. A key finding of the nonlinear models is that there is diminishing returns to population aging in that for large metros counties. Similar to past work on county social services (Thiede et al. 2017), increases in the elderly population in initially young counties increases affordability, but population aging in high proportion elderly counties is associated with decreased affordability and decreased income. Past research on housing and aging has shown that there is not a single set pattern on whether America's elderly population has experienced increased or decreased affordability over time (Harvard JCHS 2019a; Vega and Wallace 2016). This study's analyses show that population aging is beneficial to rates of affordable housing among owner households but is harmful for rates among renter households. Affordable housing is greatly stratified by housing tenure (Harvard JCHS 2018a; McConnell 2013), and the results of this study are no exception. Elderly homeowners have often paid off their mortgage in full, while elderly renters tend to be economically vulnerable and susceptible to the instability often associated with renting (Gibson-Davis and Percheski 2018; Harvard JCHS 2019a).

In this study, population aging was measured as the percent of the population over the age of 65. While this measure does reflect population aging it combines the underlying drivers of population aging—elderly in-migration (i.e. retirement migration), youth out-migration, and aging in place of long-term residents—into a single variable. It is possible that positive effects of aging in metro areas and the non-effect in nonmetro areas documented here originate from only one of these underlying processes. One potential reason for the estimated non-effect in nonmetro areas is that potential changes in income and housing costs are caused by separate age-specific migration streams and processes—thus population aging in the aggregate has no effect on affordability. Further, the subgroups that are a part of these processes are potentially experiencing significant changes in their housing costs and affordability even if the overall population is not. In short, this study has shown that changes in county age structure likely have important consequences for housing, and future research should further explore how age-specific migration patterns affect affordable housing and its subcomponents.

Finally, employment related to NAD has no association with change in affordability. This goes against what past research would have suggested and what was originally hypothesized (Nelson and Hines 2018). While NAD does have a slight effect on housing costs in certain types of counties, there is not a corresponding effect on income. NAD and population aging often go

together in many rural communities (Glasgow and Brown 2012; Nelson et al. 2010), and since both phenomenon do not have an estimated effect on affordability in nonmetro counties, one could argue that rural retirement destination communities are not likely to experience significant declines in affordability. Future research may need to test other operationalizations of NAD to fully understand the potential impacts on housing.

All things considered, this study provides a starting point for research on how demographic and economic change have produced disparities in affordability over the past few decades. At the individual level, the risk of living in unaffordable housing is much higher among ethnic and racial minority groups (Harvard JCHS 2018a; McConnell 2013; Stone 2004; Zavisca and Gerber 2016). While this study included some ethnoracial variables in these models, they served as controls. As such, this study does not provide answers into the extent of which place-level diversity may be associated with declines in affordable housing. Future research must look at place-level ethnoracial processes and disparities in affordability. In the end, this study speaks most directly to the continued need to look at changes in affordability at the county scale. At the county level, population growth and aging can play a significant role in change in affordability and its subcomponents. Furthermore, given that affordability has decreased across the rural-urban continuum, this study's finding suggests that researchers can no longer ignore housing problems in rural America. As social problems related to unaffordability—like poverty and income inequality—continue to grow and become more spatial unequal, and as the U.S. population continues to age and grow, it is likely that the landscape of affordable housing will continue to change in the coming decades.

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Appendix

Table A1 Counties collapsed to produce time-consistent geographic units

State	Counties
Colorado	Broomfield (8014) + Adams (8001) + Boulder (8013) + Weld (8123) + Jefferson (8059)
Florida	Miami-Dade (12086) + Dade (12025)
Massachusetts	Barnstable (25001) + Dukes (25007) + Nantucket (25019)
Montana	Park (30067) + Yellowstone National Park (30113)
South Dakota	Oglala Lakota (46102) + Shannon (46113)
Virginia	Augusta (51015) + Staunton City (51790) + Waynesboro City (51820) Albemarle (51103) + Charlottesville City (51540) Alleghany (51005) + Clifton Forge City (51560) + Covington City (51580) Bedford (51019) + Bedford City (51515) Carroll (51033) + Galax City (51640) Dinwiddie (51053) + Colonial Heights City (51570) + Petersburg City (51730) Fairfax (51059) + Fairfax City (51600) + Falls Church City (51610) Fredrick (51069) + Winchester City (51840) Greensville (51081) + Emporia City (51595) Halifax (51083) + South Boston City (51780) Henry (51089) + Martinsville City (51690) James City (51095) + Williamsburg City (51830) Montgomery (51121) + Radford City (51750) Norfolk (51710) + Portsmouth City (51740) Pittsylvania (51143) + Dansville City (51590) Prince George (51147) + Hopewell City (51670) Prince William (51153) + Manassas City (51683) + Manassas Park (51685) Roanoke (51165) + Roanoke City (51770) + Salem City (51775) Rockbridge (51163) + Buena Vista City (51530) + Lexington City (51678) + Lynchburg (51680) Rockingham (51165) + Harrisonburg City (51660) Southampton (51175) + Franklin City (51620) Spotsylvania (51177) + Fredericksburg City (51630) Washington (51191) + Bristol City (51520) Wise (51195) + Norton City (51720) York (51199) + Poquoson (51735)
Washington	Skagit (253057) + San Juan (53055)

Table A2 Descriptive statistics of variables by metropolitan status and year.

	Large metro	Small metro	Nonmetro adj.	Nonmetro remote	All Counties
Rate of affordable housing					
1990	71.920 (6.058)	73.405 (5.402)	73.102 (5.843)	72.846 (6.578)	72.931 (6.121)
2000	71.313 (5.659)	72.250 (5.343)	72.507 (5.365)	72.335 (6.225)	72.276 (5.768)
2010	55.673 (6.659)	60.641 (6.168)	63.423 (6.226)	65.571 (6.639)	63.091 (7.093)
2016	66.044 (6.825)	68.066 (5.485)	69.503 (5.740)	70.465 (6.426)	69.323 (6.252)
Median household income					
1990	5288.212 (1,223.475)	4204.001 (746.115)	3462.948 (671.083)	3161.106 (629.367)	3639.937 (985.297)
2000	5870.357 (1,360.832)	4618.719 (845.801)	3957.221 (743.974)	3607.355 (675.472)	4109.647 (1,060.378)
2010	5778.840 (1,436.044)	4514.411 (900.475)	3966.265 (734.545)	3737.183 (704.964)	4139.965 (1,038.153)
2016	5595.097 (1,441.002)	4376.586 (923.360)	3824.891 (818.014)	3653.414 (844.941)	4018.892 (1,089.176)
Median housing costs					
1990	1042.729 (325.429)	762.770 (196.249)	542.473 (157.946)	479.248 (139.374)	601.922 (251.919)
2000	1211.861 (343.564)	877.182 (213.383)	667.862 (191.367)	575.805 (162.220)	717.819 (281.047)
2010	1405.526 (405.720)	982.936 (256.413)	751.038 (222.494)	638.340 (180.841)	807.012 (330.744)
2016	1250.388 (375.261)	890.886 (227.218)	688.673 (188.089)	607.519 (156.959)	743.690 (285.028)
Total population (1000s)					
1990	412.025 (743.823)	142.716 (142.300)	28.471 (24.083)	17.524 (16.886)	80.473 (267.360)
2000	468.607 (816.111)	163.049 (168.540)	31.883 (27.274)	18.923 (18.722)	91.070 (296.787)
2010	505.428 (849.463)	180.121 (193.762)	33.717 (30.091)	19.521 (20.434)	98.352 (313.444)
2016	535.302 (892.466)	189.686 (208.146)	34.065 (31.144)	19.729 (21.294)	103.064 (330.506)
Natural amenities employment share					
1990	7.970 (1.706)	7.414 (1.945)	5.545 (2.268)	5.377 (2.290)	6.024 (2.383)
2000	7.792 (3.796)	7.353 (2.992)	5.606 (4.712)	5.647 (4.842)	6.128 (4.520)
2010	8.415 (3.213)	7.970 (2.778)	6.092 (4.752)	5.963 (4.893)	6.579 (4.510)
2016	8.853 (3.058)	8.451 (2.783)	6.369 (4.688)	6.208 (4.923)	6.892 (4.512)
Elderly population share					
1990	11.386 (3.560)	12.531 (3.437)	15.318 (3.503)	16.509 (4.477)	14.962 (4.325)
2000	11.343 (3.249)	12.819 (3.398)	14.843 (3.246)	16.434 (4.268)	14.822 (4.099)
2010	11.936 (2.869)	13.444 (3.146)	15.666 (3.249)	17.270 (4.443)	15.595 (4.154)

2016	14.052 (3.125)	15.494 (3.586)	17.964 (3.688)	19.138 (4.721)	17.656 (4.436)
Black population share					
1990	10.056 (12.062)	9.584 (11.658)	10.312 (16.269)	6.302 (13.754)	8.505 (14.269)
2000	10.772 (12.824)	9.864 (12.072)	10.162 (15.988)	6.532 (14.079)	8.669 (14.412)
2010	11.753 (13.279)	10.161 (12.256)	10.025 (15.882)	6.688 (14.373)	8.835 (14.567)
2016	12.010 (13.385)	10.282 (12.299)	9.931 (15.600)	6.784 (14.218)	8.890 (14.420)
Hispanic population share					
1990	5.362 (8.008)	4.531 (10.730)	4.430 (11.791)	4.356 (11.455)	4.507 (11.157)
2000	7.882 (9.733)	6.468 (12.027)	6.064 (12.666)	5.857 (12.160)	6.223 (12.099)
2010	10.553 (10.869)	8.632 (13.070)	7.493 (13.466)	7.184 (12.881)	7.854 (12.958)
2016	11.732 (11.455)	9.710 (13.692)	8.531 (14.207)	8.388 (13.720)	8.981 (13.703)
Manufacturing employment share					
1990	12.981 (6.974)	14.826 (9.371)	15.164 (10.989)	10.942 (10.272)	13.147 (10.277)
2000	10.270 (6.206)	12.280 (8.138)	13.299 (10.069)	9.693 (9.650)	11.340 (9.408)
2010	6.567 (4.290)	8.249 (5.793)	9.132 (7.554)	6.905 (7.163)	7.812 (6.930)
2016	6.527 (4.498)	8.388 (6.394)	9.502 (7.959)	7.226 (7.547)	8.083 (7.342)

Note: Standard deviations in parentheses.

Table A3 Impact of demographic and economic change on county rate of affordable housing; 1990-2016

	Coef.	S.E.
<u>County variables</u>		
Total population (1000s)	0.002 *	(0.001)
Small metro	-0.004	(0.002)
Nonmetro adj.	-0.077 ***	(0.015)
Nonmetro remote	-0.124 ***	(0.019)
Natural amenities employment share	-0.063	(0.067)
Small metro	0.062	(0.085)
Nonmetro adj.	0.076	(0.085)
Nonmetro remote	0.078	(0.076)
Elderly population share	0.19 *	(0.075)
Small metro	0.021	(0.114)
Nonmetro adj.	-0.123	(0.102)
Nonmetro remote	-0.181	(0.133)
Black population share	-0.212 ***	(0.041)
Small metro	-0.206 *	(0.096)
Nonmetro adj.	0.121	(0.070)
Nonmetro remote	0.2 *	(0.078)
Hispanic population share	-0.283 ***	(0.057)
Small metro	0.154	(0.079)
Nonmetro adj.	0.27 ***	(0.076)
Nonmetro remote	0.189 *	(0.076)
Manufacturing employment share	0.178 ***	(0.052)
Small metro	-0.09	(0.057)
Nonmetro adj.	-0.094	(0.054)
Nonmetro remote	-0.116 *	(0.054)
<u>Lagged variables</u>		
Total population (1000s)	-0.001 ***	0.000)
Small metro	-0.005 ***	(0.001)
Nonmetro adj.	-0.005 ***	(0.001)
Nonmetro remote	-0.001	(0.002)
Natural amenities employment share	-0.265 *	(0.125)
Small metro	0.293 *	(0.145)
Nonmetro adj.	0.184	(0.145)
Nonmetro remote	0.173	(0.140)
Natural amenities employment share	0.137	(0.115)
Small metro	-0.563 ***	(0.141)
Nonmetro adj.	-0.488 ***	(0.143)
Nonmetro remote	-0.255	(0.159)
Black population share	-0.096 ***	(0.016)
Small metro	0.052 **	(0.019)
Nonmetro adj.	0.101 ***	(0.017)
Nonmetro remote	0.132 ***	(0.018)
Hispanic population share	-0.175 *	(0.080)
Small metro	-0.097	(0.104)
Nonmetro adj.	0.186	(0.100)
Nonmetro remote	0.271 **	(0.101)
Manufacturing employment Share	0.523 ***	(0.067)
Small metro	-0.223 **	(0.075)
Nonmetro adj.	-0.33 ***	(0.070)
Nonmetro remote	-0.494 ***	(0.070)
<u>Year (ref=1990)</u>		
2000	0.36 ***	(0.087)
2010	-7.28 ***	(0.191)
2016	-1.098 ***	(0.218)

R-Square	0.274
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Note: Reference category is large metro counties unless stated otherwise. Sig: * <.05 ** <.01 *** <.01

Table A4 Impact of demographic and economic change on county income and housing cost

	Median household income		Median housing cost	
	Coef.	S.E.	Coef.	S.E.
<u>County variables</u>				
Total population (1000s)	0.097	(0.168)	-0.136 ***	(0.039)
Small metro	0.576	(0.395)	0.125	(0.065)
Nonmetro adj.	4.85 ***	(1.306)	2.394 ***	(0.375)
Nonmetro remote	6.435 **	(2.060)	2.777 ***	(0.498)
Natural amenities employment share	5.991	(6.420)	0.786	(1.573)
Small metro	-1.281	(9.753)	2.118	(2.066)
Nonmetro adj.	-3.524	(6.819)	1.484	(1.764)
Nonmetro remote	0.535	(6.792)	0.215	(1.777)
Elderly population share	-33.425 *	(13.687)	-19.189 ***	(4.177)
Small metro	-1.893	(17.785)	-1.189	(4.784)
Nonmetro adj.	10.119	(15.625)	10 *	(4.414)
Nonmetro remote	-0.666	(15.528)	13.444 **	(4.256)
Black population share	-36.827 ***	(5.026)	-10.17 ***	(1.565)
Small metro	-21.549 *	(8.529)	2.138	(2.040)
Nonmetro adj.	11.199	(7.503)	2.832	(2.004)
Nonmetro remote	24.227 ***	(6.600)	5.411 **	(1.775)
Hispanic population share	-53.157 ***	(10.549)	-4.28	(2.913)
Small metro	32.127 *	(12.473)	1.997	(3.366)
Nonmetro adj.	38.206 **	(11.624)	-0.931	(3.082)
Nonmetro remote	33.901 **	(11.399)	1.763	(2.972)
Manufacturing employment share	16.295 *	(7.782)	-1.334	(1.871)
Small metro	-1.321	(8.219)	2.346	(1.927)
Nonmetro adj.	-6.893	(7.921)	1.503	(1.907)
Nonmetro remote	-7.392	(7.925)	2.668	(1.887)
<u>Lagged variables</u>				
Total population (1000s)	0.079	(0.078)	0.026	(0.020)
Small metro	0.194	(0.118)	0.073 *	(0.034)
Nonmetro adj.	-0.047	(0.172)	0.063	(0.044)
Nonmetro remote	0.522	(0.354)	0.017	(0.049)
Natural amenities employment share	8.132	(10.460)	1.927	(3.385)
Small metro	7.989	(14.436)	3.015	(4.277)
Nonmetro adj.	9.504	(11.705)	0.577	(3.710)
Nonmetro remote	7.343	(11.712)	1.272	(3.593)
Natural amenities employment share	-95.178 ***	(19.378)	-21.104 ***	(5.780)
Small metro	19.85	(21.693)	16.778 **	(6.126)
Nonmetro adj.	10.934	(21.135)	15.338 *	(5.959)
Nonmetro remote	51.873 *	(20.422)	17.94 **	(5.791)
Black population share	-0.488	(2.656)	0.239	(0.732)
Small metro	0.67	(3.029)	-0.318	(0.766)
Nonmetro adj.	4.973	(2.762)	-0.22	(0.745)
Nonmetro remote	6.966 *	(2.758)	-0.244	(0.744)
Hispanic population share	46.409 ***	(12.415)	20.587 ***	(3.626)
Small metro	-60.409 ***	(14.889)	-13.634 **	(4.195)
Nonmetro adj.	-46.857 ***	(13.795)	-17.171 ***	(3.875)
Nonmetro remote	-46.734 ***	(13.629)	-22.679 ***	(3.749)
Manufacturing employment Share	19.61	(10.476)	-9.499 ***	(2.383)
Small metro	6.98	(11.001)	8.246 ***	(2.479)
Nonmetro adj.	12.573	(10.643)	11.134 ***	(2.421)
Nonmetro remote	8.432	(10.623)	12.997 ***	(2.391)
<u>Year (ref=1990)</u>				
2000	551.425 ***	(8.707)	110.195 ***	(1.879)
2010	815.048 ***	(16.339)	209.94 ***	(3.507)

2016	950.26	***	(25.177)	185.745	***	(4.257)
R-Square	0.006			0.031		

Note: Reference category is large metro counties unless stated otherwise. Sig: * <.05 ** <.01 *** <.01

Table A5 Impact of demographic and economic change on affordability by tenure

	Owner households			Renter Households		
	Coef.		S.E.	Coef.		S.E.
<u>County variables</u>						
Total population (1000s)	0.004	**	(0.001)	0.001		(0.001)
Small metro	-0.007	**	(0.003)	-0.002		(0.002)
Nonmetro adj.	-0.102	***	(0.016)	-0.015		(0.017)
Nonmetro remote	-0.151	***	(0.021)	-0.005		(0.023)
Natural amenities employment share	-0.058		(0.082)	0.007		(0.049)
Small metro	0.091		(0.100)	0.014		(0.081)
Nonmetro adj.	0.019		(0.094)	0.132	*	(0.065)
Nonmetro remote	0.056		(0.094)	0.038		(0.072)
Elderly population share	0.314	***	(0.086)	-0.17	*	(0.083)
Small metro	-0.121		(0.124)	-0.029		(0.138)
Nonmetro adj.	-0.4	***	(0.109)	-0.064		(0.132)
Nonmetro remote	-0.437	***	(0.128)	-0.031		(0.148)
Black population share	-0.116	**	(0.044)	-0.182	***	(0.040)
Small metro	-0.087		(0.071)	-0.299	**	(0.097)
Nonmetro adj.	0.069		(0.073)	0.161		(0.089)
Nonmetro remote	0.192	*	(0.080)	0.114		(0.091)
Hispanic population share	-0.259	***	(0.065)	-0.255	***	(0.063)
Small metro	0.087		(0.089)	0.204	*	(0.090)
Nonmetro adj.	0.253	**	(0.084)	0.303	**	(0.095)
Nonmetro remote	0.228	**	(0.080)	0.198	*	(0.087)
Manufacturing employment share	0.186	**	(0.059)	0.147	**	(0.049)
Small metro	-0.139	*	(0.063)	-0.04		(0.056)
Nonmetro adj.	-0.139	*	(0.061)	-0.045		(0.054)
Nonmetro remote	-0.176	**	(0.061)	-0.022		(0.055)
<u>Lagged variables</u>						
Total population (1000s)	-0.003	***	(0.001)	0.001	**	(0.000)
Small metro	-0.007	***	(0.002)	-0.002	*	(0.001)
Nonmetro adj.	-0.006	***	(0.001)	-0.004		(0.002)
Nonmetro remote	0.001		(0.002)	-0.008	**	(0.003)
Natural amenities employment share	-0.36	*	(0.149)	0.035		(0.118)
Small metro	0.324		(0.169)	0.166		(0.151)
Nonmetro adj.	0.171		(0.161)	0.032		(0.157)
Nonmetro remote	0.221		(0.160)	-0.121		(0.153)
Natural amenities employment share	0.324	*	(0.130)	-0.153		(0.130)
Small metro	-0.547	***	(0.158)	-0.15		(0.159)
Nonmetro adj.	-0.613	***	(0.156)	-0.19		(0.178)
Nonmetro remote	-0.52	**	(0.164)	0.087		(0.183)
Black population share	-0.142	***	(0.017)	-0.012		(0.018)
Small metro	0.084	***	(0.019)	-0.005		(0.023)
Nonmetro adj.	0.122	***	(0.019)	0.04		(0.022)
Nonmetro remote	0.149	***	(0.020)	0.039		(0.022)
Hispanic population share	-0.27	**	(0.088)	-0.016		(0.084)
Small metro	0.003		(0.112)	-0.208		(0.115)
Nonmetro adj.	0.272	*	(0.106)	-0.006		(0.117)
Nonmetro remote	0.349	***	(0.103)	0.045		(0.115)
Manufacturing employment Share	0.573	***	(0.079)	0.239	***	(0.054)
Small metro	-0.25	**	(0.084)	-0.029		(0.065)
Nonmetro adj.	-0.426	***	(0.082)	-0.013		(0.064)
Nonmetro remote	-0.596	***	(0.082)	-0.064		(0.065)
<u>Year (ref=1990)</u>						
2000	-1.09	***	(0.090)	1.884	***	(0.138)
2010	-11.035	***	(0.203)	-5.801	***	(0.257)

2016	-2.015	***	(0.219)	-4.698	***	(0.318)
R-Square	0.172			0.170		

Note: Reference category is large metro counties unless stated otherwise. Sig: * <.05 ** <.01 *** <.01

Table A6 Impact of demographic and economic change on county rate of affordable housing with quadratics

	Coef.	S.E.
<u>County variables</u>		
Total population (1000s)	0.004 *	(0.001)
Small metro	-0.012 *	(0.005)
Nonmetro adj.	-0.112 ***	(0.031)
Nonmetro remote	-0.227 ***	(0.049)
Total population (1000s) squared	0.000	(0.000)
Small metro	0.000	(0.000)
Nonmetro adj.	0.000	(0.000)
Nonmetro remote	0.001 *	(0.000)
Natural amenities employment share	-0.142	(0.119)
Small metro	0.098	(0.171)
Nonmetro adj.	0.092	(0.130)
Nonmetro remote	0.117	(0.133)
Natural amenities employment share squared	0.002	(0.002)
Small metro	-0.001	(0.004)
Nonmetro adj.	-0.001	(0.002)
Nonmetro remote	-0.001	(0.002)
Elderly population share	0.013	(0.228)
Small metro	0.899 **	(0.346)
Nonmetro adj.	0.155	(0.303)
Nonmetro remote	-0.059	(0.500)
Elderly population share squared	0.007	(0.007)
Small metro	-0.031 **	(0.011)
Nonmetro adj.	-0.009	(0.008)
Nonmetro remote	-0.006	(0.011)
Black population share	-0.196 ***	(0.041)
Small metro	-0.235 *	(0.093)
Nonmetro adj.	0.103	(0.072)
Nonmetro remote	0.186 *	(0.079)
Hispanic population share	-0.299 ***	(0.059)
Small metro	0.184 *	(0.081)
Nonmetro adj.	0.287 ***	(0.078)
Nonmetro remote	0.214 **	(0.078)
Manufacturing employment share	0.169 **	(0.054)
Small metro	-0.088	(0.059)
Nonmetro adj.	-0.088	(0.056)
Nonmetro remote	-0.109	(0.057)
<u>Lagged variables</u>		
Total population (1000s)	-0.004 ***	(0.001)
Small metro	-0.007 ***	(0.002)
Nonmetro adj.	-0.005 *	(0.002)
Nonmetro remote	0.001	(0.007)
Total population (1000s) squared	0.000 ***	(0.000)
Small metro	0.000 **	(0.000)
Nonmetro adj.	0.000	(0.000)
Nonmetro remote	0.000	(0.000)
Natural amenities employment share	-1.168 ***	(0.330)
Small metro	1.296 ***	(0.393)
Nonmetro adj.	1.231 ***	(0.355)
Nonmetro remote	1.262 ***	(0.356)
Natural amenities employment share squared	0.039 **	(0.015)
Small metro	-0.044 *	(0.018)
Nonmetro adj.	-0.045 **	(0.015)
Nonmetro remote	-0.05 **	(0.016)

Elderly population share	-0.226		(0.329)
Small metro	-1.727	***	(0.498)
Nonmetro adj.	-0.075		(0.467)
Nonmetro remote	1.306	*	(0.562)
Elderly population share squared	0.011		(0.008)
Small metro	0.036	**	(0.014)
Nonmetro adj.	-0.014		(0.012)
Nonmetro remote	-0.043	***	(0.013)
Black population share	-0.087	***	(0.017)
Small metro	0.042	*	(0.020)
Nonmetro adj.	0.092	***	(0.019)
Nonmetro remote	0.131	***	(0.019)
Hispanic population share	-0.187	*	(0.084)
Small metro	-0.084		(0.106)
Nonmetro adj.	0.2		(0.103)
Nonmetro remote	0.274	**	(0.103)
Manufacturing employment share	0.519	***	(0.070)
Small metro	-0.226	**	(0.077)
Nonmetro adj.	-0.328	***	(0.073)
Nonmetro remote	-0.49	***	(0.073)
	<u>Year (ref=1990)</u>		
2000	0.404	***	(0.091)
2010	-7.254	***	(0.193)
2016	-1.194	***	(0.235)
R-Square	0.208		

Note: Reference category is large metro counties unless stated otherwise. Sig: * <.05 ** <.01 *** <.01

Table A7 Impact of demographic and economic change on county income and housing cost with quadratics;
1990-2016

	Median household income			Median housing cost		
	Coef.		S.E.	Coef.		S.E.
<u>County variables</u>						
Total population (1000s)	0.949	***	(0.286)	-0.078		(0.069)
Small metro	1.699	*	(0.667)	0.276		(0.143)
Nonmetro adj.	13.465	**	(4.133)	5.417	***	(0.927)
Nonmetro remote	23.352	***	(5.684)	8.675	***	(0.909)
Total population (1000s) squared	0	***	(0.000)	0		(0.000)
Small metro	-0.001	**	(0.000)	0		(0.000)
Nonmetro adj.	-0.046	**	(0.017)	-0.015	***	(0.004)
Nonmetro remote	-0.102	***	(0.029)	-0.034	***	(0.005)
Natural amenities employment share	6.779		(15.350)	0.003		(4.289)
Small metro	12.743		(21.203)	-0.058		(5.206)
Nonmetro adj.	-6.435		(15.989)	3.987		(4.429)
Nonmetro remote	0.439		(15.921)	3.384		(4.426)
Natural amenities employment share squared	-0.017		(0.266)	0.01		(0.078)
Small metro	-0.548		(0.528)	0.109		(0.116)
Nonmetro adj.	0.048		(0.272)	-0.043		(0.081)
Nonmetro remote	0.001		(0.274)	-0.075		(0.083)
Elderly population share	-99.487	*	(38.650)	-48.763	***	(11.209)
Small metro	126.049	**	(47.597)	17.09		(13.223)
Nonmetro adj.	25.402		(42.975)	31.676	*	(12.451)
Nonmetro remote	-14.205		(45.930)	28.197	*	(11.699)
Elderly population share squared	2.373	*	(1.190)	1.006	**	(0.353)
Small metro	-4.399	**	(1.437)	-0.618		(0.423)
Nonmetro adj.	-1.132		(1.255)	-0.808	*	(0.383)
Nonmetro remote	-0.389		(1.303)	-0.632		(0.361)
Black population share	-35.942	***	(4.868)	-9.522	***	(1.537)
Small metro	-24.513	**	(8.438)	1.537		(2.022)
Nonmetro adj.	12.918		(7.475)	2.619		(1.976)
Nonmetro remote	23.18	***	(6.406)	4.657	**	(1.728)
Hispanic population share	-61.627	***	(10.502)	-5.231		(3.032)
Small metro	38.68	**	(12.671)	2.528		(3.466)
Nonmetro adj.	45.6	***	(11.588)	-0.26		(3.193)
Nonmetro remote	40.664	***	(11.219)	2.236		(3.075)
Manufacturing employment share	15.926	*	(7.731)	-0.951		(1.875)
Small metro	-1.085		(8.174)	2.039		(1.931)
Nonmetro adj.	-6.173		(7.870)	1.245		(1.911)
Nonmetro remote	-7.323		(7.872)	2.289		(1.890)
<u>Lagged variables</u>						
Total population (1000s)	0.45	***	(0.120)	0.116	**	(0.036)
Small metro	-0.066		(0.231)	0.082		(0.055)
Nonmetro adj.	0.048		(0.259)	0.077		(0.061)
Nonmetro remote	1.321	*	(0.635)	0.073		(0.142)
Total population (1000s) squared	0.000	***	(0.000)	0.000	***	(0.000)
Small metro	0.000		(0.000)	0.000		(0.000)
Nonmetro adj.	0.000	*	(0.000)	0.000	**	(0.000)
Nonmetro remote	-0.001		(0.001)	0.000		(0.000)
Natural amenities employment share	-54.513		(32.666)	2.329		(9.697)
Small metro	47.964		(44.333)	-2.493		(12.427)
Nonmetro adj.	53.961		(34.748)	7.401		(10.048)
Nonmetro remote	54.345		(34.865)	-2.887		(9.932)
Natural amenities employment share squared	2.55	*	(1.182)	-0.047		(0.321)
Small metro	-1.273		(2.066)	0.315		(0.564)

Nonmetro adj.	-1.756		(1.271)	-0.265		(0.334)
Nonmetro remote	-1.985		(1.326)	0.225		(0.338)
Elderly population share	-141.856	**	(48.853)	-17.63		(12.258)
Small metro	-27.411		(69.240)	34.874	*	(16.280)
Nonmetro adj.	56.176		(63.140)	-5.505		(16.021)
Nonmetro remote	169.245	**	(58.287)	0.302		(13.467)
Elderly population share squared	2.033		(1.244)	0.037		(0.279)
Small metro	0.793		(1.908)	-0.704		(0.431)
Nonmetro adj.	-1.667		(1.664)	0.522		(0.417)
Nonmetro remote	-3.865	**	(1.474)	0.358		(0.314)
Black population share	-3.504		(2.616)	-0.431		(0.728)
Small metro	4.437		(2.998)	0.348		(0.763)
Nonmetro adj.	7.689	**	(2.730)	0.314		(0.741)
Nonmetro remote	9.394	***	(2.727)	0.096		(0.739)
Hispanic population share	55.507	***	(11.908)	22.828	***	(3.590)
Small metro	-75.741	***	(14.439)	-16.1	***	(4.163)
Nonmetro adj.	-56.229	***	(13.399)	-19.818	***	(3.827)
Nonmetro remote	-56.435	***	(12.963)	-24.917	***	(3.683)
Manufacturing employment share	21.602	*	(10.415)	-9.309	***	(2.438)
Small metro	5.456		(10.936)	8.229	**	(2.534)
Nonmetro adj.	10.826		(10.584)	11.259	***	(2.479)
Nonmetro remote	7.071		(10.560)	13.125	***	(2.443)
<u>Year (ref=1990)</u>						
2000	535.799	***	(8.935)	107.838	***	(1.892)
2010	804.186	***	(16.426)	209.703	***	(3.485)
2016	966.199	***	(25.745)	190.298	***	(4.506)
R-Square	0.002			0.001		

Note: Reference category is large metro counties unless stated otherwise. Sig: * <.05 ** <.01 *** <.001

Table A8 Impact of demographic and economic change on county rate of affordable housing, income, and housing cost without lagged variables; 1990-2016

	Rate of affordable housing			Median household income		Median housing cost		
	Coef.		SE	Coef.	SE	Coef.		SE
<u>County variables</u>								
Total population (1000s)	0.003	**	(0.001)	0.197	(0.197)	-0.127	**	(0.048)
Small metro	-0.006	*	(0.003)	0.327	(0.395)	0.141		(0.075)
Nonmetro adj.	-0.09	***	(0.016)	2.323	(1.890)	2.274	***	(0.373)
Nonmetro remote	-0.123	***	(0.018)	3.196	(2.207)	2.254	***	(0.474)
Natural amenities employment share	-0.071		(0.043)	7.408	(6.017)	1.533		(1.696)
Small metro	0.048		(0.069)	-2.815	(9.825)	1.892		(2.116)
Nonmetro adj.	0.071		(0.067)	-5.055	(6.463)	0.895		(1.883)
Nonmetro remote	0.075		(0.055)	-0.244	(6.432)	-0.293		(1.875)
Elderly population share	0.358	***	(0.060)	-47.484	*** (11.359)	-22.03	***	(2.997)
Small metro	-0.385	***	(0.078)	-26.075	* (13.067)	2.369		(3.256)
Nonmetro adj.	-0.455	***	(0.070)	-12.25	(12.322)	10.998	***	(3.034)
Nonmetro remote	-0.383	***	(0.079)	3.028	(11.774)	15.305	***	(3.004)
Black population share	-0.24	***	(0.036)	-40.618	*** (4.794)	-10.545	***	(1.612)
Small metro	-0.174	*	(0.087)	-17.543	* (8.617)	2.403		(2.059)
Nonmetro adj.	0.199	**	(0.069)	24.807	** (7.874)	3.445		(2.025)
Nonmetro remote	0.249	***	(0.073)	28.515	*** (6.570)	5.231	**	(1.823)
Hispanic population share	-0.412	***	(0.045)	-24.299	*** (6.294)	9.812	***	(2.191)
Small metro	0.103		(0.064)	-5.781	(7.864)	-7.464	**	(2.373)
Nonmetro adj.	0.4	***	(0.054)	8.058	(7.116)	-13.338	***	(2.247)
Nonmetro remote	0.401	***	(0.052)	11.433	(6.612)	-13.373	***	(2.196)
Manufacturing employment share	0.487	***	(0.039)	17.913	*** (5.195)	-9.488	***	(1.605)
Small metro	-0.284	***	(0.054)	5.249	(6.285)	9.69	***	(1.656)
Nonmetro adj.	-0.348	***	(0.041)	1.521	(5.447)	10.151	***	(1.630)
Nonmetro remote	-0.432	***	(0.042)	-0.811	(5.327)	12.122	***	(1.617)
<u>Year (ref=1990)</u>								
2000	0.066		(0.081)	527.55	*** (7.891)	113.311	***	(1.722)
2010	-8.184	***	(0.169)	699.13	*** (14.156)	210.956	***	(2.873)
2016	-1.805	***	(0.214)	705.104	*** (21.622)	172.858	***	(3.351)
R-Square	0.257			0.019		0.008		

Note: Reference category is large metro counties unless stated otherwise. Sig: * <.05 ** <.01 *** <.01

Figure A1 Change in rates of affordable housing between 1990-2016