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A Demographic Deficit? Local Population Aging and Access to Services in Rural America, 1990–2010

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Abstract

Population aging is being experienced by many rural communities in the U.S., as evidenced by increases in the median age and the high incidence of natural population decrease. The implications of these changes in population structure for the daily lives of the residents in such communities have received little attention. We address this issue in the current study by examining the relationship between population aging and the availability of service-providing establishments in the rural U.S. between 1990 and 2010. Using data mainly from the U.S. Census Bureau and the Bureau of Labor Statistics, we estimate a series of fixed-effects regression models to identify the relationship between median age and establishment counts net of changes in overall population and other factors. We find a significant, but non-linear relationship between county median age and the total number of service-providing establishments, and counts of most specific types of services. We find a positive effect of total population size across all of our models. This total population effect is consistent with other research, but the independent effects of age structure that we observe represent a novel finding and suggest that age structure is a salient factor in local rural development and community wellbeing.

Introduction

Many rural communities in the United States (U.S.) face the challenge of maintaining a full complement of establishments providing essential services to the local population. These challenges are particularly acute among communities with declining populations. Since the viability of service-providing establishments depends on sufficient numbers of consumers,

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one would expect changes in population size to be associated with the maintenance of such businesses in local areas. The implication is that maintaining a comprehensive service sector is thought to be especially difficult in places experiencing long-term population decline.¹ Inadequate access to the services provided by such businesses and other organizations can adversely affect quality of life in shrinking rural communities, and over time further reduce a place's ability to retain population—let alone attract highly skilled persons who contribute to community development.

While the link between declining population size and the presence of service-providing establishments in local economies is in many respects straightforward, other demographic research shows that changes in population composition—particularly age structure—may also have important effects on economic development (Brown and Eloundou-Enyegue forthcoming). Much of this work has examined the role of dependency ratios and the age composition of the labor force on economic development at the national level, but we argue that there is reason to believe that these compositional effects also operate at the more localized county level. Indeed, it is at such geographic scales that many economic decisions and interactions take place. Despite these expectations, previous research on the association between population change and the availability of essential services at the local level has focused almost exclusively on the effects of population size and density (Adamchak et al. 1999; Vias 2006). Few studies have examined the impacts of changing age composition. Moreover, the limited research that has examined the relationship between changing age structure and the availability of essential services focused on retirement destinations and other unique cases (Brown and Glasgow 2008) rather than on the majority of aging rural places which lack these specific attributes.

The present research seeks to fill this gap, which is increasingly relevant in a context of deepening and increasingly widespread population aging in the rural U.S. (Glasgow 2000a; Johnson 2011). Our paper proceeds as follows. In the next section, we review existing research and develop hypotheses about the link between population change and local establishment structure. We then outline the goals of our study, describe our data and analytic methods, and present the results of our analysis. Finally, we discuss the implications of our findings and suggest topics for future research.

Population Change and Changes in Economic Activity

Population dynamics and economic transformation have been closely linked in the rural U.S. In particular, the decline of employment in agriculture, extractive industries and manufacturing have resulted in diminished population growth and chronic outmigration of young adults in many rural places (Carr and Kefalas 2009). Such net loss of young persons has both direct and indirect impacts on population size and age structure. Chronic net outmigration among younger populations has the direct effect of diminishing population size and increasing median age. Young out migrants also take their children and their reproductive potential with them, further exacerbating the negative effect of their loss on

¹Maintaining local services also seems challenging where a large proportion of working age persons work outside of the local community and obtain goods and services during their journey to or/and from work.

population size and age structure over the longer run. That is, persistent out-migration of young adults contributes to a cumulative process of decline. The overall result is both population decline and a distorted age structure characterized by extreme aging. In a growing number of cases, populations have aged to the point at which they experience natural population decrease, or the excess of deaths over births. Regardless of the fertility rate of remaining women of childbearing age in such populations, there are often simply not enough women in this age group to produce a sufficient number of children to counterbalance the deaths experienced by older residents. The incidence and drivers of natural decrease is well documented by prior research (Johnson 2011; Johnson and Lichter 2013; Johnson, Field, and Poston 2015).

In addition to this primary demographic effect, we expect that population decline and extreme aging will also result in economic restructuring, specifically diminished access to service-providing establishments. The link between population size and economic activity is well established (Adamchak et al. 1999; Espenshade and Serow 1978; Vias 2004, 2006). For example, Carlino and Mills (1987) showed that employment in the retail sector is sensitive to population change because the consumption demands of growing and declining populations increase or decrease with changes in the number of local residents. In another study, Johnson (1985) showed that local economies adjusted to population change through changes in scale, employment, and number of establishments. He found that prolonged population growth resulted in establishment gains while persistent population loss resulted in a loss of establishments. Importantly, he also showed that local economic systems have sufficient flexibility to absorb short-term changes in population size without adding or losing establishments. Only sustained growth or decline was shown to elicit gains and losses of businesses.

The basic notion that the location of economic activities responds to variability in population size and density derives from central place theory. First developed in 1933 by Walter Christaller (1966), this theory seeks to explain the number, size, and location of human settlements in an urban system. Since settlements provide services to their own population and to persons residing in surrounding areas, the number and kinds of economic activities found in a place is directly related to its population size, including the size of the surrounding communities with which it is interdependent. The theory is based on the idea of centrality, as indicated by threshold—the minimum market size that is needed to establish and maintain an economic establishment—and range—the average minimum distance that people will travel to buy these services or goods. An implication is that population change would be expected to induce changes in the number of economic establishments in particular places as they grow or decline.

Christaller's theory stimulated a large body of research by economic geographers and regional scientists. Berry's (1967: vii) influential essay on the geography of market centers and retail distribution demonstrated that "the geography of retail and services businesses displays regularities over space and through time." This essay brought central place theory into the mainstream of social science analysis of settlement structure and change in complex societies. While the precise geometry of Christaller's hierarchical central place system has not been fully supported by empirical evidence, the general notions of centrality, threshold,

and range still shape our understanding of the relationship between population and economic dynamics within countries and sub-regions.

A number of other studies—including many motivated by the arguments of central place theory—have examined the link between local population change and business activity. Drabenstott and Smith (1996) found that commerce and financial services had consolidated in a twelve-state “Heartland” region resulting in fewer and larger service centers. Stone (1988) also showed a dramatic consolidation of retail trade, health and financial services, a reduction of central places, and an expansion of market regions in rural America. Adamchak and colleagues (1999), influenced by central place theory, reasoned that retail and services are most likely to locate in or close to larger places in order to take advantage of economies of scale and transportation efficiencies. In other words, they argued that residents of smaller places are likely to obtain goods and services from their larger neighbors rather than locally. They found a consistent positive relationship between the rate of population change and the rate of change in wholesale and retail employment from 1950 through 1990 in the Great Plains. Even during decades when the Great Plains experienced overall population decline, trade continued to concentrate in larger places that were growing more rapidly. This finding is particularly important because it underlines the salience of local population dynamics relative to those at regional or higher levels. In a final pair of examples, Vias (2004, 2006) showed that population change was an important factor underlying changes in the rural retail sector in recent decades. His studies, respectively of the U.S. in general and the Great Plains in particular, demonstrate that population change was an important driver of the decline and/or concentration in the rural retail sector, independent of broader political and economic forces to which rural restructuring is often attributed. As with Adamchak et al. (1999), Vias (2004) highlights the role of local conditions—including population decline—by arguing that these conditions shape how national or global processes actually manifest in the social world.

In contrast to this robust body of evidence on the link between population growth and decline and changes in local and regional economic activity, the effects of changing age structure at the local level have been understudied to date. While policymakers realize that changes in population size and age structure are both important determinants of national and regional social and economic conditions, such as labor force replacement, the costs of social welfare programs, saving patterns and other institutional arrangements, little research has sought to disentangle the impacts of changing size from changing population aging at more local levels (Zoubanov 2000). This gap in knowledge may be the result of an implicit assumption among social scientists that population aging is derivative of total population change, and will therefore exert no independent effect on local or regional economic activity once changes in population size have been accounted for.² Yet this is ultimately an empirical question that we believe merits examination. The evidence on the relationship between age structure and the economy that does exist is almost exclusively at the national level (Bloom, Caning, and Fink 2011). Here, the argument is that declines in the dependency ratio³, driven by the transition from high to low fertility rates, have a positive effect on economic growth

²For example, population age structure does not even appear in the index of Brian Berry’s (1967) classic study, *Geography of Market Centers and Retail Distribution*.

and per capita income. The growing share of the population in productive ages that is produced by declining fertility allows families and national governments to allocate more resources to more productive ends than under the prior high fertility regime, leading to a “demographic dividend” for the economy. Research on the demographic dividend has underlined how the population-economy relationship goes beyond growth or decline in population size, demonstrating the independent role of age structure (Bloom, Canning, and Sevilla 2002; Brown and Eloundou-Enyegue forthcoming).

The demographic dividend focuses on the impact of changes in age structure on overall economic development at the national level, while our research focuses on the effects of changes in age structure at the local level on the availability of services people use in their everyday lives. Nonetheless, knowledge that age structure has an independent effect on national-level development—and that this effect operates through both micro- and macro-level mechanisms—motivates our interest in examining the local-level impacts of population aging on service availability. It should also be noted that research on the demographic dividend suggests the potential for accelerated development typically occurs for a limited amount of time. In fact, this research shows that the dividend can switch to a demographic deficit if fertility rates persist at low levels for a long period and produce high old age dependency. This is another link with our research: population aging and correspondingly high old age dependency is being experienced today by many rural communities in the U.S.⁴ Our research considers whether such population dynamics at the local level also correspond with declining prospects for development, as the notion of the demographic deficit would suggest.

Why would one expect the local availability of services to respond to changes in population age structure? One reason may be that owners of service providing businesses in extremely old places have difficulty transferring their businesses to younger persons (who are relatively scarce). Similar issues regarding inter-generational transfers have been shown to explain why aging farmers have such difficulty transferring their farms to younger persons, including their own children (Ashok et al. 2010). Another possible reason for this expectation is that older populations typically depend more on non-earning income such as pensions, investments, rents, and Social Security compared with younger persons (Nelson 2005). While this can benefit a community’s economic base if the non-earnings income sources are diverse (Nelson and Byers 1998), it can become problematic if older residents depend primarily on Social Security⁵ or other relatively fixed sources of income. Therefore, in extremely old places where most older residents have fixed, limited incomes, the viability of service providing establishments may be called into question by current and prospective establishment owners.

³The dependency ratio is a measure of population structure that expresses the ratio between population in the prime working ages (usually 15–64) to persons at both older and younger ages.

⁴One other difference is that low fertility in the rural U.S. is a direct result of out-migration of young adults, and not necessarily of low fertility rates. In contrast, the shift from a demographic dividend to a demographic deficit in the developing world is mainly associated with persisting low fertility rates.

⁵For example, Social Security did not receive a cost of living adjustment (COLA) in 2016 (nor in 2009, 2010, or 2015) (US Social Security Administration 2016).

One final reason to expect the local availability of services to respond to changes in population age structure is that research shows that consumption patterns differ by age, with older persons having lower per capita consumption compared with younger populations. Danziger (1982–83), for example, found that older persons spent less on consumer goods and services than did nonelderly people at all levels of income. This finding has been replicated in other countries. In Germany, Stover (2012) examined data from that nation's System of National Accounts and showed that per capita consumption increased up to age 55, but then declined regularly with increasing age. However, this was not true for all categories of consumption. While consumption of food and beverages declined with age, the opposite was true of consumption of health care. Similarly, Chen and Chu (1982) showed that older households spend more of their income on basic needs than do younger households. Compared to their younger counterparts, the elderly spend more on housing, food, and healthcare, and less on clothing, transportation, and household furnishings. Notably, this research showed that grouping all older person into an undifferentiated consumer category can be misleading (Abdel-Ghany and Sharpe 1997; Paulin 2000). Using data from the BLS Consumer Expenditures Survey, Abdel-Ghany and Sharpe (1997) showed that the oldest old (age 75+) consume 25 percent less than young-old (65–74). Their findings suggest that the exact age composition of older populations matters. That said, their analysis confirmed prior studies and showed that per capita consumption declined with age for food at home, housing, transport, entertainment and insurance while consumption of health care increased. Together, these studies show that regardless of the sources of income, when older populations are concentrated in local populations they can be expected to exert lower per capita demand for goods and services than their younger counterparts. And, this situation can be exacerbated as older populations age in place, and the oldest old comprise a growing share of the older population.

Another relevant set of studies focuses on the effects of older in-migrants, such as those to rural retirement destinations. These findings generally suggest that in-migration of older persons has positive economic impacts (Serow 2003). Some of this research is survey based (Brown and Glasgow 2008; Nelson 2014), while other authors use input-output analysis to examine the economic impacts of migration at older ages (Day and Bartlett 2000; Deller 1995; Serow and Haas 1992). In more recent research, Nelson et al. (2014) showed that in-migration of retirees to amenity-rich rural locations tends to induce economic expansion, as indicated by corresponding net in-migration of working-age Latinos to fill jobs in construction and services. Such findings—and their own research —have led Brown and Glasgow (2008) to suggest that retirement migrants often constitute a source of “gray gold.” In contrast, Sanders and his colleagues (2016) found that retirement migrants are more likely to seek healthcare from larger neighboring communities than longer-term residents. Furthermore, the likelihood of out-shopping increases migrants' dissatisfaction with other local services. These findings indicate the possible disconnect between retirement migrants' place of residence and the places that they seek services. If a significant share of in-migrants travel elsewhere for services, the local service sector will fail to benefit from their residential presence.

The emergence of such retirement destinations clearly has important consequences for local economic conditions. However, changes in age structure associated with in-migration of

older populations correspond to special cases of population aging, and there is heterogeneity even among such places. For example, while most retirement destinations experience significant population aging, those that attract both older and younger migrants have markedly lower median ages than places that attract only older in-migrants (Brown and Glasgow 2008; Rowles and Watkins 1993). This point suggests a need to differentiate between in-migration of older populations, as indicated by positive age-specific net migration rates at age 65 and above, and population aging, as indicated by increases in the median age. One would not generally hypothesize that places with populations that are ageing in place would experience an increase in service-providing establishments since most older populations have a downward momentum. With such negative future prospects, economic actors are unlikely to invest in the community. One notable exception is cases where the older population is wealthy, and can therefore stimulate economic activity by spending their retirement savings and other sources of wealth (Nelson et al. 2014). We expect such cases to have only a trivial influence on statistical averages, with aging linked to economic and population decline in a large majority of cases. In contrast, places where in-migration of older populations also stimulates in-migration of younger populations to meet elders' demand for services are likely to be more economically dynamic, and will be characterized by lower median ages relative to the oldest populations (Glasgow and Brown 2012). As such, we expect aging to be associated with relative declines in services, a working hypothesis we take as our point of departure.

Current study

Research focus

This analysis addresses a straightforward question: what are the respective effects of changes in counties' median age and total population size on the number of service-providing establishments? We consider both the total number of service-providing establishments and counts of specific types of services (see below) to capture potential differences across categories of services. Given prior research discussed above, we expect a consistent negative association between population loss and the number of service-providing establishments. However, we also expect that population aging will be associated with changing service availability net of population size effects. In particular, we expect that populating aging—shifts toward extreme old age—will be associated with declining service availability. Older population structures reflect historical patterns of adverse demographic change (e.g., chronic net out-migration of younger populations), and are often a precursor to continued demographic decline, both of which we expect to undermine the availability of services. We speculate that older populations' general reliance on non-work, often fixed incomes may negatively shape demand for local services and therefore affect establishments' location decisions.

Data

Our analyses draw mainly upon data from the U.S. Bureau of Labor Statistics (BLS) and U.S. Census Bureau. Using these data, we construct a county-decade dataset with time intervals corresponding to the ten-year periods between each census. Each observation captures outcomes and conditions for a specific county and year (i.e., one of the three census

years between 1990 and 2010). Our outcome variables are measured using data from the BLS Quarterly Census of Employment and Wages (QCEW). We use the QCEW's annual counts of the number of establishments per industrial category for each county in the United States. For the explanatory and control variables, we draw upon data from the 1990, 2000, and 2010 decennial censuses. We also use data from the American Community Survey's (ACS) 2008–2012 5-year estimates to measure median income and educational attainment in 2010. These variables were no longer available through the decennial census after the long form was discontinued in 2000. Both the census and ACS data were accessed via the National Historic Geographic Information System (NHGIS) (Minnesota Population Center 2011). Finally, two of our control variables are constructed using data from net migration estimates produced by Winkler and colleagues (2013).

We restrict our analysis to nonmetropolitan counties, using a constant metropolitan delineation based on the 2000 Census. In other words, we include all counties that were classified as nonmetropolitan based on those figures, regardless of whether a given nonmetropolitan county (so defined) was reclassified between 1990 and 2000 or between 2000 and 2010. This is one among a number of possible approaches (Fuguitt et al. 1988). While each approach has its advantages, we feel that this is the appropriate choice for our analysis for two main reasons. First, by using metropolitan definitions from the mid-point of our 20-year period of analysis, we minimize the misclassification associated with assigning counties a time-invariant status despite transitions into and out of each category during this period.⁶ Second, we conduct supplemental analyses that show our regression estimates are robust to the primary alternative definition of the non-metropolitan universe. For this robustness check, we considered non-metropolitan counties based on the floating, decade-specific delineations. Given the structure of the fixed effects model, we analyzed data from only counties that were classified as non-metropolitan for at least two of the three decades in the 1990–2010 period. The results of these analyses are consistent with the results for all models shown below in Table 2 in terms of both the direction and statistical significance of coefficients. For the analyses shown in this paper, our analytic sample contains only nonmetropolitan counties as delineated in 2000 with observations from all three rounds of data, with a total of 6,003 county-decade observations from 2,001 counties.⁷

The Special Case of Rural Areas

Our focus on nonmetropolitan counties is appropriate given the unique demographic trends and conditions in this subset of counties relative to the metropolitan U.S. The association between population size and the availability of economic functions is of particular relevance in rural regions, where the demographic conditions hypothesized to support economic activities have become increasingly constrained in recent decades (Glasgow and Brown 2012, Johnson 2013). While most urban places have sufficient population size and density to

⁶The logic of our choice is as follows. If we use the universe based on 1990 delineations, we are *including* the set of counties that were non-metropolitan in 1990, but metropolitan in 2000 and 2010. If we choose 2010, we are *excluding* counties that were non-metropolitan in 1990 and 2000 but transitioned to metropolitan by 2010. By using the 2000 delineations, however, the problematic inclusions/exclusions described in the first two scenarios are minimized. That is, our misclassifications are limited to including counties that were non-metropolitan for 1990 and 2000 but transitioned to metropolitan in 2010; and excluding counties that were non-metropolitan in 1990 but metropolitan in 2000 and 2010.

⁷We use the terms “nonmetropolitan” and “rural” interchangeably in the text. Data are for nonmetropolitan counties, not rural areas.

support at least a basic level of most services, the same is not true farther down the urban hierarchy. By definition, rural places have relatively small and low density populations. Therefore, a further loss of population may push places below the threshold necessary to support service-providing establishments.

Rural population loss is an ongoing problem. About two thirds of nonmetropolitan counties have lost population since the 2010 Decennial Census. In fact, between 2010 and 2014, the overall nonmetropolitan population declined, the first instance of such negative growth in U.S. demographic history. Many local areas in the rural U.S. have also experienced substantial declines in the past. Nonmetropolitan population loss is associated with high unemployment, housing market challenges, and reduced migration to amenity rich rural areas (Cromartie 2015).

In addition to declines in total population and population density, many rural communities in the U.S. are also experiencing unusually high levels of population aging—our second independent variable of interest. According to the 2005–2009 ACS and the 2010 Decennial Census, more than 15 percent of the nonmetropolitan population was aged 65 or older, compared with 12 percent of the metropolitan population (Glasgow and Berry 2013; Glasgow and Brown 2012; U.S. Census Bureau 2009). Population aging has reached extreme levels in certain parts of the nonmetropolitan U.S. (Glasgow and Brown 2012). In these places, the median age has increased to exceptional levels. For example, the median age in Sumter County, FL was 65.9 in 2014—meaning over half of the population was aged 65 or older (U.S. Census Bureau 2015). Older populations tend to exhibit rectangularized or top-heavy population structures, and in many cases experience negative demographic momentum driven by natural population decrease. As one indication of how widespread population aging is in the rural U.S., consider that 1,135 U.S. counties had natural population decrease in 2012 (Johnson 2013). The majority of these counties were nonmetropolitan, which is consistent with the disproportionately high prevalence of natural decrease counties within the rural U.S.: 46% of nonmetropolitan counties experienced natural decrease in 2012 compared with only 17% of metropolitan counties (Johnson 2013). While some metropolitan counties have also experienced population aging and overall population decline, we argue that the concentration of these phenomena in rural areas, along with the fundamentally different structures of rural and urban economies, justify the exclusive focus on rural areas.

Measures

Our analyses focus on changes in local access to five categories of service-providing establishments. Establishment categories are defined according to the North American Industry Classification System (NAICS). Here, we aggregate industrial groups to a super-sector level to minimize the effects of re-categorization at finer-grained sectors. Our sectors of interest are: (1) professional and business services; (2) education; (3) health (4) leisure and hospitality, and (5) personal and household services.⁸ We also model as an outcome the

⁸The personal and household services sector is identified as “other services” in the BLS data set. As a residual category, this super sector includes some services other than those delivered directly to persons and household. However, the vast majority of activities in this category are personal and household services such as barber shops, laundries, etc.

sum of all five categories for comparative purposes. To reduce the impact of idiosyncratic year-to-year fluctuations in the number of establishments, we measure the number of establishments using the average of observations across the first three years of each intercensal period. For example, the establishment counts corresponding to 1990 are based on annual averages across the 1990–1992 period.

Our primary explanatory variables of interest are county population size and age structure. We measure population size using counts of total population, and measure age structure using median age. In preliminary analyses, we found that median age was strongly correlated with other indicators of age structure, including the share of the population aged 65+ years and an indicator of whether a county experienced natural population decrease.⁹ Hence, we do not examine these other indicators of aging here.

Since the analytic method we use controls for all time-invariant county characteristics (see below), we restrict our control variables to a limited set of time-varying factors known to be associated with local economic activity. These include population density, median income, share of the population who identify as black, share of the population aged 25+ with a bachelor's degree or higher and net migration rates for two age groups: 15–44 and 65+. Finally, we include a pair of decade indicator variables to capture common temporal trends in establishment counts across the nonmetropolitan U.S.

Analytic approach

Our analyses center on a series of linear regression models that estimate how changes in counties' population size and age structure affect the availability (number) of service establishments as defined above. We include county-level fixed effects in our models to remove the impact of unobserved time invariant characteristics on the county-level counts of service providing establishments we are interested in.¹⁰ This stands in contrast to a pooled cross-sectional approach, which would compare establishment counts between relatively young and old counties without accounting for the unobserved (and unobservable) factors that may confound the relationship between county median age and establishment counts.

Our analyses also account for the relationship between the establishment count in one county and establishment counts in surrounding counties. This step is necessary given that county boundaries are in large part administrative artifacts rather than divisions between socially and economically independent units. Considerable flows of persons, capital, and goods cross county boundaries, which for our purposes makes it problematic to assume true independence between the economic structures of a given county and its neighbors. We address this issue by including a spatially lagged dependent variable in each of our models. The lag term accounts for the effect of the number of establishments among a county i 's neighbors on the number of establishments in county i . We define neighbors using a queen

⁹For example, the zero-order correlation between median age and number of years a county experienced natural decrease was approximately 0.70 during the 2000–2010 period.

¹⁰Given the practical need to use a fixed universe of nonmetropolitan counties (i.e., counties that were nonmetropolitan according to the 2000 Census), differences within the nonmetropolitan universe are considered time-invariant for the purposes of our analysis. Therefore, the county fixed effects included in our models absorb the linear effect of important time-invariant factors such as adjacency to metropolitan areas.

first order weights matrix where any county that shares a border or matrix with a given county is considered a neighbor.

For each outcome Y , our models can be expressed formally as:

$$Y_{it} = \alpha_i + \beta_n X_{it} + \sigma lag_{it} + \varepsilon_{it}$$

where α represents the intercept for county i , X represents a vector of time-varying variables measured for county i at time t , β represents a vector of n coefficients corresponding to all variables, σ represents the coefficient corresponding to the effect of the spatially lagged dependent variable for county i at time t , and ε represents the error term for each observation. The set of time-varying explanatory and control variables, X , includes county population size and median age, the latter of which we model as a quadratic function. Initial data analyses revealed a non-monotonic relationship between some service categories and median age, and demonstrated that the use of a quadratic function for the age variable was consistent with and more parsimonious than the alternative approach of using a series of indicator variables for five- or ten-year age groups.

Analysis

Descriptive statistics

We begin by summarizing the variables included in our analysis for each year (1990, 2000, and 2010) (Table 1). The average number of service-providing business establishments in nonmetropolitan counties increased from 137.6 (SD=197.9) in 1990 to 272.7 (SD=320.2) in 2010.¹¹ While the number of establishments in all five constituent categories increased over this time period, the growth rate was especially high in health, education and professional and business establishments, each of which increased by at least 150%—and in the case of educational services over 350%.

The county-level averages of our two independent variables of interest, population size and median age, also increased in the rural U.S across the twenty years that we observe. The population of the average rural county increased 13.9% between 1990 and 2010, from 21,917 to 24,954. Median age rose at an even greater rate (18.1%) from 35.1 years in 1990 to 41.5 years in 2010. We observe considerable variation about the mean of both variables. In addition to the standard deviations shown in Table 1, consider that the total populations ranged from 82 to 200,186 in 2010; and the inter-quartile range (IQR) of population size was 25,929 (8,256; 34,185). In the same year, median age ranged from 22.6 to 62.7; and the IQR of median age was 6.1 years (38.7; 44.8).

We also present descriptive statistics for our control variables (Table 1). Between 1990 and 2010, population density increased from approximately 35 to 40 persons per square mile. Both income and education increased during the 1990–2010 period in nonmetropolitan America, while the share of the population identifying as black remained nearly constant

¹¹The total establishments row in table 1 includes household and personal, health, education, professional and business, and leisure and hospitality.

around 7.7%.¹² All four of these socioeconomic indicators vary substantially among nonmetropolitan counties, underlying the diversity of local conditions across the rural U.S. Finally, net migration among young adults was consistently negative during all three points in the 1990–2010 period, and consistently positive, but small in magnitude (around 2 per 100) among older populations. These net migration statistics suggest that, on average, age-specific migration dynamics have been placing upward pressure on the age structure of rural counties. It should also be noted that inter-county differences in age specific net migration rates has diminished over this time period indicating that nonmetropolitan counties are becoming more alike in this aspect. Overall, our descriptive analyses show that there have been significant changes over time in nonmetropolitan population dynamics and socioeconomic indicators, and the findings highlight the diversity of local conditions across the 2,001 nonmetropolitan counties that constitute our sample.

To underline the extent and spatial pattern of population aging across the rural U.S., we have mapped the median age of all nonmetropolitan counties in 1990 and 2010 (Figure 1). To facilitate comparisons over time, we use a constant scale for each year with categories defined by the Jenks natural breaks for 1990 (Jenks and Caspall 1971). At least three key patterns emerge from this pair of maps. First is a clear shift toward older median ages across the rural U.S. This shift in the entire age distribution is consistent with our descriptive statistics, which yielded a 6.4-year increase in the average median age (see above). Second, the map reveals considerable variation across the nonmetropolitan U.S. In many cases, the pockets of aging evident in the 1990 map expanded outward by 2010, reflecting the momentum in many populations with older age structures.¹³ Yet while the clusters of older populations expanded considerably, there were still a non-trivial number of nonmetropolitan counties with relatively low median ages in 2010. A close inspection of this map reveals that in nearly all states, a group of nonmetropolitan counties maintained young median ages—in some cases far below the 2010 average median age of 41.5 years. Third, a comparison of individual counties in 1990 and 2010 demonstrates that the pace of population aging varied considerably across counties. While some counties transitioned from very young to very old median ages over the twenty years we consider, others experienced little to no increase and therefore remained in the same category. Clearly, the rural population in the U.S. is aging, but the shift toward older age structures at the county level has been far from uniform with respect to the rate or extent of change.

To provide additional descriptive evidence of the link between service-providing establishments and county-level aging, we mapped the service growth in nonmetropolitan counties between 1990 and 2010 (Figure 2). The spatial pattern of below average rural service growth has many similarities to the spatial pattern of population aging displayed in Figure 1. It is notable that while the pattern of below average service growth is most apparent in the central U.S., below average service growth occurred in many non-metropolitan counties across the country. Second, the spatial distribution of below average rural service growth resembles the pattern of rural county aging. In fact, 57.1% of counties

¹²Note that after accounting for inflation, median income only increased by around 12%, not the 195% reflected in the nominal income figures shown in the summary statistics. Further note that our regression models account for inflation.

¹³This clustering of population age indicates the need for using a spatially lagged dependent variable as we have done in this paper.

reporting a median age above the 2010 average median age of 41.5 years also experienced below average service growth between 1990 and 2010. These findings provide additional descriptive support for the link between aging rural populations and a decline in the number of service-providing establishments.

Multivariate analysis

Our multivariate analyses examine whether access to service-providing establishments is affected by the extent of county population aging, net of changes in population size and other variables. We begin by examining the effect of changing county population size and age composition on the total number of the service-providing establishments of interest (defined above). The results (Table 2) indicate, first, that increases (decreases) in total population size have the expected positive (negative) effect on the number of these service-providing establishments. This relationship is strong and consistent across service types. Our coefficient estimates indicate that every 100-person increase in population between 1990 and 2010 is associated with an increase of approximately 1.5 service-providing establishments. In additional analyses (not shown), we estimate a model with a quadratic function of total population. The squared term is non-significant and does not affect the direction or statistical significance of the total population term, so our final models use the more parsimonious linear function.

The relationship between population size and service-providing establishments is consistent with central place theory, and with the prior research that motivated our study (Adamchak et al. 1999; Espenshade and Serow 1978; Vias 2004, 2006). However, as hypothesized, our estimates also demonstrate that changes in population age structure affect the number of service-providing establishments per county, independent of the effects of changes in population size. Such age composition effects have, to our knowledge, not been documented in prior research at the county (or other local) level. The relationship between county median age and the number of service-providing establishments per county is non-monotonic, indicating that the economic structure of counties evolves in a non-linear pattern as median age increases. Establishment density increases steadily during initial increases in county median age, but then declines as median age increases across the highest median ages. County economies clearly have development histories of their own

To examine the non-linear pattern of establishment growth across county median ages more closely, we generate expected counts of total service-providing establishments at 5-year intervals (e.g., median age = 25, 30... 60) across the approximate range of county median ages in our data, holding all other values at their means (Figure 3). This exercise reveals that the effects of local population aging on the number of establishments is initially positive, but then reverses as county age composition approaches the upper bounds of the observed range. Specifically, our analyses identify a threshold of approximately 45 years, after which further aging results in a decline in the total number of service-providing establishments. To put this figure in perspective, consider that across the 20-year period we examine, the average county median age across nonmetropolitan areas was 38.3, with a standard deviation of 5.0. This suggests that counties exceeding the mean by just a single standard deviation will begin to

experience a decline in the count of service-providing establishments irrespective of changes in total population.

Next, we consider whether the observed trends with respect to the total count of service-providing establishments mask differences according to particular categories of service providers (Table 2). Our results demonstrate that the positive effect of total population change and the inverted U-shaped pattern observed with respect to the count of total establishments and increasing median age are also apparent for most sub-categories of service-providing establishments. The one exception we observe is in the household and personal service category. In this case there was no significant association between changes in median age and change in the counts of this type of establishment (joint F-test of age + age²=0.70, p=0.497), although the positive effect of population growth is still observed. A possible explanation is that this category is a heterogeneous residual of many kinds of services. As well, compared with the other service categories, most nonmetropolitan counties experienced very little change in the number of personal and household service establishments between 1990 and 2010.

Across the other four categories of establishments, differences are a matter of degree rather than kind. To illustrate between-category variation in the association between aging and changing establishment counts, we use our regression estimates to predict the number of establishments in each of the four sub-categories of services for which age has a significant effect. We generate predicted values for county median ages 38.3—the mean across 1990–2010—and 48.3—two standard deviations above the mean (Table 3). Comparisons of the percentage change in establishment counts between these two median ages yield insight into cross-category differences in the relationship between aging and local establishment structure. These results reveal that the relative declines in counts are steepest in percentage terms among establishments providing health and educational services. As counties move from the pooled average median age (38.3) to two standard deviations above the pooled average (48.3), the count of these types of establishments decline 51.3% and 15.8%, respectively. Declines in educational institutions are likely to be fairly unproblematic since increasing median age strongly correlated with declines in the population share in school ages. In contrast, steep declines in healthcare-providing establishments suggest that many of the oldest rural populations in the U.S. face declining direct access to healthcare. These declines may reflect relatively low rates of privately-insured (and thus profitable-to-serve) older populations, but are at odds with the high health care needs of these populations.

With respect to the goals of our analysis, the estimated effect of the spatial lag variable has some substantive importance. The spatial lag effects are positive and statistically significant for models of educational, health, and household and personal services, which indicates that there is significant clustering of service rich areas for these sectors. Of course, the opposite is also true: areas lacking such services are also spatially clustered. This finding suggests a pattern of spatial inequality in access to key services. Such a pattern is consistent with the spatially clustered ‘geography of aging’ presented earlier in the paper, pointing to a new spatial inequality of both demographic and economic conditions.

As a supplementary and final step, we consider the potential effects of heterogeneity among the universe of nonmetropolitan counties in our analysis. Given the insights of central place theory and prior research on this topic (e.g., Adamchack et al. 1999), we consider the possibility that the effects of changing population size and median age vary by adjacency to metropolitan areas. Lack of direct access to a metropolitan economy may place communities at a competitive advantage or a disadvantage with respect to service provision. On the one hand, the protection of distance from competition might make relatively small places adequate markets for various service establishments. On the other, being located at a distance from a larger place could be a source of disadvantage since firms may be reluctant to relocate to small and isolated communities that lack nearby markets. Using a binary indicator variable drawn from the United States Department of Agriculture (USDA) Economic Research Services' (ERS) Rural-Urban Continuum Codes, we conduct two additional analyses. First, we re-estimate the model predicting the overall count of service-providing establishments and interact population size, median age, and median age-squared with the indicator of adjacency. The interaction term between population size and adjacency is statistically significant ($p=0.006$), and a joint test of the interactions between adjacency and median age and median age-squared is statistically significant as well ($F=5.62$, $p = 0.004$).

Given evidence of significant differences in the effects of population size and median age between adjacent and non-adjacent counties, our second step is to stratify our sample by adjacency and estimate the model of total service-providing establishment counts separately for each group (Table 4). The general patterns of population and median age effects are consistent across both areas, which demonstrates the robustness of our main results. However, the estimates in Table 4 suggest some substantively important differences in the magnitude of these effects. The positive effect of population size appears to be stronger in non-adjacent counties than adjacent ones. This may be because such counties are in less competition with neighboring metropolitan areas, such that with increasing size they are more able to serve themselves and their own neighbors (i.e., to act as central places). In contrast, when such non-adjacent counties decline in size, establishment counts decline most rapidly since they lack the demand from neighboring metropolitan areas that adjacent counties benefit from. The effects of median age are also somewhat amplified in non-adjacent counties. For our purposes, the highlight here is that non-adjacent counties experience sharper declines in establishment counts under conditions of extreme aging than their adjacent counterparts. To illustrate these effects, we again generate expected establishment counts at various median ages, holding all other variables at their means (results not shown). As one clear example, consider that a shift from median age = 50 to median age = 55 produces a 9.8% (243.9 to 219.9) decline in establishment counts in adjacent nonmetropolitan counties, but a full 24.6% (148.8 to 112.2) decline in non-adjacent areas. It appears that distance to the nearest metropolitan area provides some protection for places that are large and young enough to go it alone, while this same isolation further disadvantages counties with declining and/or extremely old populations that are experiencing negative momentum with respect to their service structures. This demonstrates that the effects of population change are contingent on organizational and institutional

contexts: in this case proximity to nearby larger places and the opportunities for both cooperation and competition afforded by such location.

Discussion and Conclusion

This paper has explored the implications of local population aging—an increasingly common issue across the rural U.S.—for residents' access to service-providing establishments within their county of residence. Our primary goal was to understand whether changes in county median age had an effect on the number of service-providing establishments per county, net of the effect of changes in the total population and other controls. Our analyses reveal significant, but complex age effects on county level counts of establishments for most types of services. Specifically, in these instances we find that shifts from the youngest to moderate median ages are associated with increased growth in establishment counts. However, shifts from moderate to extremely old population structures have a relatively negative effect on growth in establishment counts. This finding indicates that the many rural counties experiencing significant population aging are experiencing relative declines in the availability of often essential services, irrespective of changes in the overall population

It should be noted, however, that our analysis indicates that service rich areas cluster spatially, as do areas poor in services. Net of population size and structure, local access to services is in part contingent upon whether or not individuals reside in a county with establishment-rich or -poor neighbors. Spatial inequality was especially marked with respect to health services, which is important for our purposes given the degree to which older populations depend on health services. Evidence of spatial clustering indicates that some rural populations are increasingly concentrated in generalized areas of low service availability and access. In addition to lacking services locally, residents of such areas also lack access to services in neighboring places.

We also find that total population change has a significant and positive effect on establishment counts. An implication is that counties that are experiencing both extreme population aging and population decline—which many rural counties are—are likely to experience the largest declines in service-providing establishments. In contrast, aging communities that are experiencing population growth (e.g., retirement destinations) may experience relatively favorable conditions, as the positive effect of population growth offsets the impact of transitioning to an extremely old age structure.

There are three noteworthy nuances among our findings. First, the inverted-U shaped relationship between county median age and establishment counts was not observed among household and personal services, though the effect of population size was positive and significant for this group of services. The age composition effects were observed when modeling the combined count of all types of service-providing establishments and the other four sub-categories of establishments we considered (health, education, professional and business, and leisure and hospitality). Second, the effects of transitioning to an extremely high median age were largest in health and education, and, while statistically significant, relatively small with respect to professional and business and leisure and hospitality

establishments. Third, the magnitude of aging effects seemingly varies by adjacency to metropolitan areas, demonstrating the moderating role of spatial, organizational, and institutional contexts.

The negative effect of aging on access to healthcare is perhaps the most consequential and troubling finding. This result suggests that the oldest populations in the rural U.S., who are typically most likely to need health care and relatively easy access to it, face diminished healthcare access. This dynamic is consistent with general trends in rural health care access (see Cutler and Morton 2013; Gaynor and Hass-Wilson 1998), and may reflect the reliance of older populations on publicly funded services. Because clinics dependent on Medicare tend to be less profitable and are more likely to exit a market, rural aging may fuel a decline in local access to health care in such areas (Huckfeldt et al. 2013). Additionally, older populations are more vulnerable to the loss of local services because poor road conditions, weather, and the cessation or limiting of driving can prohibit these persons from accessing vital healthcare services that are not locally available (Glasgow 2000b; Panelli, Gallagher, and Kearns 2006). The loss of local healthcare may also be exacerbated when the few remaining local healthcare options are bypassed because non-local healthcare options located in larger neighboring communities are perceived to be more satisfactory. And, as the level of satisfaction with one type of local service declines, older rural residents are more likely to bundle multiple types of services, i.e. consumer services and health care, in larger neighboring communities (Sanders et al. forthcoming).

Additional research is needed to examine the causal processes that lead from population aging to a loss of service providing establishments. While our analysis of existing county-level data has demonstrated the empirical link, it raises many questions about why and how these changes occur, as well as what such loss of services means for the wellbeing of residents of communities with extremely old populations. Quantitative analysis of nationally-representative data is a good way to establish empirical links between population change and social transformation, but future research should work to identify the causal mechanisms linking population aging to changes in the local supply of services. We plan to pursue this objective by conducting a set of comparative case studies using a mixed methods research design. For example, as a part of our ongoing research, we propose to examine how service sectors respond to population aging in different kinds of places. We plan to interview individuals from both the public and private sector with service providing responsibilities to gain insights into the factors they consider when deciding whether to remain in aging places; to contract or expand their service offerings; to invest in distance diminishing technology; and/or to join with neighboring vendors in collaborative ventures. We also plan to investigate whether the loss of establishments we observed in extremely old places might be explained by difficulties that retiring owners have in transferring their businesses to younger owners. Demographic change such as extreme aging establishes constraints, but not all communities respond similarly to such changes. One approach would be to compare extremely old communities that are losing service establishments with similarly old places that are not experiencing service losses.

In addition to examining the causal pathways linking population aging and changes in local services availability, case studies of extremely old places would allow researchers to

examine the experience of those people—old and young—who live in extremely old places. Some possible questions might include: How do older persons, and persons lacking personal transportation, access services in places with growing service deficits? Can electronic technology substitute for some loss of direct access via local establishments? Do informal helper networks substitute for personal mobility in helping older residents access services? How are inter-generational relations affected by population aging? Other questions abound.

Additional research is also needed to determine whether the declines in services that we observe in our data are large enough to shape the health and wellbeing of older (and younger) populations in aging communities. A scarcity of services in communities with the oldest population structures may necessitate access-increasing solutions over and above direct local availability. In the health care arena, for example, telemedicine and other distance-nullifying options may maintain service access even in the absence of local providers (Grigsby and Goetz 2004). Other options include providing safe, convenient ride services to facilities located in nearby larger places.

Overall, the decline in service-providing establishments in aging communities suggests that the populations living in extremely old communities may face challenges accessing the services they depend upon for daily life. While, by definition, a large share of these older populations is in older age groups themselves, it is important to remember that youth and middle-aged adults also inhabit these places. The adverse changes in economic structure that we observe are likely to affect the quality of life of all persons living in aging communities, although perhaps in different ways. To the extent that such conditions decrease the likelihood of a county retaining younger populations, they may also promote further population aging (and decline), and have further deleterious effects for affected communities. County level population aging is a time varying, path dependent process, and many places not currently characterized by extreme aging are on a trajectory to experience such population structure in the future. On the other hand, our results indicate that population growth can offset some or all of the effects of population aging. While negative population momentum (i.e., self perpetuating population decline resulting from chronic net out migration, distorted age structure, and low fertility), will place upward pressure on the median ages of many communities in the years to come, rural development policies that promote economic growth and population retention may lead to relative improvements in economic conditions. If these changes correspond to improvements in quality of life, communities may be able to begin attracting sufficient numbers of young adults to reverse population aging and decline.

As a final note, our research has implications beyond the U.S., given that many rural communities throughout Europe and Asia are experiencing significant population aging as well (Harper 2014; Krout and Kristina 2014). While these countries differ with respect to their social welfare and health care systems, and operate by somewhat different market rules, extreme aging at the sub-national level in these countries may also lead to a loss of essential service providers in these countries (Johnson et al. 2015). We hope that this study stimulates additional research on the effects of population aging at the local level, where most social and economic interactions take place. Policymakers in both the U.S. and other contexts

affected by this issue would benefit from additional knowledge, including cross-national comparative studies.

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Figure 1.
County median age, nonmetropolitan counties, 1990 and 2010

Figure 2.
Nonmetropolitan counties with below average service growth, 1990 – 2010

Figure 3.
Linear prediction of service-providing establishments (total) by county median age, with
95% confidence intervals

Table 1

Summary of variables, non-metropolitan counties

Variable	1990		2000		2010	
	Mean	SD	Mean	SD	Mean	SD
Establishments						
<i>Total</i>	137.6	197.9	187.4	264.2	272.7	320.2
<i>Household and personal</i>	47.4	61.8	57.9	90.9	63.8	104.8
<i>Health</i>	19.5	41.7	29.6	53.2	61.8	71.3
<i>Education</i>	2.9	7.8	5.4	12.1	13.5	16.4
<i>Professional and business</i>	28.1	45.9	43.3	70.8	70.5	96.8
<i>Leisure and hospitality</i>	39.7	62.2	51.2	70.1	63.1	73.3
Total population	21,917	20,458	23,897	22,698	24,954	24,846
Median age	35.1	3.7	38.2	4.0	41.5	5.1
Population density	35.2	36.0	38.3	39.7	40.0	43.1
Median income	21,329	4,322	31,859	5,897	41,526	8,397
Percent black	7.6	14.7	7.8	14.8	7.7	14.7
Percent BA/BS+	11.8	4.8	14.4	5.7	16.8	6.5
Net migration rate 15–44, per 100	–12.2	15.4	–1.3	16.1	–7.0	13.3
Net migration rate 65+, per 100	2.0	11.9	2.2	11.3	2.5	10.8
N	2,001		2,001		2,001	

Table 2

Results of regression models predicting number of establishments, by establishment type

Variable	Total		Household + personal		Health	
	β	SE	β	SE	β	SE
Total population, 100 persons	1.5267	***	0.3433	***	0.2489	***
Median age, months	2.4950	***	-0.1114	0.1617	0.7749	***
Median age ² , months	-0.0025	***	0.0001	0.0001	-0.0009	***
Population density	-1.1239		-1.0485	**	-0.1525	0.2176
Median income, \$1,000	0.0989		-0.0053	0.1432	-0.7203	***
Percent black	2.7211	***	0.8332	0.3456	1.6194	***
Percent BA/BS+	4.2369	***	0.6327	0.2436	0.8237	***
Decade = 1990	(ref)		(ref)		(ref)	
Decade = 2000	2.5473		5.4855	7.1701	7.8938	***
Decade = 2010	59.8139	***	9.3973	7.9045	38.7408	***
Net migration rate 15–44, per 100	-0.2198	*	0.1119	-0.1095	-0.0342	0.0358
Net migration rate 65+, per 100	-0.4542	**	0.1935	-0.1524	0.1083	0.0546
Lagged dependent variable	0.0009		0.0008	0.0759	0.0244	***
Constant	-838.4757	***	85.7665	17.2707	41.4617	***
Observations	6,003		6,003		6,003	
Counties	2,001		2,001		2,001	
Joint test, age+age ²	F=29.40	***	F=0.70		F=47.55	***
R-squared (overall)	0.7703		0.5005		0.5728	

Variable	Education		Professional + business		Leisure + hospitality	
	β	SE	β	SE	β	SE
Total population, 100 persons	0.0737	***	0.5623	***	0.1953	***
Median age, months	0.2245	***	1.1571	***	0.2845	***
Median age ² , months	-0.0002	***	-0.0011	***	-0.0003	***
Population density	-0.1313		0.0717	0.5780	0.0967	0.2289
Median income, \$1,000	-0.0860	**	0.7953	***	0.0853	0.0617
Percent black	0.2948	***	0.3901	0.4053	-0.0447	0.2005
Percent BA/BS+	0.2957	***	2.2504	***	0.5084	***

Variable	Education		Professional + business		Leisure + hospitality	
	β	SE	β	SE	β	SE
Decade = 1990	(ref)		(ref)		(ref)	
Decade = 2000	0.0209	0.4703	-15.5125	2.5727	3.2539	1.0935
Decade = 2010	5.9118	0.8541	-9.6317	4.2730	10.2154	1.7641
Net migration rate 15–44, per 100	0.0018	0.0091	-0.0663	0.0458	0.0146	0.0216
Net migration rate 65+, per 100	0.0080	0.0159	-0.1739	0.0763	-0.0288	0.0423
Lagged dependent variable	0.1523	0.0282	0.0022	...	0.0126	0.0149
Constant	-67.0325	8.0709	-430.1720	46.1762	-84.9446	18.0996
Observations	6,003		6,003		6,003	
Counties	2,001		2,001		2,001	
Joint test, age+age ²	F=31.16***		F=23.13***		F=8.73***	
R-squared (overall)	0.4721		0.6659		0.6990	

p<0.01,

**
p<0.05,

*
p<0.10

Results are estimates for all valid nonmetropolitan counties. All models include county fixed effects.

Table 3

Linear prediction, by establishment type and county median age

Establishment type	Median age=38.3		Median age=48.3		Percentage change
	Est.	SE	Est.	SE	
Health	40.0	0.4	26.5	2.7	-51.3%
Education	8.2	0.1	7.0	0.7	-15.8%
Professional and business	51.4	0.6	49.8	3.4	-3.3%
Leisure and hospitality	52.4	0.2	52.3	1.5	-0.2%

Estimates derived from the regression model that corresponds to each establishment type.

Table 4

Results of regression models predicting total number of establishments, stratified by county adjacency to a metropolitan area

Variable	Adjacent		Non-adjacent	
	β	SE	β	SE
Total population, 100 persons	1.3067 ***	0.2647	2.2456 ***	0.3580
Median age, months	1.9781 ***	0.5417	2.4844 ***	0.3525
Median age ² , months	-0.0019 ***	0.0005	-0.0025 ***	0.0003
Observations	3,117		2,886	
Counties	1,039		962	
Joint test, age+age ²	F=6.78 ***		F=27.03 ***	
R-squared (overall)	0.7595		0.7698	

p<0.01,

**
p<0.05,

*
p<0.10

Results are estimates for all valid nonmetropolitan counties. Model includes all controls included in prior models and county fixed effects.