As Births Diminish and Deaths Increase, Natural Decrease becomes More Widespread in Rural America*

Kenneth M. Johnson iD
Department of Sociology and Carsey School of Public Policy
University of New Hampshire

ABSTRACT   Even before the onset of the Covid-19 pandemic, the U.S. population growth rate last year was the lowest in 100 years. And, from 2010 to 2019 nonmetropolitan America lost population for the first time in history. Diminished natural increase was a major contributor to this and also accelerated the incidence of natural decrease (more deaths than births), particularly in rural America. Deaths exceeded births in 46 percent of all U.S. counties—a near record high. Nearly 79 percent of these natural decrease counties were nonmetropolitan. This research uses recent data and a multivariate spatial regression model to update our understanding of the growing incidence of natural decrease in both rural and urban America. In light of the mortality increase and likely fertility declines stemming from the Covid-19 pandemic, these findings have significant implications for future nonmetropolitan demographic trends.

Introduction

Even before the onset of the COVID-19 pandemic, the U.S. population grew by just .48 percent between July of 2018 and July of 2019, the lowest growth rate since the Spanish Flu pandemic of 1919, according to recent Census Bureau estimates (U.S. Census Bureau 2020). Diminished natural increase was a major contributor to this minimal population gain. Deaths were at a record high last year (2,835,000), but there were the fewest births (3,792,000) since 1986. As a result, the surplus of births over deaths was the least in more than 50 years. This small natural increase, together with diminished immigration, produced the lowest U.S. population growth rate in 100 years.

The demographic situation in rural America is even more striking. Rural America experienced an absolute population decline between 2010 and 2019.[1] This population loss was minimal (−.5 percent), but it is the

[1]The terms nonmetropolitan and rural are used interchangeably as are the terms metropolitan and urban.

first time the rural population has ever declined (Cromartie 2017). Diminished natural increase was a major contributor to this nonmetropolitan population decline. The average annual natural increase was 53,000 between 2010 and 2019, just half the annual rate of the previous decade. Natural increase diminished substantially over the course of the decade, so that by 2019 there were just 1,000 more births than deaths in rural America. The diminished natural increase in rural America was not sufficient to offset rural net out-migration resulting in overall population loss.

Of interest here is how this diminished natural increase contributed to the growing incidence of natural decrease (more deaths than births) in subareas of the United States, and particularly in nonmetropolitan America. Our objectives are to: delineated the incidence of natural decrease since 2010; identify its immediate demographic causes; and examine how these demographic factors combine to produce natural decrease in both the United States as a whole and in nonmetropolitan areas. Examining how the incidence of rural natural decrease accelerated in an era of economic and demographic turbulence updates earlier research published in *Rural Sociology* (Johnson 2011) and sets the stage for future research on the impact of the COVID-19 pandemic on rural fertility and mortality.

The Great Recession exerted a significant influence on U.S. fertility and that impact has persisted. In 2018, the United States had the lowest general fertility rate on record and the fewest births in 32 years (National Center for Health Statistics 2019). There were 12 percent fewer births in 2019 than in 2007, just before the Great Recession began to influence fertility. In nonmetropolitan areas, the fertility decline was even greater at 15 percent.

Growing mortality has also contributed to the increased incidence of natural decrease. There were more deaths in the United States last year than in any previous year and 16 percent more than ten years ago. In rural areas, deaths were up more than 11 percent compared to ten years ago. The growing number of deaths reflects the long-term aging of the population, as well as near term factors such as deaths of despair. And, looming on the mortality horizon are the coronavirus pandemic and the large cohorts of aging baby boomer, both of which will likely increase the number of deaths and the incidence of natural decrease.

Natural decrease is the result of a complex interaction between fertility, migration, age structure, and mortality over a protracted period coupled with near term shocks to demographic trends. Dorn (1939) documented the brief emergence of overall natural decrease in a few places during the Great Depression due to birth declines; but it was short-lived. Later, Beale (1964, 1969) reported that even during the baby boom era there was a

growing incidence of natural decrease in rural counties. Later research documented that natural decrease has consistently been higher in nonmetropolitan areas (Johnson 2011). Natural decrease rose during the 1970s, subsided during the 1980s, accelerated again from 1990 through 2004, and then, modestly diminished between 2005 and 2009 (Fuguitt, Brown, and Beale 1989; Johnson 2011; Morrill 1995).

Johnson, Field, and Poston (2015) identified three powerful demographic forces that accounted for differences in the incidence of natural decrease in subareas of the United States and Europe between 2000 and 2010. These include low fertility rates, a smaller proportion of women of childbearing age and a larger proportion of older adults. Later research on white natural decrease in U.S. counties and states found similar results (Johnson 2020a; Saenz and Johnson 2018). Here, we examine the impact of these variables on recent natural decrease both in the United States as a whole and in nonmetropolitan counties.

Methods

Counties are the unit of analysis. They have historically stable boundaries and are a basic unit for reporting fertility, mortality, and census data. The choice of unit of analysis is constrained by the administrative units and data available, but the reader should be cognizant of the heterogeneity in the size of the population in our units of analysis. All 3,143 counties are included, but our focus will be on the 1,974 counties defined as nonmetropolitan in 2013. Because of difficulties with boundary changes and historical data in Alaska and a few other counties, the number of cases varies slightly from analysis to analysis. We use the terms rural and nonmetropolitan interchangeably as we do the term metropolitan and urban.

Data on births and deaths are from the Census Bureau's Population Estimates Series covering April 1, 2010 to July 1, 2019 (U.S. Census Bureau 2020). Data on the population 65 and over, the number of women of childbearing age (15–44) and the number of children under age five are from the Decennial Census of 2010.

The concentration of older adults is measured by the percentage of the population age 65 and older in 2010. We measure the child bearing age female population by calculating the number of females age 15 to 44 per 1,000 women in the population in 2010. Fertility is measured using the child-women ratio (children under 5/women 15–44) in 2010. For the bivariate analysis, the dependent variable is the number of years between 2010 and 2019 in which the county experienced natural decrease. In the multivariate analysis, the dependent variable is the birth/death ratio, which reflects the number of births per 1,000 deaths between 2010 and 2019. This

is a more nuanced measure than that used in the bivariate analyses and is more appropriate in the multivariate context. The log of the birth/death ratio is used to address some nonlinearity problems with the measure.

Results

Natural decrease accelerated during the Great Recession and its aftermath. Between 2010 and 2019, deaths exceeded births in 1,342 of the 3,143 U.S. counties (42.7 percent). Natural decrease is primarily a nonmetropolitan phenomenon. It occurred in 54 percent of the 1,974 nonmetropolitan counties, but just 24 percent of the 1,166 metropolitan counties (Table 1). Natural decrease has a long history in nonmetropolitan America, but it has accelerated rapidly in the last decade. Between 2000 and 2010, just 28 percent of all U.S. counties had overall natural decrease including 38 percent of the nonmetropolitan and 11 percent of the metropolitan counties.

Not all counties with recent incidences of natural decrease experienced it every year, though reoccurrences are common (Johnson 2011; Johnson et al. 2015). Between 2010 and 2019, 20 percent of all counties had natural decrease every year, 23 percent in 5 to 8 years and 19 percent in 1 to 4 years. Only 39 percent of all counties had more births than deaths in every year. By 2019, 91 percent of the counties that had experienced at least one year of natural decrease between 2010 and 2019 had multiple occurrences of it. In nonmetropolitan counties, both the overall incidence and duration of natural decrease was higher. Only 25 percent of nonmetropolitan counties did not experience any natural decrease compared to 61 percent of the metropolitan counties. In contrast, 25 percent of rural counties compared to 11 percent of urban counties had natural decrease in every year 2010 to 2019.

There is significant spatial variation in both the incidence and extent of natural decrease. It is regionally concentrated in the Great Plains, Corn Belt, Central Texas, Ozarks and Appalachians, Upper Great Lakes, Northern New England, and parts of the Northwest (Figure 1). Much of this territory encompasses rural areas dependent on agriculture and other extractive industries, as well as some older manufacturing regions. Natural decrease is also widespread in retirement counties in Florida and elsewhere. In each region of the country (with the exception of Florida), the incidence of natural decrease is far greater in nonmetropolitan counties than it is in metropolitan counties (outlined in black).

The Immediate Demographic Causes of Natural Decrease

The factors that lead to natural decrease are embedded in the economic, social, and technological transformations of the last century. As

Table 1. Years of Natural Decrease 2010 to 2019 by Metropolitan Status.

County Type	Number of Counties	Years of Natural Decrease				Overall Natural Decrease Counties 2010–2019
		None	1 to 4	5 to 8	All Years	
All counties	3,140	38.7	18.7	22.9	19.8	42.7
Metropolitan	1,166	61.3	14.0	13.8	10.9	24.4
Nonmetropolitan	1,974	25.3	21.5	28.2	25.0	53.5

Source: U.S. Census Bureau Population Estimates 2010 to 2019.
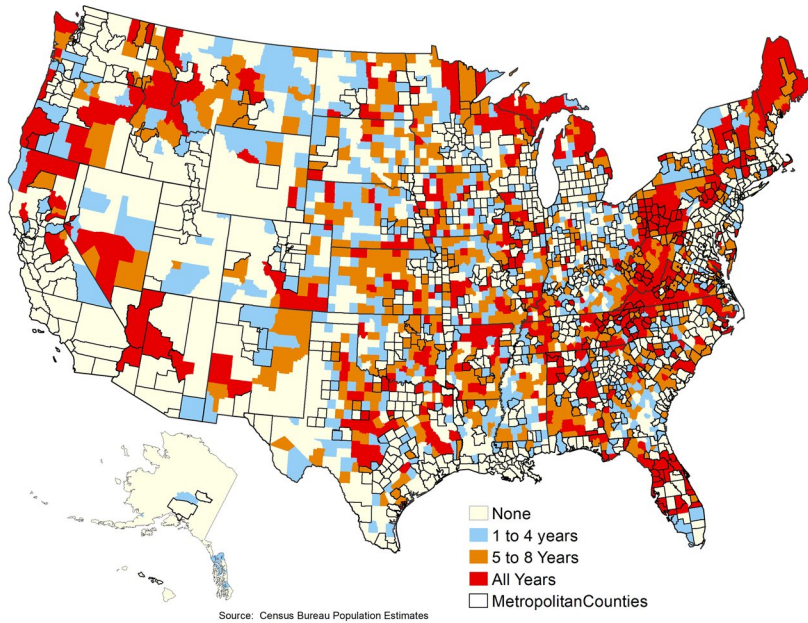*Note:* Data missing for three counties.

Figure 1. Years of Natural Decrease 2010 to 2019. [Colour figure can be viewed at wileyonlinelibrary.com]

noted, past research in the United States and Europe suggest that natural decrease is more common in sub-areas with larger proportions of older adults, fewer women of child-bearing age, and low fertility rates. There are other factors that influence the likelihood of natural decrease, but most are mediated by these three demographic factors. Here, we focus on these immediate demographic causes of natural decrease and examine their impact on the recent incidence of natural decrease.

There is a clear link between the proportion of the population over age 64 and natural decrease (Figure 2). Nearly 82 percent of counties with a low proportion of their residents age 65 or more had no instances of natural decrease between 2010 and 2019. In contrast, 45 percent of the counties with the highest proportion of older adults had natural decrease in every year from 2010 to 2019. Overall, there is a strong, positive, and statistically significant relationship between the proportion over age 64 and the incidence of natural decrease.

Counties with smaller proportion of women in their child-bearing years have a greater risk of protracted natural decrease. Only 2 percent of the counties with the largest proportions of women in their
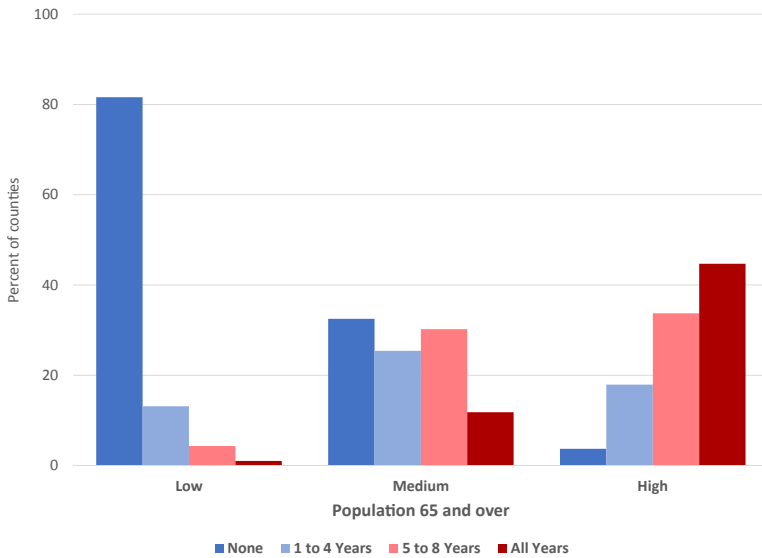
Figure 2. Years of Natural Decrease by Proportion 65 and over 2010 to 2019. [Colour figure can be viewed at wileyonlinelibrary.com]

child-bearing years had continuous natural decrease between 2010 and 2019 (Figure 3). In contrast, nearly 43 percent of the counties with the smallest proportions of women in their child-bearing years had continuous natural decrease. In general, there is a strong and statistically significant negative relationship between the proportion of women in their prime child-bearing years and natural decrease.

Counties with lower fertility rates are at a greater risk of natural decrease. Some 30 percent of the counties with the lowest fertility rates had continuous natural decrease compared to 10 percent of those with the highest fertility rates (Figure 4). However, the impact of fertility rates is modest. Some 44 percent of the counties with high fertility levels have continuous natural increase, but so do 37 percent of those with low fertility. As a result, fertility rates have only a modest negative relationship with natural decrease, though it is statistically significant.

The higher incidence of rural natural decrease in nonmetropolitan counties rests in part on differences in the distribution of metropolitan and nonmetropolitan counties on these three variables. Nearly half of all rural counties have a higher share of population over 65 compared to just 13 percent of the metropolitan counties (Table 2). Given the strong association between larger proportions of older adults and natural decrease, this disadvantages rural counties. Many nonmetropolitan
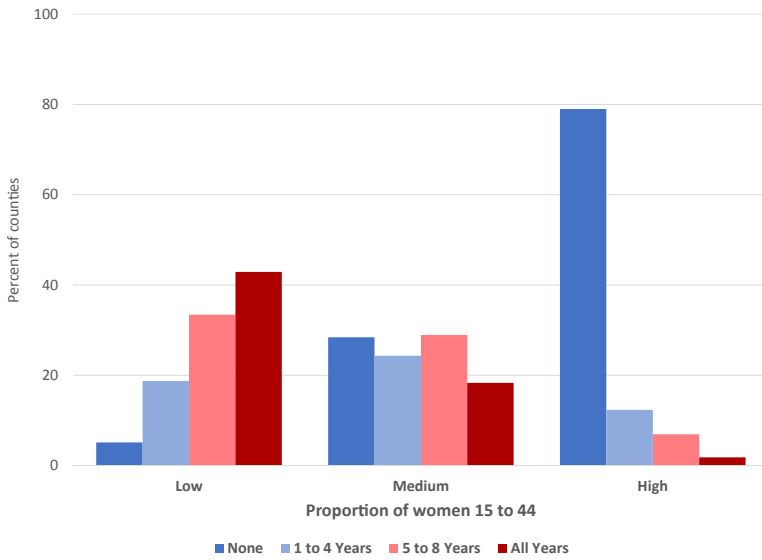
Figure 3. Years of Natural Decrease by Proportion of Women of Childbearing Age 2010 to 2019. [Colour figure can be viewed at wileyonlinelibrary.com]
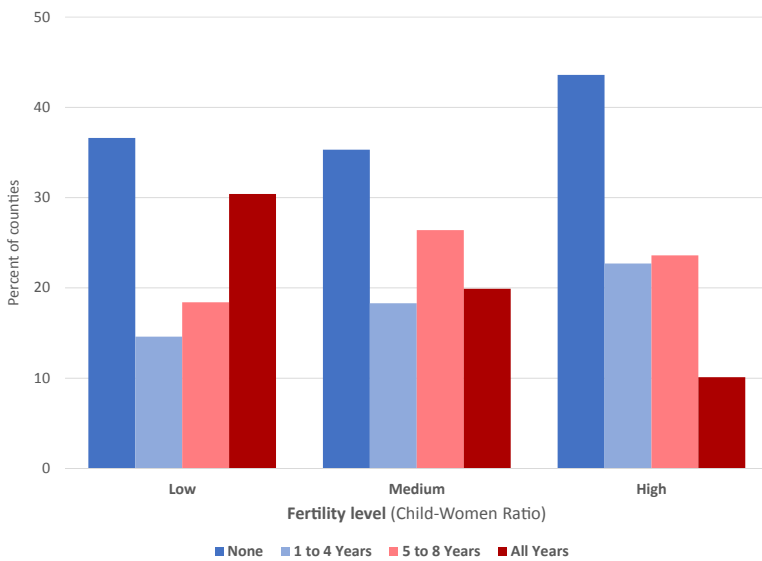

Figure 4. Years of Natural Decrease by Fertility Level 2010 to 2019. [Colour figure can be viewed at wileyonlinelibrary.com]

Table 2. Percent of Counties with Selected Demographic Characteristics by Metropolitan Status, 2010.

	Demographic Characteristic		
County Type	Low	Medium	High
Percent of population 65 and over			
Overall	33.1	31.8	35.1
Metropolitan	55.7	31.4	13.0
Nonmetropolitan	19.8	32.1	48.2
Percent of all women 15 to 44			
Overall	28.3	38.5	33.2
Metropolitan	10.3	33.7	56.0
Nonmetropolitan	39.0	41.2	19.8
Child age 0 to 4 per 1,000 women 15–44			
Overall	32.0	32.6	35.4
Metropolitan	46.7	35.6	17.7
Nonmetropolitan	23.3	30.9	45.8

Source: U.S. Census Bureau, Census of 2010.

counties also have relatively few women of child bearing age, which is also strongly associated with a higher incidence of natural decrease. Nearly 40 percent of the rural counties have relatively few women of child bearing age compared to just 10 percent of the metropolitan counties. These age-based differences that disadvantage rural counties may be partially offset by the higher proportion of nonmetropolitan counties that have higher fertility rates. Nearly 46 percent of the nonmetropolitan counties are in the highest fertility category compared to just 18 percent of the metropolitan counties. Thus, even though the proportion of child-bearing age women may be smaller in rural counties, they tend to have higher fertility rates. However, the association between fertility rates and natural decrease is only modest. Thus, the older age structure in rural America increases the mortality risks in these counties and reduces births by diminishing the number of women of childbearing age. This may be partially offset by higher rural fertility rates.

Analyses of the bivariate relationships document associations between each factor and natural decrease. However, these factors do not work in isolation from one another, nor are they unrelated. Past research suggests that low fertility in a population with a small proportion of women of childbearing age and a large proportion of older adults residing in nonmetropolitan counties maximizes the likelihood of natural decrease. To ascertain the effect of these four variables on recent natural decrease, a multivariate spatial regression model is used to estimate the dependent variable, which is the log of the birth/death ratio. A moderate spatial

autocorrelation (Moran's I –.42) necessitates a spatial error model (Anselin and Bera 1998).

As expected, there is a substantial bivariate correlation between each independent variables and the log of the birth/death ratio. The strongest correlations are with the percent of individuals over age 64 (–.79) and the proportion of women in their childbearing years (.69). The correlation between a dummy variable reflecting whether a county is nonmetropolitan or metropolitan and the log of the birth/death ratio is –.32 and that for the child-women ratio is .21.

The four variable multivariate model accounts for a substantial percent of the variation in the log of the birth/death ratio. The individual coefficients and their levels of statistical significance are reported in Table 3. The percent of the population age 65 and older exerts a substantial negative influence on the birth-death ratio; the higher the proportion of older adults in a county, the lower the birth-death ratio. The proportion of women in their child-bearing years is also influential. The lower the proportions of women of child-bearing age, the lower the logged birth/death ratio when other variables are held constant. The fertility rate also has a substantial impact on natural decrease. Holding other variables constant, lower fertility rates diminish the birth/death ratio, thus, increasing the likelihood of natural decrease. This finding suggests the fertility rate has more influence than evident in the bivariate

Table 3. Spatial Error Regression of Birth to Death Ratio (Logged) and Selected Variables for 2010 to 2019.

	Coefficient	Stand Error	Z-Value	Significance
Constant	−1.09190	.08589	−12.71	.000
Child-women ratio	.03166	.00127	24.83	.000
Over 65 percent	−.03798	.00164	−23.14	.000
Child-bearing age rate	.01978	.00070	28.22	.000
Nonmetropolitan dummy	−.04752	.00703	−6.76	.000
Lambda	.68309	.01721	39.70	.000
Pseudo R-square	.845			
Log likelihood	1,415			
Alaike	−2,819			
Schwarz	−2,789			

Note: Child-Women ratio = ((age under 5 / women 15–44) * 1,000) in 2010 Over 65 percent = ((population age 65 or more / total population) * 100) in 2010 Child-Bearing age ratio = ((Women 15–44 / Total women) * 1,000) in 2010. Nonmetropolitan Dummy coded 1 for nonmetropolitan county and 0 for metropolitan county Birth to death ratio 2010 to 2019 = (Log (births 2010 to 2019 / deaths 2010 to 2019)).

Source: U.S. Census Bureau Population Estimates 2010 to 2019.

analysis and underscores the importance of the multivariate analysis. Clearly, among counties with similar proportions of older adults and child-bearing age women, fertility rates have a significant impact on the ratio of births to deaths. Even when the three influential demographic variables are taken into account, being a nonmetropolitan county is still likely to result in a lower birth to death ratio.

In sum, the spatial regression model demonstrates that the three demographic variables (over-65 population, child-women ratio, and women of childbearing age) as well as nonmetropolitan status each exert a significant impact on the birth-death ratio. The models including these four variables, as well as the spatial error coefficient, do an excellent job of estimating the ratio of births to deaths in U.S. counties between 2010 and 2019.

Conclusion

Natural decrease is predominately a nonmetropolitan phenomenon. Of the 1,342 counties that experienced overall natural decrease between 2010 and 2019, 79 percent were nonmetropolitan. Rural America has an older population and fewer women of childbearing age than metropolitan areas. This increases the rural population at higher risk of mortality and reduces the population able to bear children. Nonmetropolitan counties do gain a modest advantage from higher fertility rates. But, the overall impact of these three critical demographic variables is to increase the incidence of nonmetropolitan natural decrease. With few young adults and a growing older population, the future viability of many rural natural decrease areas is not encouraging. Nonmetropolitan natural decrease has increased the incidence of rural depopulation, which now affects nearly 35 percent of all rural counties (Johnson and Lichter 2019). Natural decrease and the resulting depopulation also raises significant questions about the continuing viability of rural places because of its impact on the infrastructure serving rural communities (Thiede et al. 2017).

Natural decrease is the ultimate demographic consequence of population aging, low fertility, and a diminishing proportion of women of childbearing-age. Once natural decrease begins in a county, it is likely to reoccur. Current demographic trends increase the likelihood of future natural decrease in rural areas. The large baby boom cohorts now retiring will increase the number of older adults at high risk of mortality dramatically over the next several decades. Nonmetropolitan counties also continue to experience a net migration loss of young adults, which further reduces the population of child-bearing age adults (Johnson and Winkler 2015). This coupled with short-term factors, such as the

diminished fertility of the postrecession era and deaths of despair, have already produced a "perfect demographic storm" with the pandemic likely to fuel addition natural decrease in the near term.

The pandemic and its associated economic, social, and psychological impacts are too recent to be reflected in the demographic analysis presented here. However, the pandemic will have a significant impact on future natural decrease. Initially this will be reflected in rising mortality. Rural America was spared from much of the first wave of infections and deaths, but recently rural areas have experienced a disproportionately large share of new infections. This has serious consequences because the rural population is at higher risk since it is older and has more pre-existing health conditions. Should infection occur, the risk of hospital-ization and death is high in 32 percent of nonmetropolitan counties compared to just 7 percent of metropolitan counties (Johnson 2020b). As of mid-November, there have already been 250,000 COVID-19 deaths in the United States (Center for Disease Control and Prevention 2020), with the expectation of more by the end of the year. These COVID-19 death will likely increase the incidence of natural decrease in 2020 to 52 percent of all counties from 46 percent had the pandemic not occurred.[2] The implications for nonmetropolitan America are significant. In 2020, more people will likely die than be born in rural America for the first time in history and nearly 61 percent of nonmetropolitan counties are likely to have natural decrease. Nor is mortality the only demographic factor impacted by COVID-19. Beginning in 2021, fertility declines are likely from the economic, social, and psychological displacements caused by the pandemic. How large these fertility declines will be is unclear, but the Great Recession reduced births by 12 percent and the impact of the pandemic will likely rival or exceed this.

Natural decrease will continue in many rural areas and appear for the first time in others, but it is not a demographic certainty for all areas. Fertility declines associated with the Great Recession and its aftermath were greatest among younger women and it is unclear whether these births have been delayed or will be foregone. In the short term, there is little likelihood of an upturn in fertility in the shadow of the pandemic,

---

[2]The impact of COVID-19-related deaths on natural increase in 2020 is an estimate. It assumes that the number of births and non-COVID deaths in each U.S. country in 2020 will match recent Census Bureau estimates from July of 2018 to July of 2019. Estimated COVID-19 deaths in 2020 were then added by combining reported COVID deaths from January to October 15, 2020 with estimated deaths from October 15 to December 31, assuming deaths for the later period equal those from August 1 to October 15. This is a conservative esti-mate because it does not include the surge in COVID-19 deaths after October 15, 2020 nor the so called "excess deaths" from delayed or foregone treatment for other conditions (Center for Disease Control and Prevention 2020).

but many women who have yet to have children are still in their child-bearing years. Immigration has also reversed the incidence of natural decrease in some rural counties and diminished its likelihood in others (Lichter et al. 2012). A near term uptick in immigration appears unlikely, but over the longer term labor force shortages may stimulate it. Predicting the demographic future is always perilous, doing so in an era of economic turbulence with the rapidly unfolding COVID-19 pandemic adds additional uncertainty. Yet, there is little doubt natural decrease will be a significant element of the nation's demographic future, both in nonmetropolitan and metropolitan counties.

References

Anselin, Lou and Anil K. Bera. 1998. "Spatial Dependence in Linear Regression Models with an Introduction to Spatial Econometrics." Pp. 237–89 in *Handbook of Applied Economic Statistics*, edited by A. Ullah and D. A. Giles. New York: Marcel Dekker.

Beale, Calvin. 1964. "Rural Depopulation in the United States: Some Demographic Consequences of Agricultural Adjustments." *Demography* 1(1):264–72.

Beale, Calvin L. 1969. "Natural Decrease of Population: The Current and Prospective Status of an Emergent American Phenomenon." *Demography* 6(2):91–99.

Center for Disease Control and Prevention. 2020. "Excess Deaths Associated with COVID-19 by Age and Race and Ethnicity-United States." *Mortality and Morbidity Weekly Report* 69:1522–27. Retrieved October 20, 2020 (http://dx.doi.org/10.15585/mmwr.mm6942e2).

Cromartie, John. 2017. *Recent Population Change*. Retrieved April 4, 2018 (https://www.ers.usda.gov/topics/rural-economy-population/population-migration/recent-population-change/).

Dorn, Harold F. 1939. "The Natural Decrease of Population in Certain American Communities." *Journal of the American Statistical Association* 34(205):106–09.

Fuguitt, Glenn V., David L. Brown, and Calvin L. Beale. 1989. *Rural and Small Town America*. New York: Russel Sage Foundation.

Johnson, Kenneth M. 2011. "The Continuing Incidence of Natural Decrease in American Counties." *Rural Sociology* 76(1):74–100.

———. 2020a. "Subnational Non-Hispanic White Natural Decrease in the United States." *Population and Development Review* 46(1):7–31.

———. 2020b. "Health Conditions and an Older Population Increase COVID-19 Risks in Rural America." *Carsey Research National Issue Brief*. Durham, N.H. Carsey School of Public Policy. University of New Hampshire. Retrieved October 1, 2020 (https://scholars.unh.edu/cgi/viewcontent.cgi?article=1415&context=carsey).

Johnson, Kenneth M. and Daniel T. Lichter. 2019. "Rural Depopulation: Growth and Decline Processes over the Past Century." *Rural Sociology* 84(1):3–27.

Johnson, Kenneth M., Layton Field, and Dudley L. Poston, Jr. 2015. "More Deaths than Births: Subnational Natural Decrease in Europe and the United States." *Population and Development Review* 41(1):651–68.

Johnson, Kenneth M. and Richelle Winkler. 2015. "Migration Signatures across the Decades: Net Migration by Age in U.S. Counties, 1950–2010." *Demographic Research* 22(38):1065–80.

Lichter, Daniel T., Kenneth M. Johnson, Richard T. Turner, and Allison Churilla. 2012. "Immigrant Assimilation and Fertility in New Hispanic Destinations." *International Migration Review* 46(4):767–91.

Morrill, Richard L. 1995. "Aging in Place, Age Specific Migration and Natural Decrease." *Annals of Regional Science* 29(1):41–66.

National Center for Health Statistics. 2019. "Births in the United States, 2018." *National Center for Health Statistics Data Brief*. 346. Retrieved December 1, 2019 (https://www.cdc.gov/nchs/products/databriefs/db346.htm).

Saenz, Rogelio and Kenneth M. Johnson. 2018. "White Deaths Exceed Births in a Majority of U.S. States." *Census Data Brief*. Madison, WI: Applied Population Lab. University of Wisconsin. Retrieved July 1, 2019 (https://apl.wisc.edu/data-briefs/natural-decrease-18/).

Thiede, Brian, David L. Brown, Scott R. Sanders, Nina Glasgow, and Laszlo J. Kulcsar. 2017. "A Demographic Deficit? Local Population Aging and Access to Services in Rural America, 1990–2010." *Rural Sociology* 83(1):44–74.

U.S. Census Bureau. 2020. *County Population Totals and Components of Change 2010–2019*. Retrieved April 1, 2020 (https://www.census.gov/data/tables/time-series/demo/popest/2010s-counties-total.html).