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Changes to Rural Migration in the COVID-19 Pandemic☆

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Abstract Media stories highlighted accounts of migration away from city centers towards more rural destinations during the COVID-19 pandemic, but systematic research about how the pandemic changed migration in more rural destinations is only starting to emerge. This paper relies on U.S. Postal Service change-of-address data to describe whether and how established domestic migration systems changed during the COVID-19 pandemic, focusing on differences across the rural–urban gradient and by outdoor recreation resources. We find little evidence of massive urban exodus. We do find that out-migration from rural counties declined post-pandemic onset and has stayed low in the 3 years since, stemming the tide of net population loss in many rural places. Most rural counties that experienced net population loss prior to the pandemic saw either less net loss or net gains during the pandemic. Rural recreation counties experienced greater gains through both decreased out-migration and increased in-migration in the first year of the pandemic; but by year three, differences between rural recreation and non-recreation counties had balanced. Overall, counties across Rural America saw notable change to pre-pandemic migration patterns. This shift may benefit rural areas through long-term population stability and/or growth but might also exacerbate housing and childcare shortages.

Introduction

The COVID-19 global pandemic dramatically altered the day-to-day routines of most Americans. As they confronted the realities of an unprecedented national public health and economic crisis, many experienced changes in circumstances or priorities that may have impacted migration decisions, including job changes, remote work, virtual schooling, increased desire for physical space or outdoor recreation, and more. In short, the COVID-19 pandemic may have changed the push–pull migration logic for many households. Jobs and cultural opportunities in major urban centers lose their attractive qualities under conditions of remote work and social distancing, while

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high rents and population densities (and their associated viral risk) may have pushed urban dwellers out to more rural spaces.

Stories and early evidence from the beginning of the pandemic indicated that this may well have been the case. A Gallup poll from late 2020 suggested that Americans' desire to live in rural communities increased substantially in 2020 (Saad 2021), and popular media stories told of migration away from city centers towards more rural and outdoor recreation destinations (Dorsey 2020; Elder-Connors 2020; Fisher, Schwartzman, and Weissenbach 2020). Such stories have been a source of hope for many rural communities wishing to stem tides of population loss (Dobis et al. 2021; Johnson 2022) and decades-long youth out-migration (Dobis et al. 2021; Johnson and Winkler 2015). In other rural communities already considered hotspots for in-migration and second homes, especially those in the mountain West, these stories have fueled further concern about the skyrocketing housing prices, gentrification, and sprawl commonly associated with arrival of in-migrants (Glorioso and Moss 2007; Golding 2014, 2016; Pilgeram 2021; Rein 2020; "Why Americans are Rethinking where they want to Live" 2021).

Systematic research analyzing the extent of changes to migration patterns during the pandemic has only recently emerged. Initial studies show that some high-cost city centers did experience greater out-migration and slowed in-migration (Ramani and Bloom 2021; Whitaker 2021). Less is known about how migration to and from rural and outdoor recreation destinations changed over the course of the pandemic and fared overall.

The purpose of this paper is to describe pandemic-related changes to established domestic migration patterns across Rural America, focusing on spatial heterogeneity across the rural–urban gradient, differences according to outdoor recreation classification, and regional variation. We do this with monthly United States Postal Service (USPS) change-of-address data over a six-year time period from April 2017 to March 2023, comparing migration patterns in the 3 years prior to the start of widespread pandemic restrictions to the 3 years since. Specifically, we address the following research questions:

RQ1: How did county-level domestic migration patterns (i.e., in-, out-, and net migration) change in the 3 years following the onset of the COVID-19 pandemic in comparison to the 3 years prior?

RQ2: How did changes to migration vary across space (along the rural–urban gradient and by county outdoor recreation typology)?

Migration across the Rural–Urban Gradient and to Recreation Destinations

Migration is central to population change and prosperity in rural places (Schwarzweller 1979). Since the 1950s, Rural America has mostly experienced net out-migration, with the most rural, remote, and agricultural counties undergoing the most population loss (Golding and Winkler 2020; Johnson and Stewart 2005). In some decades (especially the 1970s and to a lesser extent the 1990s) rural counties fared better, attracting families with children and older people at retirement ages (Johnson and Stewart 2005; Johnson and Winkler 2015). Still, the overarching story for much of Rural America has been one of out-migration of young people (Plane, Henrie, and Perry 2005).

Despite this pattern, Rural America is diverse, and some less populated rural places tend to attract migrants. This has been particularly true in recent decades, as urban city centers have generally experienced net out-migration to suburbs and less populated exurban peripheries (Golding and Winkler 2020; Johnson and Winkler 2015; Plane et al. 2005). More rural counties with access to arts (Wojan, Lambert, and McGranahan 2007); employment that attracts immigrants or Hispanic diaspora (Johnson and Lichter 2019; Lichter and Johnson 2020); or availability of and access to natural amenities and/or outdoor recreation (Beale and Johnson 1998; Chi and Marcouiller 2013; McGranahan 1999) have disproportionately attracted migrants for decades.

Over the past 50 years, associations between migration and recreation opportunities and/or natural amenities have been remarkably consistent (McGranahan 1999; Rickman and Guettabi 2015; Ulrich-Schad 2015). Migration gains in recreation counties from 1970 to 2000 were 2.5 times that of other nonmetro counties (Johnson and Beale 2002). Rural areas with natural amenities have experienced higher levels of population and economic growth (Deller et al. 2001; McGranahan 1999) and in-migration (Golding 2016) in comparison to other nonmetropolitan counties. These patterns correspond with a sustained expansion of outdoor recreation participation by Americans over the last few decades (White et al. 2016).

The onset of COVID-19 may have further increased the importance of outdoor recreation. Across urban and rural settings, outdoor recreation participation increased during the height of the pandemic, reflecting the limited availability of other leisure activities and the mental and physical health benefits of outdoor recreation during a time of crisis (Heckert and Bristowe 2021; Morse et al. 2020; Taff et al. 2021). Moving to a recreation destination may have become more feasible during the pandemic given the lifestyle and financial changes Americans faced in job loss/departure, education, and remote work opportunities (Brynjolfsson et al. 2020; Delventhal and Parkhomenko 2022). For many, moving to a recreation destination is both a choice of where to live and *how* to live (Hoey 2005). If the COVID-19 pandemic made people rethink where and how they want to live, it may well be that Americans identified rural places with recreational opportunities as particularly attractive.

Migration Systems and the COVID-19 Pandemic

This study is based in the logic of migration systems theory: places have fairly stable patterns of in- and out-migration flows that are related to a complex and unique configuration of labor market conditions, social networks, and political, economic, social, and environmental factors in those places and the places with which they interact (Bakewell 2014; DeWaard, Curtis, and Fussell 2016; Fussell, Curtis, and DeWaard 2014). Economic and environmental shocks have been shown to disrupt these systems, at least temporarily (Curran, Meijer-Irons, and Garip 2016; Fussell et al. 2014; Hansen, Lyngemark, and Weatherall 2021). From a theoretical standpoint, the COVID-19 pandemic played out as an economic shock *and* a public health disaster with potential to alter migration systems. Following this logic, this study is designed around *within-county comparison*, looking for changes to county migration systems post-pandemic onset relative to the months and years leading up to the pandemic.

In doing so, we focus on migration flows (inflows and outflows), rather than simply changes in net migration. Most research documenting changes to county migration patterns relies on measures of net migration, largely because of data availability. For example, the U.S. Census Bureau's Population Estimates Program produces high quality annual estimates of county-level net migration. Yet, some people move in and others move out. A county's increase over time in net migration may be due to growing in-migration, slowing out-migration, or both. Net migration measures also disguise population turnover: a county might have a net migration rate of 5 per 10,000 either as a result of little population turnover (i.e., 10 people moving in and 5 people moving out), or as a result of a great deal of turnover (i.e., 10,000 people moving in and 5,000 people moving out). Such nuances have very different impacts on communities and implications for policy response and community development, so much so that Rogers (1990) calls for a "Requiem for the Net Migrant" (Rogers 1990). It is critical to consider migration flows (inflows and outflows) to gain any understanding of the system driving migration changes (Bakewell 2014; DeWaard, Kim, and Raymer 2012).

Prior to the onset of the COVID-19 pandemic, U.S. migration was already at historically low rates (Frey 2020; Frost 2020). Emerging research suggests that during the pandemic this slowing pattern continued, with Americans moving even less in the months after the pandemic's onset than in the years prior (Frey 2021; Fry and Cohn 2021; Haslag and Weagley 2021; Patino 2020). Whitaker's (2021) review of Consumer Credit Panel data finds that while urban neighborhoods saw increased out-migration in 2020, lack of in-migration had a bigger impact on urban centers, suggesting that Americans who would have otherwise moved into cities remained in place. Among those who did move, pandemic migration patterns appeared to largely match pre-pandemic patterns, continuing the trend of migrants leaving large, dense areas for less dense, smaller locales and/or moving to the warmth of the South or Southwest (Kolko, Badger, and Bui 2021; "Why Americans are Rethinking where they want to Live" 2021; Willett and Mowell 2021).

However, survey data suggests that the pandemic did influence migration decisions. In a June 2020 survey, Pew Research Center found that 3 percent of all survey respondents and 9 percent of those ages 18–29 had moved either temporarily or permanently due to reasons related to the pandemic (Cohn 2020). Haslag and Weagley's (2021) study further analyzes the drivers of individuals' moves post-pandemic onset. Using proprietary data and survey responses of 300,000 residential and interstate movers over 4 years, including months impacted by the pandemic (April 2020 through May of 2021), they find that one in six movers cited the influence of the pandemic in their decision to move; less moved for reasons of employment and more for family or lifestyle; and the ability to work remotely factored highly in decision-making. Movers perceived or knew their destinations to have less COVID-19 cases, less pandemic-related restrictions, lower density, and lower rents (Haslag and Weagley 2021). This suggests that pandemic-related factors did play a role in some movers' decisions to migrate after March 2020.

Thus far, most pandemic-related migration studies have investigated metropolitan areas, examining exodus from large metropolises or whether city-dwellers fled from COVID-19 restrictions. Two studies, however, specifically examine the impact of the COVID-19 pandemic on migration into and out of Rural America. Dimke, Lee, and Bayham (2021) use anonymized mobile device location data gathered from January 2019 to September 2020 to show population declines in urban centers and increases of people in rural areas, especially those with high recreational amenities in the Northeast, Upper Midwest, and the West. Chiumenti (2021) explores the New England region using April 2020 to February 2021 USPS change-of-address data, finding that urban areas across all New England states experienced a net out-migration of households in the first year of the pandemic, and rural communities experienced net in-migration, especially those in "high-commuting rural communities" with strong connections to urban areas. Low-density (<500 people per square mile) areas gained while high-density (>1,000 people per square mile) areas lost households, and areas with the greatest shares of seasonal homes saw the greatest increases in net migration (Chiumenti 2021).

This paper builds on these initial studies, examining changes to migration patterns within counties for 3 years after the onset of widespread COVID-19 restrictions. We extend prior regional and case study work to examine all counties in the contiguous United States, placing a unique emphasis on Rural America while recognizing the continuum of rurality. Our within-county design with controls for seasonality offers a more cautious analysis, which is important given the relatively new and unproven data source that we use. Finally, this study examines whether any initial pandemic impacts to within-county migration systems have been sustained over 3 years' time or were instead short-term migration responses.

Data and Methods

Analytical Approach

To measure changes to established county-specific migration patterns, we employ time series models with county and time fixed effects, examining differences in migration over time within counties. Taking this approach effectively holds constant a myriad of county-specific factors that could otherwise explain observed migration differences. The data are a panel where county-months are the unit of analysis, with observations of in-migration, out-migration, and net migration for 3,097 counties in the contiguous United States monthly between April 2017 and March 2023. This totals to 222,984 county-month observations ($n=3{,}097$ counties times 72 months). Variables and data sources are listed in Table 1 and explained in more detail in the text that follows.

First, we run fixed effects models with a regime to study differences along the rural–urban gradient (RUG). In other words, we run the model separately for each RUG classification so that we can detect differences by level of rurality, constituting a spatial regime approach (Anselin 1988; Chasco 2013). Then, we run the same fixed effects models for rural counties now with a regime to study differences between Recreation (Rec) and non-Recreation (non-Rec) counties.[1] This approach allows us to address both of our research questions: (1) testing for changes within

[1]As a sensitivity test, we ran an alternative random effects model specification testing differences in Recreation vs Non-Recreation counties, considering between-county and within-county effects. Results were nearly identical. We present the fixed effects results here because this model better protects against the omitted variable bias.

Table 1. Variable Names and Data Details

Variable Name	Measure	Source	Time Period
In-migration rate (IMR)	Estimate of migrants into the county per 10,000 residents	U.S. Postal Service change-of-address forms. Divided by U.S. Census Bureau population estimates	Monthly April 2017–March 2023
Out-migration rate (OMR)	Estimate of migrants out of the county per 10,000 residents	U.S. Postal Service change-of-address forms. Divided by the U.S. Census Bureau population estimates	Monthly April 2017–March 2023
Net migration rate (NMR)	IMR–OMR	U.S. Postal Service change-of-address forms. Divided by U.S. Census Bureau population estimates	Monthly April 2017–March 2023
Population	Total county population	U.S. Census Bureau population estimates program, extrapolated from annual July 1 estimates	Monthly April 2017–March 2023
Month	Calendar month		Monthly April 2017–March 2023
Year	April–March year		April 2017–March 2018 through April 2022–March 2023
RUG	Rural–urban gradient. A measure of rurality along a continuum, with 8 classes recognizing population density, commuting patterns, and proximity to urban centers	Golding and Winkler (2020)	Time invariant. Based on 2013 USDA ERS rural–urban continuum codes
Rural	Dichotomous measure of rural versus urban, such that “Rural” includes the following RUG classes: Small metro, exurban, metro-adjacent rural, micropolitan, and remote rural	Author defined	Time invariant. Based on 2013 USDA ERS rural–urban continuum codes
Rec	Recreation counties, measured as dichotomous (0/1), based on the percent of homes for seasonal or recreational use and earnings from tourism-related industry or real estate	USDA ERS typology codes	Time invariant. 2015 edition, last updated 5/31/2017
△NMR	Change in the NMR (post-pandemic vs. pre-pandemic). Shown in maps	Author calculations based on the U.S. Postal Service change-of-address data	April 2020–March 2023 versus April 2017–March 2020
△IMR	Change in IMR (post-pandemic vs. pre-pandemic). Shown in maps	Author calculations based on the U.S. Postal Service change-of-address data	April 2020–March 2023 versus April 2017–March 2020
△OMR	Change in OMR (post-pandemic vs. pre-pandemic). Shown in maps	Author calculations based on the U.S. Postal Service change-of-address data	April 2020–March 2023 versus April 2017–March 2020

counties to the established migration system post-onset of COVID-19 restrictions (with the county fixed effects), and (2) testing for differences across space along the rural–urban continuum and by Recreation status (with the RUG and Rec regimes).

The models estimate within-county changes to monthly migration (DVs = in-migration rates (IMR), out-migration rates (OMR), and net migration rates (NMR)) using Stata statistical software and the xtreg command with the "fe" suffix. Controls for total population and for seasonality (i.e., month, as more change-of-address forms are filed in summer months) are included. Because we expect differences in migration in pandemic years relative to the years prior, the key predictor variable of interest is the year. We created a categorical "year" variable that aligns with the onset of COVID-19 restrictions in the United States. Year is designated as April 2017–March 2018 (2017/18, comparison year), April 2018–March 2019 (2018/19), April 2019–March 2020 (2019/20), April 2020–March 2021 (2020/21, pandemic year 1), April 2021–March 2022 (2021/22, pandemic year 2), and April 2022–March 2023 (2022/23, pandemic year 3). Specifying both year and month as explanatory variables introduces a time fixed effect as well as a county fixed effect.

The effects of COVID-19 hit the United States in different regions in different months. By March 2020, all areas of the country experienced some effects, and various restrictions were initiated. The data show a slight downturn in migration starting in March 2020 and a bigger drop in April 2020. We chose to define the "pandemic year" as beginning in April 2020 to evenly balance our data into six, 12-month increments. This means the early impact of the pandemic may begin to affect migration estimates starting late in the 2019/20 year, but we would expect to see the greatest impacts in year 2020/21 and beyond.

Equation:

$$y_{it} = \beta_0 + \beta_i x_{it} + u_i + \epsilon_{it}$$

where, y_{it} is the outcome value of IMR, OMR, or NMR for county i at month t. β_0 is a constant. β_i is a column vector $[k \times 1]$ of regression coefficients for the k regression variables. x_{it} is a row vector of size k containing the values of all predictor variables (year, month, population) for county i at month t. u_i is the county fixed effect, effectively capturing any time invariant factors that may explain y_i. ϵ_{it} is the residual error for county i at month t, capturing the unexplained portion of the outcome variable including the effects of any nontime-invariant omitted variables.

Finally, we map geographic patterns and examine spatial clustering metrics to explore spatial patterns in changes to migration systems. Because of potential anomalies and the challenges posed for spatial analysis, data for Puerto Rico, Alaska, and Hawaii are excluded. Altogether the analytical approach allows us to present findings that capture both within-county temporal changes and across-county spatial changes.

Migration Data: U.S. Postal Service Change-of-Address Forms

We measure migration using USPS change-of-address data (USPS FOIA Library 2017, 2018, 2019, 2020, 2021, 2022, 2023). These data are based on individuals or families filing temporary or permanent USPS request forms for address change. Beginning in March 2021, monthly change-of-address data dating back to April 2017 were made publicly available. These data show the number of change-of-address forms filed that indicate temporary and permanent relocation into (inflows) and out-of (outflows) ZIP codes by month (USPS FOIA Response 2022). They are the most "real-time," publicly available data through which to examine post-pandemic onset migration at finer geographic scales (Chiumenti 2021; Frost 2021; Ramani and Bloom 2021).

USPS change-of-address data are administrative records that are not collected with the purpose of measuring migration. This presents challenges related to how data are organized, aggregated, categorized, and suppressed that we must address with assumptions (see Appendix A for a detailed explanation of assumptions and data processing). One challenge is that raw data include the number of change-of-address forms processed, rather than the number of people they represent. There are two types of forms, one for individuals and another for families. We assume individual forms represent one migrant. Because the goal is to estimate the total number of individual inflow migrants and outflow migrants for each ZIP code by month, we assume that each family change-of-address form represents 3.14 people. This assumption is based on the average U.S. mean family size of 3.14 during our study years of 2017 to 2021 (U.S. Census Bureau 2017, 2018, 2019, 2020, 2021) and aligns with the approach used in a similar study of migration using change-of-address forms (Ramani and Bloom 2021). It is possible that migrant household sizes are different than non-migrants, and that there could be rural–urban differentials in migrant household size such that rural–urban migrants are younger with smaller households than urban–rural migrants with larger households. For this reason, we tested the sensitivity of this assumption by (1) running an alternative model set (not shown here) assuming family forms represent 2.14 people versus 3.14 (preferred), and (2) running an alternative model set (shown in Appendix B, Table B1) at the household level rather than estimating individual migrants, using the number of total forms filed (individual plus family). Neither of these changed the interpretation of our results.

The phenomenon of interest for this study is permanent migrations, in comparison to temporary migrations to a vacation home or alternative location, without intention for long term relocation. For this reason, we exclude temporary change-of-address forms (filed for moves of 6 months or less) from the analysis, focusing on permanent moves only. We aggregate ZIP code level inflow and outflow data to the county-level using the U.S. Department of Housing and Urban Development's (HUD) ZIP code crosswalk file for quarter 3 of 2021 (U.S. HUD 2022). This crosswalk relates U.S. Postal Service ZIP codes to county geographies using an allocation method based on residential addresses rather than by area or by population (U.S. HUD 2022). Where ZIP codes straddle more than one county, we use the HUD crosswalk's "residential ratio" to distribute straddling ZIP codes' data appropriately within each county (Wilson and Din 2018).

To protect confidentiality, the USPS suppresses monthly data for ZIP codes where fewer than 11 change-of-address forms are filed in that month (USPS FOIA Library 2017, 2018, 2019, 2020, 2021, 2022, 2023). To address data suppression, we conduct conditional mean imputation for each county-month missing inflow and/or outflow values.

We assume that each missing value equals that county's average monthly in- or out-migration count, respectively. Given that we seek to examine differences in migration over time within counties in relation to the pandemic, we calculate the means for imputation separately for pre-pandemic (April 2017–March 2020) and post-pandemic onset (April 2020–March 2023) time periods. This imputation replaces 5,324 missing out-migration values and 6,243 missing in-migration values. After imputation, 11 counties remain with either no observed in-migration or no observed out-migration values across all county-months. These counties are excluded from analysis: Petroleum County, MT; Grant County, NE; Hooker County, NE; Keya Paha County, NE; Esmeralda County, NV; Sherman County, OR; Jones County, SD; Mellette County, SD; Kenedy County, TX; Loving County, TX; and Piute County, UT. While suppression reduces the accuracy of this dataset, our own sensitivity analyses[2] as well as Ramani and Bloom's (2021) indicate that substantive results are not sensitive to imputation bias.

Still, we expect that these data underestimate total migration. The data miss any moves where individuals or families do not file a change-of-address form. This means they are more likely to capture internal migration than immigration or emigration. We assume that we are estimating only domestic migration in this study. This also means that hard-to-count population subgroups are likely missing from this data, including young children, undocumented immigrants, and young adults leaving their parental home (Chiumenti 2021; Frost 2021; Kolko et al. 2021). For example, we see the impact of these imperfections when analyzing data for counties with relatively large college student populations, as college students are unlikely to file change-of-address forms when they first enroll in a university away from their parents' home (i.e., the inflow to the university county is undetected), but they are likely to file a change-of-address form when they graduate and move away (i.e., outflow from university county is detected).

A further complication is that the data include all requests for change-of-address whether they are to a new address within the same ZIP code or to a new ZIP code. This means measures of in-migration and out-migration shown in this paper will include moves within the county as well as moves between counties. Thus, net migration measures are better indicators of the net balance of inter-county migration because moves in and out within the same county will cancel one another.

While the USPS data are imperfect migration estimates, they are generally consistent with migration measures from other, more established data sources, including the U.S. Census Bureau's Population Estimates Program's (PEP) domestic net migration estimates (Chiumenti 2021). To test this, we aggregated our monthly USPS change-of-address data to match annual PEP domestic net migration estimates and found they correlated strongly (average $r=.74$ across PEP vintage 2018–2022) (U.S. Census Bureau 2023a, 2023b). Still, because of these limitations, we are careful to design this study to compare changes in migration over time *within* counties rather than making claims about the level of migration at any point in time. We reason that

[2]We ran the models with no imputation, dropping any missing cells from analysis. This primarily impacted counties classified as "Remote Rural," which dropped from 59,184 county-month observations to 55,582 observations with no imputation. Still, this resulted in very little numerical change to any estimate and no changes to the interpretation of results.

data flaws are mostly similar within counties over time (i.e., counties with a university presence will underestimate in-migration), and we have no reason to believe that there was any change in measurement quality during the study period. The U.S. Postal Service is a federal agency that follows federal guidelines, so there should not be differential effects of the pandemic on how they do business or how they collect change-of-address forms. All things considered, we believe that USPS change-of-address data are accurate enough to detect temporal and spatial changes to the migration system that may have resulted from the economic and public health shocks of the COVID-19 pandemic.

Population Data and Migration Rates

Estimates of total population by county-month are included as a control in the models and are also used to calculate net migration rates. We start with annual population estimates from the U.S. Census Bureau's Population Estimates Program (PEP) (U.S. Census Bureau 2023a, 2023b). These data estimate county populations for July 1 of each calendar year, and we use the values directly for July months. To estimate monthly populations between August and June of each year, we use linear interpolation. The most recent PEP estimate is from July 2022, meaning there is no end date by which to interpolate monthly populations since then. So, we linearly extrapolate population change after July 2022 based on each county's median rate of annual population change 2017–2022.

Because rates are better measures to examine migration's proportional impact on rural places, we calculate in- (IMR), out- (OMR), and net migration rates (NMR) by dividing monthly in-, out-, and net flow estimates by our interpolated monthly population estimates for each respective county. To describe migration change within counties over time, we generated change variables (ΔIMR, ΔOMR, ΔNMR) comparing each county's average migration rate in the 3 years after the pandemic onset with its average migration rate in the 3 years prior. More specifically, we sum each county's monthly in-, out-, and net flow data by each study year (April 2017–March 2018, April 2018–March 2019, April 2019–March 2020, April 2020–March 2021, April 2021–March 2022, and April 2022–March 2023). We then calculate migration rates by dividing these migration estimates by each county's annual population for each study year and multiplying by 10,000. This results in annual migration rates per 10,000 residents, which we then average across the first 3 years and the last 3 years. The change variable subtracts each county's average annual migration rate in the pandemic years ($y=4, 5, 6$) from its average annual migration rate in the 3 years prior to the pandemic ($y=1, 2, 3$). We use this variable to compare migration changes across the RUG (Figure 2) and for mapping spatial differences (Figures 4 and 5) to address Research Question 2.

$$\Delta \mathrm{IMR} = \left(\left(\mathrm{IMR}_{(y4)} + \mathrm{IMR}_{(y5)} + \mathrm{IMR}_{(y6)} \right) / 3 \right) - \left(\left(\mathrm{IMR}_{(y1)} + \mathrm{IMR}_{(y2)} + \mathrm{IMR}_{(y3)} \right) / 3 \right)$$
$$\Delta \mathrm{OMR} = \left(\left(\mathrm{OMR}_{(y4)} + \mathrm{OMR}_{(y5)} + \mathrm{OMR}_{(y6)} \right) / 3 \right) - \left(\left(\mathrm{OMR}_{(y1)} + \mathrm{OMR}_{(y2)} + \mathrm{OMR}_{(y3)} \right) / 3 \right)$$
$$\Delta \mathrm{NMR} = \left(\left(\mathrm{NMR}_{(y4)} + \mathrm{NMR}_{(y5)} + \mathrm{NMR}_{(y6)} \right) / 3 \right) - \left(\left(\mathrm{NMR}_{(y1)} + \mathrm{NMR}_{(y2)} + \mathrm{NMR}_{(y3)} \right) / 3 \right)$$

Rural–Urban Gradient

To measure dimensions of rurality/urbanity, we rely on a modified version of the Rural–Urban Continuum Codes (RUCC; USDA Economic Research Service 2020) called the Rural–Urban Gradient (RUG), which was introduced by Golding and Winkler (2020). Unlike the RUCC, the RUG effectively distinguishes central city core counties in major metropolitan areas from their suburbs and exurbs (Golding and Winkler 2020). The RUG classifies as Exurban those counties that are within Metropolitan Statistical Areas (MSAs), but that lie at the outskirts of Metro areas and that have only recently been reclassified from Nonmetro to Metro. Separating central city, suburban, and exurban areas of MSAs is essential, because MSAs contain places as different as high-density urban cores of large cities and rural farmland over an hour's drive from such urban cores. RUG classes are consistent over time, and so counties are not subject to reclassification over the period of study.

To make broader rural–urban comparisons, we sometimes group RUG classes into a simplified dichotomous measure of rurality. To do so, we categorize counties in RUG classes Small Metro, Exurban, Metro-Adjacent Rural, Micropolitan, and Remote Rural as "Rural" and counties classified in the RUG as Major Metro Core, Major Metro Suburb, and Mid-Sized Metro as "Urban".

Outdoor Recreation

We indicate counties with substantial opportunities for outdoor recreation (Recreation Counties) following the USDA Economic Research Service's County Typology Codes, 2015 edition (USDA Economic Research Service 2019a). Recreation counties are defined based on the percentage of homes that are for seasonal or recreational use as well as economic base activities in tourism- and recreation-associated activities and in real-estate (USDA Economic Research Service 2019b). As such, they capture places that have a certain amount of infrastructure associated with servicing recreational activities. In total, there are 333 recreation counties, 229 of which are non-metro by USDA classification (USDA Economic Research Service 2019b). Recreation counties are well dispersed across regions of the country.

Results

The central tasks are to investigate changes in migration during the COVID-19 pandemic in comparison to counties' established migration systems pre-pandemic (RQ1) and to compare those changes across space along a rural–urban gradient and by recreation status (RQ2). Descriptive findings show a marked decline in migration in the months following the onset of the pandemic, a decline that has continued through March 2023 (Figure 1). On average, rural counties' in- and out- migration rates dropped markedly with the onset of the pandemic (between 2019/20 and 2020/21). In that first year of the pandemic, out-migration rates dropped particularly fast in the typical rural county, reducing the gap between out-migration and in-migration, such that the typical county approached zero net migration. In the first year of the pandemic, 2,185 of 2,461 rural counties (89 percent) experienced a decline in out-migration (OMR) compared to their

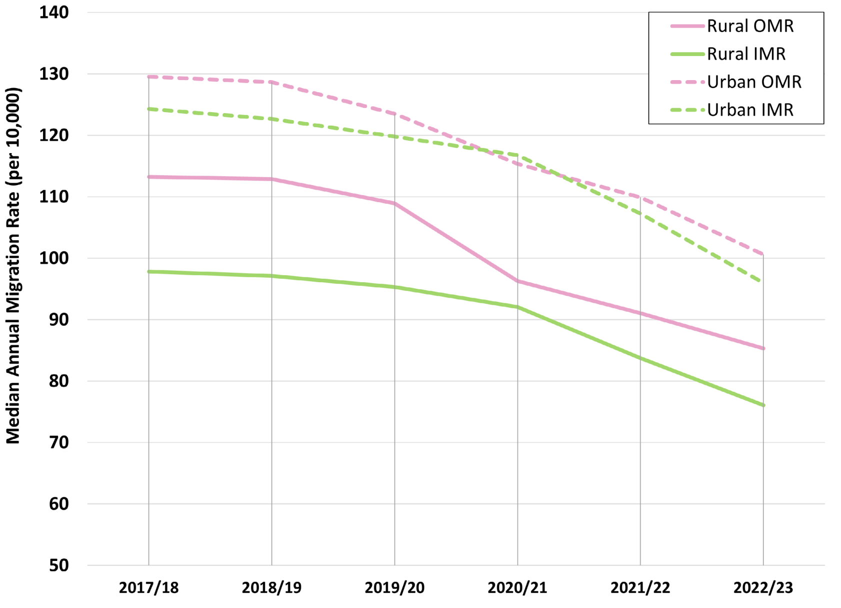

Figure 1. Change in the In-Migration Rate and Out-Migration Rate by Rurality. Change from April 2017 to March 2023 in median in-migration rates and out-migration rates, per 10,000. Values to the right of 2019/20 vertical gray line represent post-pandemic onset time points. *Source:* U.S. Postal Service change-of-address forms, as calculated by the authors.

average OMR in the 3 years prior. In the third year of the pandemic, even more rural counties (2,246 of 2,461; 91 percent) saw lower OMR than they had prior to the pandemic. Urban counties also saw reduced in-migration and out-migration over the study period. Together, the data in Figure 1 show that since the onset of the pandemic, average domestic migration rates dropped and have continued to decline in both rural and urban counties.

Turning to our second research question, Figure 2 describes spatial differences in changes to migration rates along a rural–urban gradient (RUG), showing annual rates compared to the starting year 2017/18 by RUG. The migration rates declined across all RUG categories, especially since the start of the pandemic and continuing through 2022/23. In the more urban counties shown in the top row, in-migration rates declined as much or more than out-migration rates. In the rural counties (shown in the bottom two rows), we see a starker drop in out-migration in the first year of the pandemic and overall, more declines in out-migration than in-migration.

Figure 3 shows the resulting changes to net migration rates, relative to a 2017/18 baseline. The typical Major Urban Core county has seen lower net migration since 2017/18, Suburban counties have seen little change to net migration rates, and the rural county types (indicated by solid lines) have seen notable increases to net migration rates since the pandemic. As described above, this is driven by declines in out-migration. Remote Rural, Micropolitan, and Metro-Adjacent Rural counties saw the greatest increase in net migration in the first year of the pandemic. In these most rural counties, net migration rates stayed elevated through 2022/23, though they have started to trend back toward prepandemic levels.

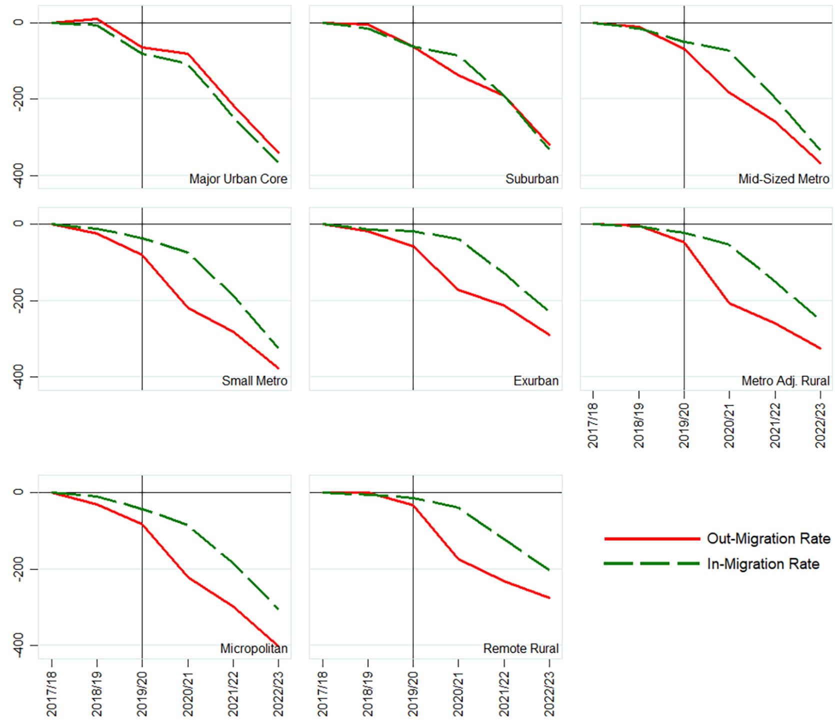

Figure 2. Annual Changes in Migration Rates versus 2017/18, across the Rural–Urban Gradient. Change from April 2017 to March 2023 in median in-migration rates and out-migration rates (per 10,000) across the RUG. Values below the horizontal black zero line indicate a lower migration rate compared to 2017/18. Values to the right of the vertical black line represent post-pandemic onset time points. *Source*: U.S. Postal Service change-of-address forms, as calculated by the authors.

Model results confirm these descriptive findings (Table 2). Migration had already slowed in 2019/20 (mostly prior to the pandemic), which is consistent with other research indicating migration had slowed to historically low levels in 2019 (Frey 2020; Frost 2020). Migration then slowed even more during the pandemic. Across the rural–urban gradient, both in- and out- migration rates declined during the pandemic and have continued to decline 3 years later. However, net changes differed in Major Urban Core counties compared to more rural counties. In these Major Urban Core counties, in-migration declined more than out-migration, resulting in a slowdown of the net migration rate during the pandemic (i.e., negative NMR coefficients in the pandemic years).

For all other RUG classes, out-migration declined more than in-migration, so net migration was more positive in the pandemic years than in 2017/18. The rural RUG classes (Small Metro, Exurban, Metro-Adjacent Rural, Micropolitan, and Remote Rural) experienced the greatest changes (increases) in net migration during the pandemic. In particular, Micropolitan counties showed the greatest and most sustained decreases in out-migration. Across all RUG classes, the greatest change to net migration was in the first year of the pandemic (2020/21). Changes diminished only

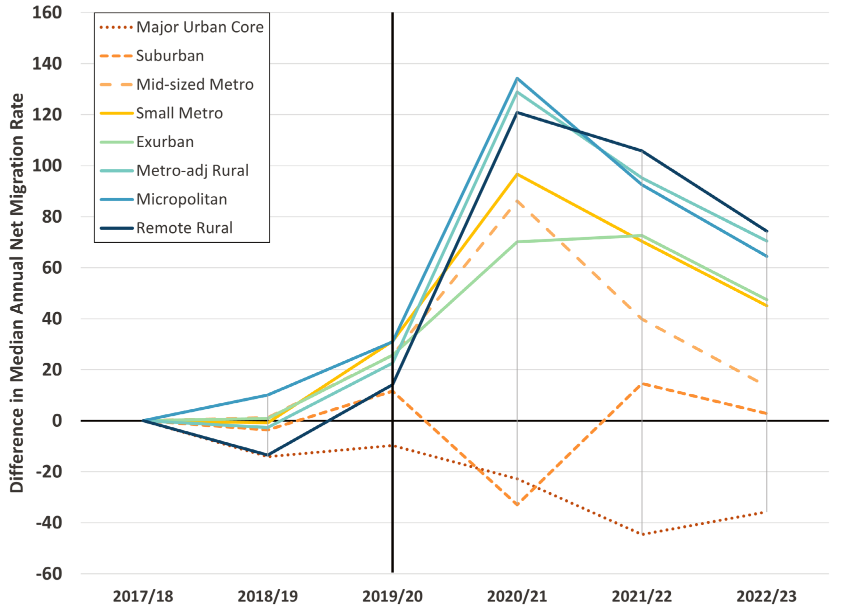

Figure 3. Annual Changes in Net Migration Rates versus 2017/18, across the Rural–Urban Gradient. Change from April 2017 to March 2023 in the median net migration rate (per 10,000) across the RUG. Values below the horizontal black zero line indicate a lower net migration rate compared to 2017/18. Values to the right of the vertical black line represent post-pandemic onset time points. *Source:* U.S. Postal Service change-of-address forms, as calculated by the authors.

somewhat in the second year of the pandemic (2021/22). In the third year of the pandemic (2022/23), net migration rates in the more rural RUG classes remained elevated in comparison to 2017/18, but less so than in the 2 years prior.

The shift toward more positive net migration was particularly apparent in the most rural counties. NMR coefficients for the pandemic years (2020/21, 2021/22, and 2022/23) are greater in the rural RUG class counties than in Suburban or Mid-Sized Metro counties. For example, the typical Remote Rural county saw 12 more net migrants per month per 10,000 residents in the first year of the pandemic, 9 more in the second year, and 6 more in the third year. The typical Suburban county, on the other hand, saw 7 more net migrants per 10,000 residents in the first pandemic year, 3 more in the second year, and 2 more in the third year. These values may seem small, but monthly differences add up to larger annual impacts. A typical Micropolitan county of 50,000 residents saw about 1,240 fewer out-migrants ($\beta = -20.7 \times 5 \times 12$ months) in the first year of the pandemic, compared to what it saw in 2017/18. Coupled with a corresponding decline in in-migration (−393 per year), this means a net increase of 847 people in that 1 year for the average Micropolitan county as compared to 2017/18.

Table 3 shows results of the models examining differences in rural pandemic migration by Recreation status. Rural Recreation and non-Recreation counties saw substantial declines in out-migration during the pandemic. Non-Recreation counties also saw declines in in-migration during the pandemic, especially in the second

Table 2. Model Results on the Monthly Migration Rates across the Rural–Urban Gradient (RUG)

	Major Urban Core			Suburban			Mid-Sized Metro			Small Metro		
	OMR	IMR	NMR	OMR	IMR	NMR	OMR	IMR	NMR	OMR	IMR	NMR
Year												
2018/19	0.85	−0.25	−1.09*	−0.90	−1.26**	−0.35	−1.24*	−1.07*	0.17	−0.20	0.06	0.26
2019/20	−5.39**	−6.17**	−0.78	−5.49**	−4.27**	1.22**	−6.14**	−3.79**	2.35**	−5.99**	−2.68**	3.31**
2020/21	−4.11**	−7.89**	−3.74**	−13.55**	−6.44**	7.12**	−15.51**	−5.85**	9.66**	−17.41**	−4.57**	12.84**
2021/22	−16.46**	−18.80**	−2.34**	−17.84**	−15.04**	2.81**	−21.46**	−15.77**	5.69**	−23.57**	−14.12**	9.45**
2022/23	−27.82**	−30.23**	−2.42**	−27.86**	−26.17**	1.68**	−30.01**	−26.48**	3.53**	−31.40**	−24.15**	7.25**
n counties	65	65	65	292	292	292	279	279	279	235	235	235
n county-months	4,680	4,680	4,680	21,024	21,024	21,024	20,088	20,088	20,088	16,920	16,920	16,920
Rho	0.94	0.98	0.94	0.75	0.87	0.89	0.84	0.92	0.54	0.66	0.91	0.70

	Exurban			Metro-Adjacent Rural			Micropolitan			Remote Rural		
	OMR	IMR	NMR	OMR	IMR	NMR	OMR	IMR	NMR	OMR	IMR	NMR
Year												
2018/19	−0.72	−0.34	0.38	−0.39	−0.63	−0.24	−2.08	−1.12	0.96	0.15	−0.53	−0.68
2019/20	−3.42**	−1.10**	2.32**	−4.58**	−2.02**	2.56**	−6.54**	−2.98**	3.55**	−4.50**	−2.53**	1.97**
2020/21	−13.83**	−1.87**	11.96**	−17.60**	−4.92**	12.68**	−20.67**	−6.55**	14.12**	−15.73**	−3.75**	11.98**
2021/22	−17.05**	−9.44	7.61**	−22.13**	−12.70**	9.43**	−23.94**	−16.57**	7.37**	−20.59**	−11.48**	9.11**
2022/23	−24.19**	−18.83**	5.37**	−27.13**	−20.74**	6.39**	−34.05**	−27.29**	6.76**	−24.63**	−18.42**	6.21**
n counties	289	289	289	1,026	1,026	1,026	89	89	89	822	822	822
n county-months	20,808	20,808	20,808	73,872	73,872	73,872	6,408	6,408	6,408	59,184	59,184	59,184
Rho	0.79	0.91	0.37	0.89	0.94	0.26	0.69	0.87	0.68	0.79	0.90	0.30

Note: Fixed effects model is run separately for each RUG class, includes a county fixed effect, and effectively estimates a time fixed effect by including month and year. The predictor variable of interest is YEAR (April–March), measuring differences in migration rate compared to April 2017–March 2018 (2017/18). *p*-values indicate comparison to 2017/18 and do not consider comparisons across groups (RUG classes).

Abbreviations: IMR, in-migration rate per 10,000; NMR, net-migration rate per 10,000; OMR, out-migration rate per 10,000.

Source: U.S. Postal Service change-of-address forms, as calculated by the authors.

*$p \leq .01$;

**$p \leq .001$.

Table 3. Model Results on Monthly Migration Rates for Rural Rec and Non-Rec Counties

	Rural Recreation		Rural Non-Recreation		Hausman Test	
Year	Coeff. (B)	Std. err.	Coeff. (b)	Std. err.	(B – b)	Std. err.
In-migration rates (per 10,000)						
2018/19	−0.19	0.6	−0.49	0.21	0.3	0.56
2019/20	−1.13	0.6	−2.17	0.21*	1.04	0.56*
2020/21	1.42	0.6*	−4.81	0.21*	6.23	0.57
2021/22	−9.27	0.61*	−12.33	0.21*	3.06	0.57*
2022/23	−21.94	0.62*	−19.64	0.21*	−2.3	0.58*
Out-migration rates (per 10,000)						
2018/19	1.12	0.91	−0.45	0.28	1.58	0.87
2019/20	−3.73	0.91*	−4.59	0.28*	0.86	0.87
2020/21	−14.04	0.92*	−16.73	0.28*	2.69	0.88
2021/22	−17.1	0.93*	−21.56	0.28*	4.46	0.89*
2022/23	−24.92	0.95*	−26.5	0.28*	1.58	0.9
Net migration rates (per 10,000)						
2018/19	−1.31	1	−0.04	0.25	−1.27	0.97
2019/20	2.6	1.01*	2.42	0.25*	0.18	0.98
2020/21	15.46	1.01*	11.92	0.25*	3.54	0.98*
2021/22	7.84	1.03*	9.23	0.26*	−1.39	1
2022/23	2.98	1.04*	6.86	0.26*	−3.88	1.01*
n counties	351	2,110				
n county-months	25,272	151,920				

Note: The fixed effects model combines a county fixed effect with time varying controls for population and seasonality (not shown), run separately for rural recreation and non-recreation counties. Year measures differences in migration rate as compared to April 2017/March 2018. Hausman tests for statistical differences in coefficients between the two datasets compare recreation versus non-recreation county coefficients (Hausman 1978).

Source: U.S. Postal Service change-of-address forms, as calculated by the authors.

$^*p \leq .05$.

and third years. Recreation counties, on the other hand, saw increased in-migration during the first year of the pandemic. This is a significant shift, particularly when overall migration slowed at this time. Rural Recreation counties saw a particular bump in migration (both in-migration and net migration) beyond the change seen in other rural counties in the first year of the pandemic. However, this bump tapered off in the second year of the pandemic when out-migration rates in rural Recreation counties increased. By the third pandemic year, Recreation counties saw lower net migration rates.

Mapping county-level changes to migration patterns allows us to explore regional comparisons and to distinguish spatial patterns with more specificity. Figure 4 shows county differences in in-, out-, and net migration rates during the pandemic years compared to the 3 years pre-pandemic onset, using the ΔIMR, ΔOMR, and ΔNMR variables. As previously discussed, declines to IMR and OMR are widespread, with 58 percent of counties showing declines in out-migration of more than 200 per 10,000 population. Only 170 counties (5 percent) experienced increased out-migration during the pandemic years compared to before. These are mostly located in oil and gas producing regions or in counties that

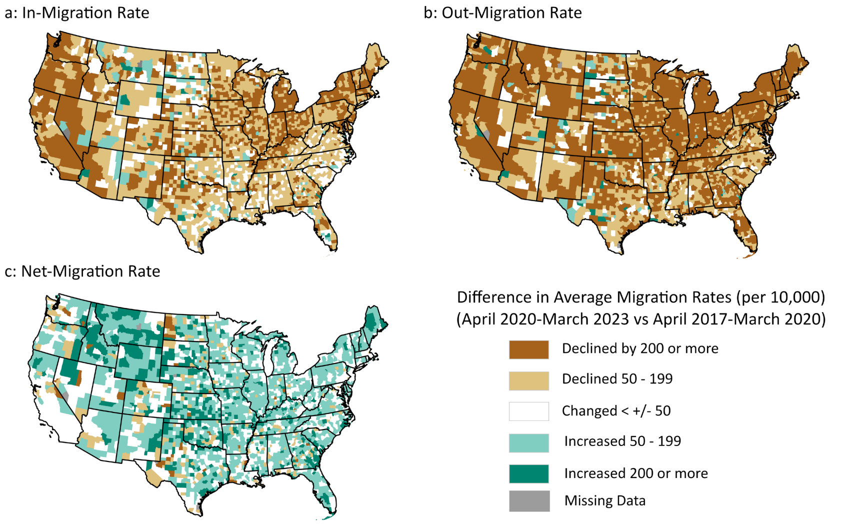

Figure 4. Pandemic Changes to Migration Rates, by County. Results of exploratory spatial data analysis mapping county-level patterns of △IMR (a), △OMR (b), and △NMR (c) variables (difference in average in/out/net migration rate April 2020–March 2023 vs. April 2017–March 2020). Brown shades indicate decline, and green shades indicate increase. *Source:* U.S. Postal Service change-of-address forms, as calculated by the authors.

experienced major wildfires or other disruptions. More counties (n=338, 11 percent) showed increased in-migration during the pandemic. These were mostly located in the northern Rockies (Montana, Idaho), across the Great Plains (some of which are associated with indigenous populations), and some pockets in Texas and the Southeast.

Most counties in Rural America (2,073 of 2,466, or 84 percent) saw an increase in net migration rate (NMR) during the pandemic relative to pre-pandemic, shown in green. Net increases were greatest in the northern Rocky Mountains; across the Northwoods areas of the Upper Midwest and New England; in southeast Georgia; and across much of the Great Plains. NMRs slowed in some oil and gas producing counties (e.g., western North Dakota and southwestern Louisiana), likely in relation to pandemic impacts (i.e., production declines) and energy sector shifts already in place (Kolko et al. 2021), and in some places that experienced major wildfires (i.e., Mono County, CA; Kittitas County, WA).

To test whether and where there is statistically significant spatial clustering in changes to counties' net migration rates since the pandemic started, we ran a global Moran's i test and performed hot spot analysis (HSA) (calculating the local Gi* statistic) in ArcGIS Pro 3.0.4. The Moran's i test indicates that counties' ΔNMRs are spatially autocorrelated (i=0.130, z=11.79), meaning that counties tend to be similar to their neighbors in how much change to NMR they have experienced during the COVID-19 pandemic. In other words, there is some evidence of spatial clustering.

The HSA allows for mapping *where* this clustering most occurs. It shows where counties and their neighbors experienced particularly high (hotspots) and particularly low (cold spots) changes to NMRs. The statistical significance of each cluster is

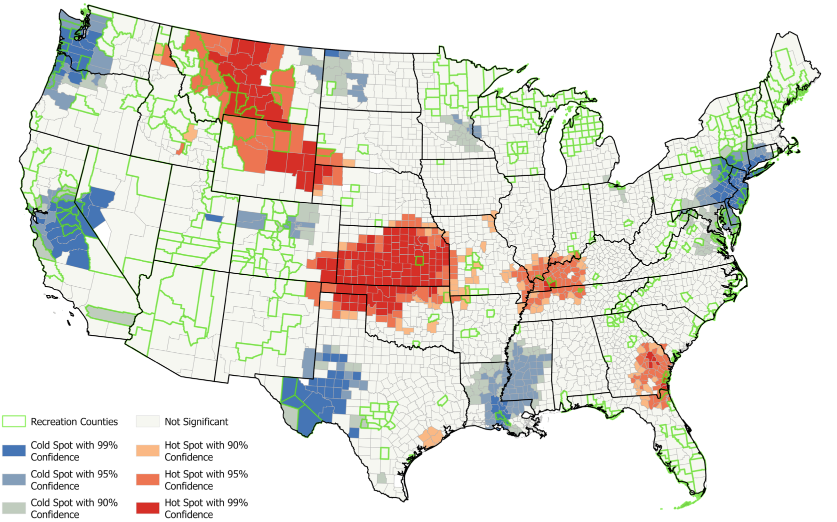

Figure 5. Optimized Hot Spot Analysis of Change in Net Migration Rates in Pandemic Years versus Prior. Results of Getis-Ord Gi* Optimized Hot Spot Analysis, performed in ArcGIS Pro 3.0.4 on ΔNMR (difference in average net migration rate April 2020–March 2023 vs. April 2017–March 2020). Cold spots (blue) indicate regions with relatively little growth in NMR or decline in NMR relative to counties. Hot spots (red) indicate regions with the greatest increases in NMR relative to all counties. *Source*: U.S. Postal Service change-of-address forms, as calculated by the authors. Recreation counties identified by USDA Economic Research Service County Typologies (2019a).

measured by calculating a *z*-score (Gi* statistic) and associated significance value for each feature (county) in the dataset. A hot spot is defined as one with a high value surrounded by other high values, such that the local area differs from what would be expected for the average county (estimated across the contiguous USA). Vice versa, cold spots are defined as clusters of counties with lower-than-average values. The higher the statistically significant *z*-score, the greater the intensity of values' clustering, and the more "hot" or "cold" the spot.

HSAs can be sensitive to specification, and we tested several approaches with generally similar results. We determined a preferred specification using ArcGIS Pro's optimized hot spot analysis (OHSA) tool, which optimizes parameters to detect spatial clustering (using incremental spatial autocorrelation) while correcting for false discovery rate and locational outliers. The OHSA tool with default settings suggested a distance band of 339 km; however conceptually, that distance is greater than the typical influence of a county's commuting zone, so we elected to reduce the distance band to 200 km to balance detection of spatial clustering with a more likely zone of influence. Across our tests, designating a smaller distance threshold shrinks the clusters identified but does little to change the overall pattern.

Figure 5 illustrates results of the Getis-Ord Gi* Optimized Hot Spot Analysis. Recreation counties are indicated with green borders to allow for spatial comparison of the relationship between Recreation designation and change in NMRs. Cold spots (shades of blue) indicate regions where pandemic changes in net migration rates were particularly low, which in this case means either less growth in the NMR or declining NMRs during the pandemic, at varying levels of confidence (light blue, 90 percent; blue, 95 percent; and dark blue, 99 percent). These cold spots include urban coastal counties in the Pacific Northwest, central California, and the Boston-to-Washington corridor. Cold spots are also seen in some oil and gas reliant counties, including western Texas, the Louisiana delta, and western North Dakota.

Shades of red clusters indicate areas that experienced particular increases in net migration post-pandemic onset relative to prepandemic. Increases are most intense in parts of Montana and Wyoming and across swaths of the Great Plains, especially Kansas and Oklahoma. Other hotspot pockets are in western Kentucky and coastal Georgia. Although in some areas, net migration red clusters are characterized by increased in-migration (e.g., parts of Montana), most are driven by decline in previously high levels of out-migration, rather than increasing in-migration (e.g., Great Plains, western Kentucky).

Discussion

Using data from change-of-address forms filed with the U.S. Postal Service, we show that migration out of Rural America slowed during the COVID-19 pandemic in comparison to the 3 years prior. Out-migration slow-downs were widespread across the country, and out-migration rates remained low through March 2023. As a result, most rural counties that saw net population loss prior to the pandemic saw either less net loss or net gains during the pandemic. In the first year of the pandemic rural Recreation counties were particularly attractive locations, experiencing increased in-migration as well as reduced out-migration. Yet, as the pandemic continued into a second and third year, Recreation counties' migration balanced back similar to other rural counties.

Contrary to many anecdotal stories, we find little evidence of a mass exit from urban centers. Instead, most urban counties saw reduced out-migration during the pandemic. Still, in-migration to Major Urban Core counties declined even more, resulting in a net loss of migrants. Suburban, exurban, small city, and rural counties all experienced greater net migration during the pandemic than prior, with more rural counties generally seeing more change. In other words, it appears that fewer people moved from Rural America to major urban centers during the pandemic. This finding was most stark in the first year of the pandemic. By the third year (2022/23), net migration rates trended back towards prepandemic patterns, especially in Suburban and Mid-sized Metro counties. Still, in the most rural counties net migration rates remained elevated (by ~70 net migrants per 10,000 residents) in 2022/23, suggesting the possibility of long-term impacts beyond the initial migration response to the pandemic shock.

This is the first nationwide study of migration in relation to the COVID-19 pandemic that focuses on Rural America and considers inflows and outflows. Our findings are generally consistent with other regional and urban-focused studies on pandemic migration. They extend prior work to consider spatial heterogeneity across the rural–urban gradient and by counties' recreation status and make comparisons over time considering the 3 years prior to the pandemic with the 3 years following its onset. Results are robust to several assumptions and include important controls for county fixed effects and seasonality.

This is also one of the first comprehensive migration studies to use USPS change-of-address data. Exploring this data source is an important contribution of this study, given that American Community Survey data on migration cannot show inflows and outflows for rural areas due to high margins of error, and IRS migration data have been a less reliable data source since 2012 (DeWaard et al. 2022). This makes alternative migration data sources like USPS change-of-address forms important to explore. Moreover, the monthly release of this USPS data during this unique, systemic shock makes them uniquely positioned to address migration questions related to the COVID-19 pandemic.

Still, this study has important limitations. Most importantly, the study relies on an administrative dataset unintended for the study of migration, and there are several related assumptions and complications inherent in that (described in detail above). We believe migration scholars can effectively address data limitations through the specific data hygiene measures described herein. Moreover, we are careful to always compare changes over time *within* counties to avoid the limitations inherent in using change-of-address data for directly making migration estimates (e.g., underestimated in-migration to university locations).

This study is entirely descriptive, and we cannot say what is driving the changes shown here, nor can we comment on their social, economic, or ecological implications. There is still much to learn about how the pandemic impacted domestic migration, especially regarding economic and housing variables. This study does not include any variables measuring economic change over time, as the collinearity with the onset of the COVID-19 pandemic would complicate results. Even more important to include are measures relating to the housing market and housing values. Housing affordability may well have driven migration decisions during the pandemic, and we encourage future studies to examine the bidirectional relationships between migration and housing market change, especially in rural destination counties where housing affordability has shifted dramatically in short periods of time (Nelson and Frost 2023).

These changing migration trends may be welcome news for parts of Rural America that have struggled with depopulation, though they may also mean that people who might otherwise gain better opportunities from moving are stuck in place. Slowing out-migration means more people stayed in rural places that have experienced decades of outflow. This slowdown continued in the most rural counties through March 2023, 3 years post-pandemic onset, suggesting that the impacts of the pandemic on migration patterns could be long lasting.

Rural communities looking to stabilize or grow populations could harness the opportunity that the current slowdown provides by working to become more attractive places for young people and families. Whether they can do that depends in part on the social and economic policies and programs within those communities. Policies and programs that address rural needs and services (e.g., broadband Internet, airport access, affordable housing, childcare); invest in recreational amenities; and engage rural young people and families in community-building may help rural communities maintain pandemic gains or otherwise reduce future migration losses. Ultimately, the COVID-19 pandemic was an unprecedented event, and rural places and migration patterns may feel the effects of this public health shock for decades to come.

Data Availability Statement

By county-month in-, out-, and net-migration data (Data S1) and data dictionary (Data S2) are available as a supplementary file to this publication.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article at the publisher's web site.

APPENDIX A

USPS Change-of-Address Data-Processing Steps

Raw data include the number of individual and family change-of-address forms processed, rather than the number of people they represent. We estimate the total number of people represented in both the individual and family categorization using the following steps:

1. Calculate the percent of total relocations that are for "individual" (individual forms included in the raw data, but not separated by "temporary" versus "permanent").
2. Multiply the proportion "individual" by the total number of "permanent" relocation forms ("Total Permanent" in the raw data) to generate an estimate of the number of "individual permanent" relocations.
3. Calculate the percent of total relocations that are for "family" (family forms are included in the raw data, but not separated by "temporary" versus "permanent").
4. Multiply the proportion of "family" by the total number of "permanent" relocation forms to generate an estimate of the number of "family permanent" relocations.
5. Assume that each family represents an average of 3.14 people and multiply the estimated number of permanent family relocations (step 4) by 2.14 to generate the estimated number of people represented by "family" relocation forms.
6. Sum the estimated number of "individual" (step 2) and "family" (step 5) migrants, to generate the estimated number of "permanent" migrants.
7. Conduct steps for variables above for both inflows and outflows, so that step 6 results in an estimate for "permanent" in migrants and "permanent" out migrants.
8. Calculate net migrants = in migrants − out migrants.

APPENDIX B

This appendix includes an alternative version of Table 2, analyzing the household-level migration rates, rather than estimates of individual migration rates, using data from U.S. Postal Service change-of-address forms. Each form type (individual or family) represents one household in this model. The results in this alternative model set can be directly compared to results shown in Table 2 of the main text. Comparing the two, there are some minor differences, but the overall interpretation of big picture results is the same for the household level (shown here) and the individual level (estimated in Table 2).

Table B1. Alternative Results on Monthly Migration Rates across the Rural–Urban Gradient (RUG), for the Household Level

	Major Urban Core			Suburban			Mid-Sized Metro			Small Metro		
	OMR	IMR	NMR	OMR	IMR	NMR	OMR	IMR	NMR	OMR	IMR	NMR
Year												
2018/19	1.42	0.42	−0.99**	−0.06	−0.43	−0.36	−0.24	−0.28	−0.04	0.44	0.47	0.03
2019/20	−2.31**	−3.26**	−0.95*	−2.91**	−2.12**	0.79**	−3.38**	−1.82**	1.56**	−3.41**	−1.16*	2.25**
2020/21	0.25	−3.17**	−3.42**	−8.33**	−3.11**	5.22**	−9.59**	−2.63**	6.96**	−11.12**	−1.82**	9.30**
2021/22	−10.59**	−12.66**	−2.07**	−12.34**	−10.35**	1.99**	−15.09**	−11.09**	4.00**	−16.82**	−10.00**	6.81**
2022/23	−19.47**	−21.71**	−2.24**	−19.92**	−18.69**	1.23**	−21.62**	−19.11**	2.51**	−22.79**	−17.62**	5.16**
n counties	65	65	65	292	292	292	279	279	279	235	235	235
n county-months	4,680	4,680	4,680	21,024	21,024	21,024	20,088	20,088	20,088	16,920	16,920	16,920
Rho	0.90	0.98	0.95	0.80	0.84	0.89	0.81	0.90	0.63	0.66	0.90	0.74

	Exurban			Metro-Adjacent Rural			Micropolitan			Remote Rural		
	OMR	IMR	NMR	OMR	IMR	NMR	OMR	IMR	NMR	OMR	IMR	NMR
Year												
2018/19	0.13	0.04	−0.09	0.27	−0.18	−0.45	−0.96	−0.46	0.49	0.49	−0.04	−0.53
2019/20	−1.69**	−0.09	1.61**	−2.50**	−0.78**	1.72**	−3.78**	−1.47	2.31**	−2.50**	−1.27**	1.23*
2020/21	−8.58**	−0.10	8.48**	−11.56**	−2.48**	9.08**	−13.45**	−3.34**	10.10**	−10.34**	−1.72**	8.61**
2021/22	−12.11**	−6.67**	5.43**	−15.90**	−9.31**	6.59**	−17.43**	−12.11**	5.32**	−14.57**	−8.22**	6.35**
2022/23	−17.58**	−13.82**	3.76**	−19.82**	−15.35**	4.48**	−24.99**	−20.16**	4.83**	−17.81**	−13.57**	4.24**
n counties	289	289	289	1,026	1,026	1,026	89	89	89	822	822	822
n county-months	20,808	20,808	20,808	73,872	73,872	73,872	6,408	6,408	6,408	59,184	59,184	59,184
Rho	0.78	0.90	0.39	0.89	0.94	0.29	0.70	0.87	0.71	0.82	0.91	0.33

Note: Same model as Table 2 but run by household rather than by an individual (family form = 3.14 individuals). Fixed effects model is run separately for each RUG class, includes a county fixed effect, and effectively estimates a time fixed effect by including month and year. The predictor variable of interest is Year (April–March), measuring differences in migration rate compared to April 2017–March 2018 (2017/18). *p*-values indicate the comparison to 2017/18 and do not consider comparisons across groups (RUG classes).

Abbreviations: IMR, in-migration rate per 10,000; NMR, net-migration rate per 10,000; OMR, out-migration rate per 10,000.

Source: U.S. Postal Service change-of-address forms, as calculated by the authors.

*$p \leq .01$; **$p \leq .001$.