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Recreational Homes and Migration to Remote Amenity-Rich Areas

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Abstract. Counterurbanization pressures in remote amenity-rich regions present a host of land use and development planning issues. In the work reported here, we identify, examine and spatially analyze residential housing characteristics, land ownership, land developability, natural and human-built amenities, infrastructure density, and socio-demographic data at the minor civil division level for an eight county region of Northern Wisconsin. This is done using spatial error and spatial regime models to distinguish between rural "remote" and "frontier" levels of population density. Our intent is to develop initial empirical insights into the counterurbanization process that has been at the core of forest fragmentation and land parcelization during the latter half of the 20th and early 21st Centuries. Results suggest that land developability and the presence of public lands are central significant factors involved in in-migration to the frontier region. Further, we note that seasonal, recreational, and occasional use housing units, while an important metric, only partially captures important transitions in housing options for both full-time and part-time residents. Both policy implications and further research needs serve as segues into future regional science effort.

1. Introduction

Non-metropolitan regions throughout the developed world are progressing through a dramatic and sustained post-industrial transition. Traditional forms of rural growth achieved through food and fiber production, mining, and rustic tourism are giving way to large scale corporate agriculture, forestry, and energy exploration, footloose and globally competitive processing firms, the rise of the service sector, and mass tourism on an unprecedented scale. The implications of this transition for sustaining rural households involve an increased presence of urban amenity migrants and retirees in concert with an increase in low-wage, seasonal work. Despite the obvious short-term economic opportunities for entrepreneurs, there remains both persistent poverty and a continual drain of young people to urban areas (Ward 2011).

This said, contemporary rural structure is complex and difficult to characterize with simple generalizations. While standardized definitions of the rural United States allow initial distinctions to be made that reflect remoteness and population size (USDA 2004), others focus more on economic structure and dominant economic activity (Lapping et al., 1989). This latter definition begins to sort out important rural characteristics that reflect underlying issues of rural welfare and community development. Directly to the point of rural welfare and based on work from the National Rural Assembly, Duncan (2007) and others (e.g., Hamilton et al., 2008) have proposed that it is useful to consider four rural Americas that distinguish between *amenity-rich areas, declining resource-dependent areas, chronically poor areas,* and *amenity/decline areas.* Doing so distinguishes relevant conceptual elements important to understanding rural regional change.

Conceptual regional science themes that address positive levels of net rural migration, economic growth, and development involve exurbanization and counterurbanization. Anecdotally, these can be generalized to exist most notably in rural regions characterized by high levels of natural amenities. Indeed, there is a broad literature that speaks to the fact that amenity-rich rural regions are witnessing a rebound (Gude et al., 2006; Waltert and Schläpfer, 2010). Exurbanization and counterurbanization are two distinctly different and relevant phenomena (Löffler and Steinike, 2006). Exurbanization refers to low-density expansion of metropolitan areas on the peri-urban fringe (beyond the outer suburban belt), primarily catering to the development of rural bedroom developments and hobby farms within metropolitan commuter-sheds. Counterurbanization, on the other hand, reflects the diffusion of more affluent "urban refugees" to remote high-quality environments (Mitchell, 2004; Halfacree, 2012) catering to the development of recreational housing as second, third, or fourth homes. Indeed, counterurbanization represents the driving factor behind enclaves of the rural rich with their spatial presence, leisure activities, and resulting community impacts (Rudzitis et al., 2011).

Processes that involve positive net migration and growth of these two distinctly different regional change phenomena are likewise distinct. Unlike exurbanizing rural regions proximate to metropolitan areas which benefit from agglomeration and suburbanization effects, remote areas experiencing counterurbanization typically lack agglomerating developmental stimuli and are often left to fend for themselves (Isserman, 2001; Cho and Newman, 2005). Those remote rural regions that experience counterurbanization do so, in large part, because of their endowments of significant natural resource assets and recreational resources. These regions have experienced a turn-around net in-migration and limited amenity-led residential development. The driving notion behind this turn-around was that migrants understood, internalized, and were moved to act by the attractiveness of natural amenities as a principal motivating factor (Isserman, Feser, and Warren, 2009; Ward and Brown, 2009; Waltert and Schläpfer, 2010). A combination of increased affluence, development of transportation infrastructure, active regional competitiveness, globalization, and environmental awareness/sensitivity has driven development into a post-industrial phase which places quality-of-life and amenities as central determinants of migration (Frentz et al., 2004; Gartner, 2005; Thompson, Hammond, and Weiler, 2006).

Net in-migration into more remote rural regions has resulted in the conversion of forest and agricultural lands into dispersed residential and commercial developments (Smith and Spadoni, 2005). Future development in these regions, however, is limited by the availability of land for conversion and development. More remote rural regions exist within unique developmental contexts and face significant constraints to economic growth and socio-demographic change (Löffler and Steinike, 2006). These regions have traditionally relied on extractive resources for economic development. Increasingly, natural amenities are thought to be primary driving factors associated with regional economic and demographic change (Gunderson and Ng, 2005; Gunderson et al., 2008).[1] An important empirical need is to better capture changes in land-based resources upon which non-consumptive (amenity) resource use depends. An example relates to constraints imposed on growth due to reduced availability of developable land.

The resettlement of remote rural regions in the Lake States of Minnesota, Wisconsin, and Michigan provides a basis upon which to examine counterurbanization. In this article, we extend a case study of a relatively remote rural sub-region of the U.S. Lake States. A spatial regression approach is used to investigate the impacts of natural amenities, housing characteristics, land ownership, and land developability on in-migration within the context of regional socioeconomic and physical infrastructure characteristics. Given our interest in counterurbanization combined with the rapid growth in recreational homes in this region, we are explicit in testing the importance of seasonal, recreational, and occasional use (SROU) housing units as a factor involved in in-migration. Implications drawn from our work

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[1] The role of natural amenities as primary driving factors involved in regional socio-demographic and economic change is complex and supported by limited theoretical constructs. The theoretical basis most often used to explain regional economic-amenity relationships (Roback, 1982, 1988) remains overly growth-focused and lacks joint production, rural multifunctionality, and key sector distinction resulting in ill-defined amenity and touristic linkages. Further, economic-amenity theory remains disassociated from important land-based resource dependency and land developability elements. While often providing mixed and inconsistent results (Partridge and Rickman, 1997; Deller, 2009), the existing theoretically-grounded empirical work continues to suffer from a lack of standardized control metrics and questionable geographic scales (county level versus finer-grained MCD and parcel level specifications).

provide a basis for additional research and allow a more complete exploration of strategies that address development and counterurbanization in amenity-rich remote rural regions.

This article is organized into three subsequent sections. Following this is a section describing the research data and the analytical approach used in this empirical case study. We then report our empirical findings that focus on the migratory effects of natural amenities, land developability, and changes in SROU housing units. Finally, we conclude with a summary and brief discussion of policy implications that can be drawn from our empirical results focused on the unique counter-urbanization dilemmas faced within amenity-rich remote rural regions.

2. Data and methods

2.1. The study area

In this analytical extension, we examined the effects of natural amenities and land developability on in-migration with a specific focus on the inclusion of seasonal, recreational, and occasional use (SROU) housing units. The case study region for this research was a portion of Northern Wisconsin known for its endowment of lakes, rivers, and forest resources (Figure 1). This region provides an interesting case study to examine further due to its dual classification as a grouping of both *recreational counties* typed as "Midwest Lake/Second Home" (Johnson and Beale, 2002) and *amenity/decline* "Midwest/decline" (Hamilton et al., 2008). A recent Carsey Institute report (Hamilton et al., 2008) contains an apt definition that provides place-based context for this region. *Amenity/decline rural America* is defined as (ibid p. 6):

> … a transitional type, with similarities to both amenity-rich and declining resource dependent communities. The traditional resource-based economies of these places have weakened but not vanished, and their aging populations reflect out-migration. At the same time, these areas show signs and potential for amenity-based growth.

Also, selection of this region as a case study relates to our ability to build understanding from previous research. For instance, earlier research in Vilas County (located in the middle of this region) implied that the potential for amenity-based growth relates to issues related to place attachment, environmental quality, and the role of public lands (Schnaiberg et al., 2002; Stedman and Hammer, 2006; Stedman et al., 2007). Selection of this region can provide important, triangulated evidence for us to better understand the underlying land use and development dynamics at play in this and analogous regions.

Our analysis was based on data collected for the minor civil division (MCD) level within eight counties (Ashland, Florence, Forest, Iron, Oneida, Price, Sawyer, and Vilas). All eight counties exist as non-adjacent to a metropolitan area and, based on the 2003 Urban-Rural Continuum codes, are identified either as 7 (urban population of 2,500 to 19,999, not adjacent to a metro area) or as 9 (completely rural or less than 2,500 urban population, not adjacent to a metro area). The eight counties used in this case study make up the largest contiguous remote rural region in Wisconsin. Further, the bulk of these counties are classified as "Recreation" and fall within the "Midwest Lake/Second Home" regional sub-type from Johnson and Beale (2002) and the "Recreation Dependent – East North Central" region in the analysis by Gunderson and Ng (2005).

Our analysis was based upon a dataset that consisted of all 129 MCDs within the eight county case study region. The MCD geography represents a non-nested, exhaustive, and mutually exclusive political landscape. The advantage of using MCDs is their relevance to planning and public policy-making. In most parts of the state, census tracts have an average size similar to MCDs and provide an alternative unit of analysis. However, census tracts are geographic units delineated by the Census Bureau only for purposes of the decennial census, and exist without political or social meaning.

The data used in this study were compiled from a variety of primary and secondary sources. Migration and SROU housing data were from the 1990 and 2000 decennial censuses. The data of natural amenity characteristics and land developability came from the U.S. Geological Survey, the Wisconsin Department of Natural Resources, and the Environmental Remote Sensing Center and the Land Information and Computer Graphics Facility of the University of Wisconsin-Madison. Demographic, socioeconomic, and transportation infrastructure data were acquired from federal and state governmental agencies including the U.S. Census Bureau, the Federal Bureau of Investigation, the Wisconsin Departments of Public Instruction and Transportation, and the State of Wisconsin Blue Books.

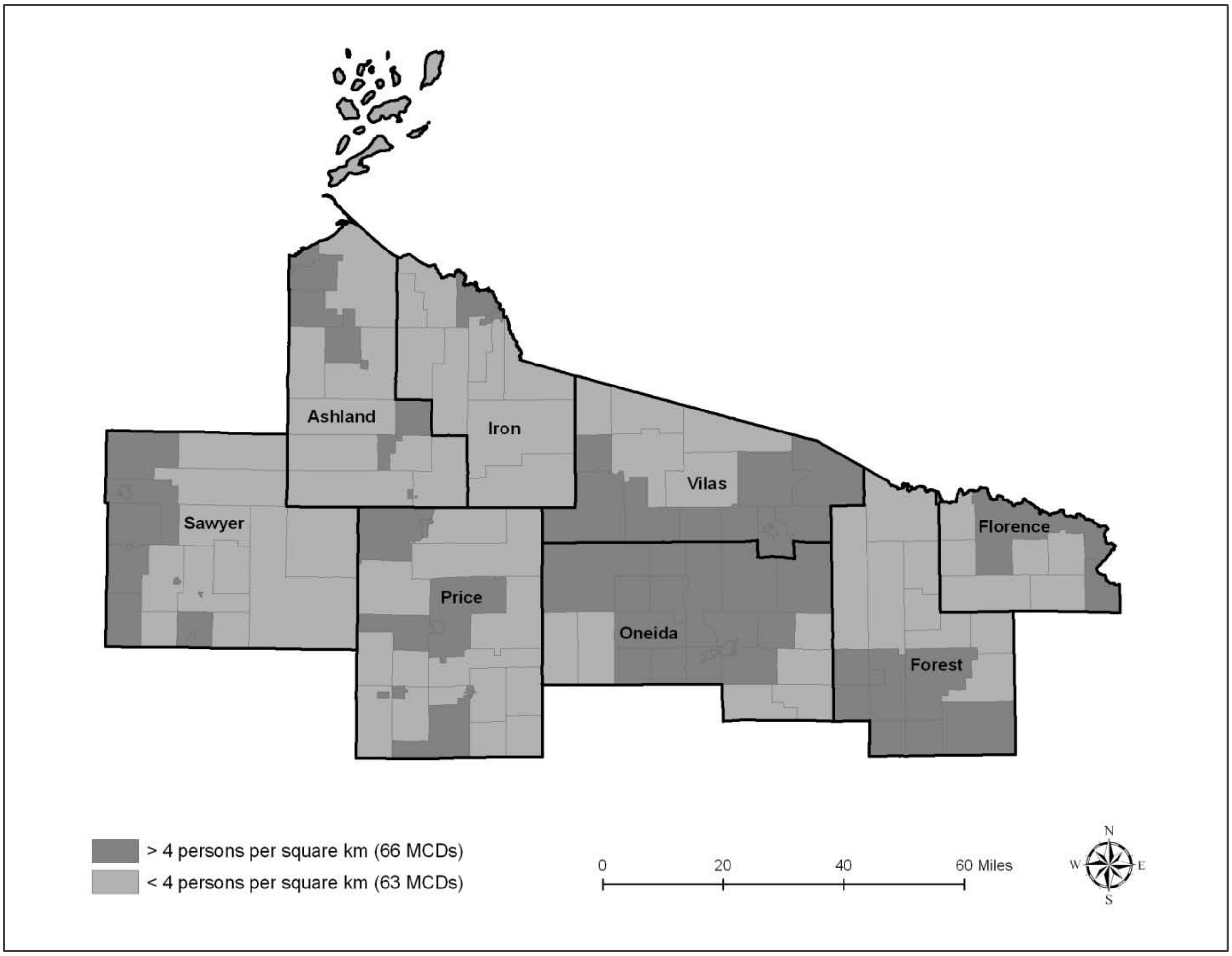

Figure 1. Northern Wisconsin counties and MCDs used in the case study distinguished as rural remote (> 4 persons/km^2) and rural frontier (<4 persons/km^2).

2.2. *Response and explanatory variables*

The response variable was represented by the in-migration rate from 1995–2000 which is shown graphically in Figure 2.[2] The MCDs in the eight Northwood counties experienced rapid in-migration in the five years under study. While most MCDs gained more than 25% of their population through in-migration, there was significant variation, with some MCDs gaining more than 35 percent during the five year period.

The explanatory variables included natural amenities, SROU, land ownership, land developability, and population density. Definitions of natural amenities vary widely, as different researchers focus on different sets of variables to study the influences of natural amenities. No single accepted method for measuring natural amenities exists (Waltert and Schläpfer, 2010). In this study we use seven typical variables to represent natural amenities. They included the percent of forest coverage, water area, wetlands, public lands, the length of lakeshore/riverbank/coastline (adjusted by the square root of the MCD area), golf course coverage, and viewsheds (the proportion of a MCD's area with slope between 12.5% and 20%). Descriptive statistics of select variables for this eight-county region are summarized in Table 1.

[2] We use the in-migration rate rather than the net migration rate as the response variable because of our interest in the urban refugee aspects associated with counterurbanization. Further, net migration data does not exist at the MCD level in Wisconsin and would be very difficult to create. We recognize that this presents a limitation to the empirical assessment which does not allow us to address important regional demographic characteristics noted by a recent Carsey Institute report (Hamilton et al., 2008)as elements of "amenity/decline rural America", namely persistent out-migration of younger age groups (the rural brain-drain). Incorporation of these elements into empirical models is left for further research.

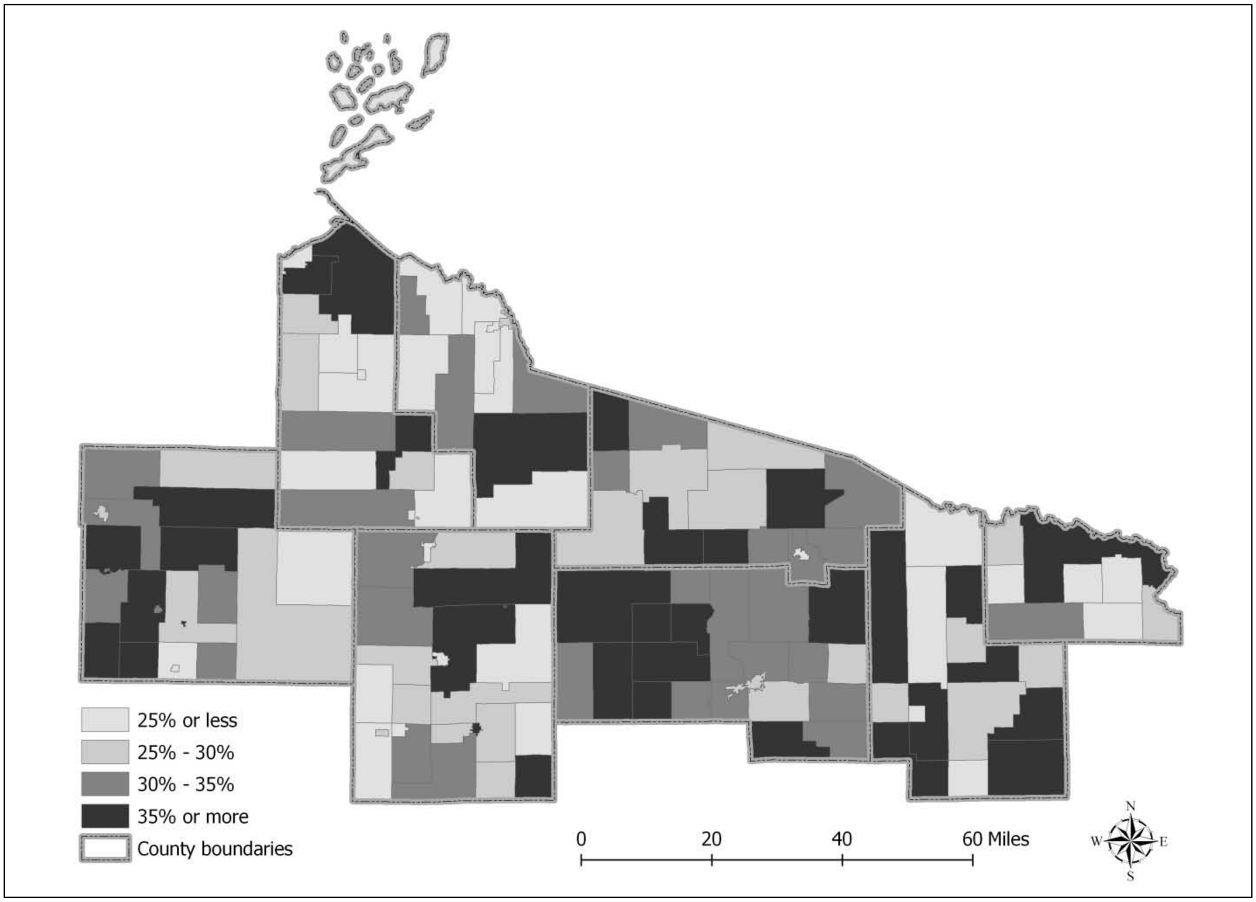

Figure 2. In-migration rate from 1995-2000 in northern Wisconsin region used as a case study.

Table 1. In-migration rate and explanatory variables in the Northern Wisconsin region (N = 129 MCDs) used as a case study.

	Mean	Minimum	Maximum	Std. Dev.
In-migration rate 1995–2000	0.31	0.06	0.68	0.09
In-migration rate 1985–1990	0.18	0.01	0.57	0.09
The proportion of forest area	0.60	0.18	0.90	0.14
The proportion of water area	0.05	0.00	0.31	0.06
Riverbank, lakeshore, and coastline	21.65	2.08	75.17	10.21
Golf courses	9,415.38	30.72	81,779.82	11,223.85
Viewsheds	0.03	0.00	0.19	0.03
The proportion of wetland area	0.25	0.03	0.68	0.15
The proportion of public land area	0.22	0.00	1.00	0.29
Land developability index	0.57	0.10	0.94	0.21
Population density in 1990 (person/km^2)	25.55	0.32	364.02	64.63
SROU in 1990	317.21	2.00	2,066.00	375.74
SROU growth rate from 1990–2000	0.19	-0.50	4.17	0.55
Highway density (km/km^2)	0.17	0.00	1.49	0.23
County road density (km/km^2)	0.13	0.00	1.05	0.17
Local road density (km/km^2)	1.21	0.24	8.16	1.15

Note from this table that the northern Wisconsin region studied is heavily forested (60 percent of all lands were covered by forests) and dotted with lakes and rivers. Much of the land (roughly 22 percent, more than four times the statewide average) was in the public ownership of the USDA Forest Service, State of Wisconsin, and/or county ownerships. Much of the land is considered difficult to develop due to its wetland status; the average proportion of wetland area in these counties was 25 percent (twice as much as that in Wisconsin). SROU housing was often found as the majority housing unit type of all local housing units in this region. While there was wide variability among MCDs in SROU change, overall the numbers of this type of housing unit have grown by nearly 20 percent during the last decade (between 2000 and 2010).[3]

Land developability was specified based on water, wetland, slope (>20%), tax-exempt lands, and built-up lands considered undevelopable. Instead of using the five variables individually, we used a spatial overlay method to generate an index to represent land developability. Spatial overlay is a set of methods that share all or part of the same area into one data layer that identifies spatial relationships. In this research, we first overlaid the data layers of these variables to create one layer representing all undevelopable lands in Wisconsin. This layer was then intersected with a geographic MCD layer to create a layer that contained the information for undevelopable lands at the MCD level. We then calculated the proportion of undevelopable land for each MCD. Finally, we generated the developability index by subtracting the proportion of undevelopable land from one. On average, only 57% of the land base within the eight-county case study region was developable (Table 1).

We also used population density as an explanatory variable, not only because it was often found to covary with in-migration in existing studies, but also because it is often used to represent intensity of residential land use. Population density is usually seen as negatively correlated with land developability and in-migration. The eight-county case study region exists with relatively low population density (just over 25 persons per square kilometer). In the spatial regime models, we separate this region into remote (MCDs with population density > 4 people per square kilometer) and frontier (MCDs with population density < 4 people per square kilometer) to allow us to capture areas for potential future counterurbanization.

In addition to natural amenities, housing types, land developability, and population density, in-migration is further thought to have other explanatory factors including demographic characteristics, socioeconomic conditions, and transportation accessibility. These factors are often not well-controlled in the existing literature of natural amenity effects. Inefficiency and bias can result from models constructed with missing yet relevant model variables. Thus, these variables were incorporated into the models as controls in examining the effects of natural amenities, land use, and land developability on migration.

The demographic factors used in this study included age structure, racial and ethnic composition, institutional populations, educational attainment, migration, and female-headed households with children. The considered socioeconomic factors included employment opportunities, crime rate, school performance, income growth, public transportation, public water, new housing, buses, county seat status, and real estate value. Transportation accessibility included proximity to metropolitan area, airports, and highways, highway infrastructure, journey to work, and buses. In total, 25 control variables (Table 2) were used to investigate effects of natural amenities and land developability on in-migration.

2.3. Dimension reduction

The large number of control variables raised problems of serious and unnecessary multicollinearity which can affect regression model efficiency. This dilemma was solved by reducing the dimensions of variables, accomplished using principal factor analysis (PFA) with varimax rotation and the Kaiser criterion. PFA seeks the least number of factors which represent the common variance of the variables and is a correlation-focused approach reproducing the intercorrelation among the variables. We were interested only in the common variance of the variables, and thus the PFA was

[3] Use of this metric raises another limitation with the empirical assessment. There are important transitions in SROU housing, particularly important during the ownership life cycle. Retirees who owned SROU housing units prior to retirement could be converting these into full-time, year-round residences, thus changing their status for purposes of the decennial census. On the other hand, many retirees become "snowbirds" and/or transmit recreational homes through inheritance. It is unclear the extent to which conversion to local full-time residence takes place. Further, there is a dearth of literature on this phenomenon. Thus, identification and incorporation of this ownership life cycle element into empirical modeling of migration remains for further research.

an appropriate approach to generate indices. The number of factors used for representing each index was determined through application of the Kaiser criterion which retains factors with eigenvalues over 1. In addition, we implemented varimax rotation (a common rotation method) to the factor analysis in order to better facilitate the interpretation of factors.

Table 2. Factor loadings and variance explained: principal factor analysis by varimax rotation with Kaiser criterion.

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
Variance explained	17.41%	13.44%	9.54%	7.76%	6.82%	6.25%	5.18%	4.49%
Loadings:								
Young	-0.450	0.116	0.444	0.135	**0.479**	0.160	-0.160	-0.038
Old	0.100	0.076	-0.622	-0.159	**0.201**	0.056	0.448	0.156
Blacks	-0.207	0.004	0.241	0.138	**0.796**	0.286	-0.042	0.124
School performance	**0.436**	-0.053	0.199	-0.032	0.123	-0.059	0.204	-0.133
Employment rate	0.173	0.049	0.392	-0.267	0.000	0.199	0.422	0.238
Income	0.426	-0.153	**0.720**	0.021	-0.098	0.026	0.167	-0.084
Public water	0.010	**0.705**	-0.148	-0.328	0.142	-0.226	-0.103	0.100
New housing	-0.431	0.578	0.188	-0.281	-0.072	-0.026	0.168	0.017
Real estate value	**0.753**	-0.326	-0.016	0.043	0.013	0.068	0.043	-0.051
County seat status	0.180	**0.610**	-0.109	-0.081	0.090	-0.201	0.030	0.187
Seasonal housing	0.209	-0.638	-0.335	0.215	0.056	0.288	0.029	0.072
Retail	0.561	0.019	-0.271	-0.213	0.120	0.120	-0.156	0.072
Agriculture	-0.604	-0.151	0.234	0.253	-0.155	0.012	0.233	0.117
Crime rate	**0.494**	-0.246	-0.224	0.231	0.365	-0.209	0.067	0.045
High school education	**0.611**	-0.006	0.337	-0.210	-0.363	0.122	-0.136	0.122
Bachelor's degree	**0.640**	0.080	0.173	-0.148	0.127	0.125	0.026	0.037
College students	0.342	0.168	-0.044	0.258	0.081	-0.061	0.127	-0.309
Female-headed households	-0.044	0.191	-0.161	-0.052	0.102	-0.119	0.070	-0.239
Proximity to metro	0.102	-0.062	0.264	**0.474**	0.038	**-0.604**	0.017	0.125
Proximity to airports	0.353	0.072	0.179	0.065	0.187	**-0.484**	0.066	0.044
Proximity to highways	0.249	**0.721**	-0.059	0.544	-0.129	0.274	0.043	0.022
Highway infrastructure	**0.470**	0.241	-0.042	0.108	-0.051	-0.084	-0.178	0.091
Journey to work (time)	0.350	0.315	0.179	-0.337	0.212	0.141	-0.075	-0.290
Journey to work (mode)	-0.187	0.047	-0.130	-0.024	0.001	-0.069	0.222	-0.392
Buses	0.213	**0.688**	-0.063	0.574	-0.159	0.321	0.041	-0.008

Note: bold indicates our interpretation of each factor.

The PFA with varimax rotation and a Kaiser criterion produced eight factors from the 25 controlled variables (Table 2). The eight factors explained 70% of the total variance. Factor 1 accounted for 17% of the variance, which is mainly explained by real estate value, high school education, bachelor's degree, school performance, income, retail, crime rate, and highway infrastructure. Factor 2 accounted for 13% of the variance, mainly explained by public water, county seat status, proximity to highways, and buses. Factor 3 accounted for 10% of the variance, mainly explained by income. Factor 4 accounted for 8% of the variance, mainly explained by proximity to metro, proximity to highways, and buses. Factor 5 accounted for 7% of the variance, mainly explained by age and race. Factor 6 accounted for 6% of the variance, mainly explained by negative proximity to metro and airports. Factors 7 and 8 accounted for 5% and 4% of the variance, respectively.

2.4. Spatial dependence

Next, natural amenity variables, housing types, land developability, population density and the generated factors were incorporated into both an ordinary least squares (OLS) regression model and an appropriate spatial regression model to examine and compare their effects on migration. Migration is a demographic characteristic often found to be spatially clustered. This observed pattern of spatial inter-relation has been well explained by regional economic theories (Perroux, 1955; Christaller, 1966), theories of population geography (Bailey, 2005), and the findings of residential preference studies (Brown et al., 1997). Migratory factors such as natural amenities in a place (city, village, or town) attract migrants who move into both the place itself and its neighboring places because of access to benefits of the attractive place as provided by transportation infrastructure. Overall, these factors and effects tend to exhibit spatial process elements, which need to be controlled for in empirical models of migration. It is important to consider spatial interactions between migration and migratory factors because model estimation and statistical inference may be unreliable if the spatial effects exist but are not accounted for.

To diagnose and account for spatial dependence in the OLS model, it was necessary to establish a neighborhood structure via a spatial weight matrix for each location by specifying those locations on the lattice that are considered as its neighbors (Anselin, 1988). It is noted that there exists little theory to guide the selection of an appropriate spatial weight matrix. For this work, we created and compared forty spatial weight matrices, and selected the 3-nearest neighbor weight matrix which achieved the highest coefficient of spatial autocorrelation along with a high level of statistical significance.

The appropriate spatial regression model for incorporating spatial dependence can be suggested by Lagrange-Multiplier (LM) tests and robust LM tests for lag and error dependence (Anselin, 1988; Anselin et al., 1996). Among these tests, only the LM test for error dependence was significant (Table 3) thus suggesting a spatial error model[4] as appropriate for controlling spatial dependence. For comparison, both an OLS regression model and a spatial error model were employed to examine the migration effects of natural amenities and land developability.

Table 3. Diagnostics for spatial dependence in OLS residuals based on 3-nearest neighbor weight matrix.

Moran's I (error)	–0.14
Lagrange Multiplier test (lag)	3.63
Robust Lagrange Multiplier test (lag)	0.06
Lagrange Multiplier test (error)	4.31*
Robust Lagrange Multiplier test (error)	0.74

Note: * significance at $p \leq 0.05$

We employed the spatial regime model to further examine the spatial variations of natural amenity effects on in-migration across MCDs with more than 4 persons per square kilometer and MCDs with less than 4 persons per square kilometer. This was done to examine and distinguish "frontier" rural remote migration characteristics from relatively higher population small town elements. The spatial regime model simultaneously considers spatial dependence and variations of the coefficients across areal types (Patton and McErlean, 2003).

3. Results

3.1. Initial OLS regression

In the initial OLS regression model (Table 4), natural amenities, land developability, population density, housing type, road density, and control variables were applied to examine their effects on in-migration from 1995–2000. The proportion of public land area, the proportion of land area in forest, and viewsheds were the three natural amenity variables found to be statistically significant (each additional percent of public land area contributed 0.273 percent (i.e., percentage points) to in-migration; each additional percent of land area in forest reduced in-migration 0.157 percent; and each additional percent of viewsheds reduced in-migration 0.492 percent). None of the other five natural amenity variables played a statistically significant role in explaining in-migration.

[4] The spatial error model was specified as $Y = X\beta + u$, $u = \rho W u + \varepsilon$, where Y denotes a vector of response variables, X denotes the matrix of explanatory variables, W denotes the spatial weight matrix, and ε denotes the vector of error terms that are independent but not necessarily identically distributed. Spatial autocorrelation was modeled by an error term (u) and the associated spatially lagged error term (Wu).

Table 4. Ordinary least squares (OLS) regression model and spatial error model of migration effects.

	OLS	Spatial error model
Explanatory variables		
The proportion of water area	–0.020	–0.011
	(0.192)	(0.161)
The proportion of forest area	–0.157*	–0.163**
	(0.076)	(0.062)
The length of riverbank/lakeshore/coastline	0.001	0.001
	(0.001)	(0.001)
Golf courses	–1.52E–7	–2.96E–8
	(7.51E–7)	(5.75E–7)
Viewsheds	–0.492†	–0.712***
	(0.277)	(0.215)
The proportion of wetland area	0.051	0.028
	(0.090)	(0.070)
The proportion of public land area	0.273**	0.268***
	(0.095)	(0.077)
Population density in 1990	–3.86E–4	–3.59E–4
	(3.09E–4)	(2.71E–4)
The proportion of lands available for development	0.389**	0.376***
	(0.140)	(0.116)
SROU in 1990	4.65E–5	3.37E–5
	(3.26E–5)	(2.74E–5)
SROU growth rate from 1990–2000	0.023	0.020
	(0.015)	(0.014)
Highway density (km/km^2)	–0.218*	–0.175*
	(0.096)	(0.080)
County road density (km/km^2)	–0.018	–0.025
	(0.048)	(0.041)
Local road density (km/km^2)	0.034†	0.021
	(0.019)	(0.016)
Control variables		
The in-migration rate across county in 1985–1990	0.264*	0.222**
	(0.103)	(0.085)
Factor 1	0.018†	0.025**
	(0.011)	(0.008)
Factor 2	0.021	0.020
	(0.015)	(0.012)
Factor 3	–0.004	–0.001
	(0.007)	(0.006)
Factor 4	–0.017*	–0.019**
	(0.008)	(0.007)
Factor 5	0.027***	0.027***
	(0.008)	(0.007)
Factor 6	0.042***	0.042***
	(0.009)	(0.007)
Factor 7	0.010	0.013†
	(0.009)	(0.007)
Factor 8	–0.016†	–0.021**
	(0.009)	(0.008)
Spatial error term	/	–0.402***
		(0.121)
Constant	0.049	0.094
	(0.135)	(0.108)
Measures of fit		
Log likelihood	174.86	181.08
AIC	–301.72	–314.15
BIC	–233.09	–245.52

Note: †significance at $p \leq 0.1$, *significance at $p \leq 0.05$, **significance at $p \leq 0.01$, ***significance at $p \leq 0.001$; standard errors in brackets.

Land developability affected in-migration significantly. Each additional percent of land available for development contributed 0.389 percent to in-migration. Historical trend effects played an important role in promoting in-migration. MCDs that had previously experienced rapid in-migration were found to continue in-migration trends. Each additional percent of previous in-migration rate contributed 0.264 percent to in-migration. This historical trend effect, however, was less than the impact of land developability. Recreational housing units as measured by SROU in 1990 and growth in SROU 1990–2000 were insignificant in explaining in-migration trends. Three measures of road density were used, and state highway density and local road density were significant in the OLS regression. Each additional percent of state highway density (measured using shape files as kilometer of state highway per square kilometer of land area) reduced in-migration by 0.218 percent and each additional percent of local road density increased in-migration by 0.034 percent. While more work is needed to draw conclusions based on this finding, this could indicate that access was less important for in-migrants to this region.

3.2. *Spatial error model*

The effects of natural amenities and land developability on in-migration were further investigated in a spatial error model, as the OLS model's residuals exhibited spatial error dependence (Table 3). With a weight matrix capturing spatial influence within a range of three nearest neighbors, we used a spatial error model to control for significant spatial dependence. The captured spatial error dependence was statistically significant in affecting in-migration (Table 4). In turn, the spatial error model appeared to exhibit a better fit than the OLS regression model, based on the fact that the AIC and BIC values were smaller but the log likelihood was larger for the former. Thus, the spatial error model was deemed superior for interpreting the migratory effects of the explanatory variables.

In the spatial error model, the proportion of public land area played a stronger role in attracting in-migrants. Each additional percent of public land area contributed 0.268 percent to in-migration. Although public lands often overlap with area in forests, water, and wetlands, only the former (forests) had significant impacts on in-migration. One possible reason may be that forests need to be converted to open space for residential development; further, water, and wetlands do not, in and of themselves, have much recreational value. They become attractive only when they are accessed through recreational homes or managed recreational areas, such as parks, trails, wildlife refuges, and fishery areas. Our results suggest that viewsheds had a significant negative effect on in-migration. Each additional percent of sloped lands (with a slope of 12.5%–20%) reduced in-migration by 0.712 percent. While viewsheds are often seen as an exurban amenity in urban, suburban, and peri-urban areas, they do not appear to be such in the counterurbanization of the specific remote rural region used in this case study. This result may be due to the fact that sloped areas are primarily concentrated in publicly-owned forest areas, which are protected from development. Golf courses, which are typically viewed as an important recreational amenity in exurbanizing regions, were not significant in explaining in-migration within the case study region.

Land developability was statistically significant in attracting in-migrants using the spatial error model. Each additional percent of land available for development contributed 0.376 percent to in-migration. Higher levels of land developability allow for more new residential development. In this study, water, wetland, and tax-exempt lands were specified as undevelopable. These types of lands limit the potential for further development.

Results suggested that population density had no statistically significant relationship with in-migration using the spatial error model. Population density did not appear to affect migration into this remote rural region, possibly due to the frontier-seeking mentality of current in-migrants. Historical trend effects continue to remain significant in the spatial error model. Each additional percent of in-migration in previous decade contributed 0.222 percent to in-migration from 1995–2000. However, it should be noted that this historical trend effect was not as strong as land developability in attracting in-migrants.

Again, neither of the two recreational housing variables was found to be significant in the spatial error model. But the state highway density variable was again significant and negative. Each additional percent of state highway density (in kilometer of state highway per square kilometer of land area) reduced in-migration by 0.175 percent. Again, while more work is needed to draw conclusions based on this finding, this could indicate that access was less important for in-migrants to this region.

3.3. *Spatial regime modeling*

Results of the spatial regime modeling for the in-migration rate dependent variable are summarized in Table 5. The coefficient stability for each variable and the overall structural stability were diagnosed by the spatial Chow test (Anselin, 1990). Results of the spatial regime modeling suggest that the proportions of forest land area, water area, public land, land developability, and population density have significantly different effects in the two areal types. Overall, the spatial Chow test indicates that the coefficients between the two areal types exhibit instability; there exists a more pronounced in-migration effect in the MCDs with less than 4 persons per square kilometer when compared to their more densely populated cousins. We noted that seasonal, recreational, and occasional use housing units, while an important metric, only partially ($p \leq 0.1$) captures important transitions in housing options for both full-time and part-time residents in the frontier region.

4. Summary and conclusions

The structure of remote rural regions has experienced a fundamental change in recent decades, the transition marked by relative declines in traditional commodity-based land uses and increases in natural amenity-based recreation and touristic uses. This has taken place within unique developmental contexts and significant constraints to economic growth and socio-demographic change. Natural resources, their amenity characteristics, and land characteristics (ownership and developability) lie at the core of this transition. The extensions of our applied research reported here examined the migratory effects of natural amenities within a synthetic spatial framework in which we modeled land developability, land use, recreational homes, demographic characteristics, socioeconomic conditions, transportation accessibility, and spatial process effects to collectively explain migration. Specific distinctions of our work address counterurbanizing elements important to expansion of human settlement into the frontier.

We developed a spatial modeling approach to compare the effects of natural amenities and land developability on migration at the minor civil division level in a case study remote rural region of northern Wisconsin. We systematically considered other influential factors of migration and reduced their dimensions using factor analysis in order to better facilitate regional modeling. Spatial dependence was carefully diagnosed and incorporated into the model, which helped improve model fitting balanced with model parsimony. We then separated the regions into two regimes based on population density to examine "frontier" effects on migration.

Our empirical findings suggested that the proportion of public land area was statistically significant in explaining in-migration to the frontier region. Other natural amenity variables such as water, wetland, the lengths of lakeshore/riverbank/coastline, and golf courses did not have statistically significant effects on in-migration within the demographic, socioeconomic, and transportation context. We posit that public lands provide a key access component that connects underlying natural resource-based amenities to the leisure pursuits of in-migrants. Land available for development appears to be important in attracting in-migrants into the case study region. Our results suggest that the higher the level of land developability, the higher the in-migration rate.

There are ample opportunities for further research along these thematic lines. Extending, refining, and adapting a more systematic examination of migration and economic development in remote rural regions will, no doubt, become increasingly important. Our empirical spatial analysis used 129 MCDs in eight Northwood counties of Wisconsin, a case representation of a rather unique set of natural amenity types and rural development contexts. Further, this work was specific to regional migration during the decade of the 1990s. Future research can extend both temporally and geographically into a larger set of remote rural regions across a longer time frame. This would have the benefit of generating a broader, more robust set of results aimed at helping us understand the impacts of natural amenities and land developability on population redistribution as well as economic growth and development.

In addition, the role of policy instruments in conserving natural amenity attributes and land developability should be investigated. On the one hand, policy instruments can act to maintain and improve natural amenity endowments of remote rural regions. On the other hand, these instruments can act to limit land development and, hence, migration, especially for regions with less available lands for development. In much the same vein as results reported in recent recreational home regions of

Table 5. Spatial regime/spatial error model of migration effects in remote and frontier regions.

	> 4 persons/km^2	< 4 persons/km^2	*Instability*
Explanatory variables			
The proportion of water area	–0.357	0.317	*
	(0.241)	(0.231)	
The proportion of forest area	–0.042	–0.407**	*
	(0.115)	(0.130)	
The length of riverbank/lakeshore/coastline	0.001	0.001	
	(0.001)	(0.001)	
Golf courses	–1.72E–7	–8.51E–7	
	(1.01E–6)	(1.06E–6)	
Viewsheds	–0.282	–0.583†	
	(0.391)	(0.352)	
The proportion of wetland area	0.014	–0.013	
	(0.114)	(0.125)	
The proportion of public land area	0.124	0.455***	†
	(0.128)	(0.117)	
Population density in 1990	–0.001†	–0.035**	**
	(3.52E–4)	(0.011)	
The proportion of lands available for development	0.077	0.731***	**
	(0.178)	(0.185)	
SROU in 1990	3.58E–5	1.57E–4†	
	(3.80E–5)	(8.18E–5)	
SROU growth rate from 1990–2000	0.023	–0.026	
	(0.016)	(0.032)	
Highway density (km/km^2)	–0.171	–0.218†	
	(0.122)	(0.121)	
County road density (km/km^2)	0.033	0.038	
	(0.064)	(0.138)	
Local road density (km/km^2)	0.050*	0.007	
	(0.022)	(0.034)	
Control variables			
The in-migration rate across county in 1985–1990	0.252	0.194†	
	(0.171)	(0.108)	
Factor 1	0.033†	0.015	
	(0.019)	(0.015)	
Factor 2	0.009	0.066*	
	(0.019)	(0.032)	
Factor 3	–8.86E–5	–0.035	
	(0.007)	(0.100)	
Factor 4	–0.023	–0.014	
	(0.013)	(0.012)	
Factor 5	–0.048	0.040***	
	(0.063)	(0.008)	
Factor 6	0.024*	0.076***	**
	(0.012)	(0.016)	
Factor 7	–0.016	0.001	
	(0.016)	(0.011)	
Factor 8	–0.025	–0.004	
	(0.020)	(0.010)	
Constant	0.175	0.083	
	(0.167)	(0.185)	
Spatial error term	0.009		
	(0.115)		
Measures of fit			
Spatial chow test	44.985 on (24, 129) degrees of freedom**		
Log likelihood	194.992		
AIC	–293.984		
BIC	–156.713		

Note: †significance at $p \leq 0.1$, *significance at $p \leq 0.05$, **significance at $p \leq 0.01$, ***significance at $p \leq 0.001$; standard errors in brackets.

northern Wisconsin (Clendenning and Field, 2005; Jensen and Field, 2005), natural resource policies, both public and private, can have effects beyond the physical and biotic aspects of regional natural resource endowments. Important human dimensions of resource policy include population dynamics as well as the economic and social development of remote rural regions.

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