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Abstract

Climate, topography, and water area are highly related to rural county population change over the past 25 years. A natural amenities index, derived and discussed here, captures much of this relationship. Average 1970-96 population change in nonmetropolitan counties was 1 percent among counties low on the natural amenities index and 120 percent among counties high on the index. Most retirement counties and recreation counties score in the top quarter of the amenities index. Employment change is also highly related to natural amenities, although more so over the past 25 years than in the current decade. The importance of particular amenities varies by region. In the Midwest, for example, people are drawn to lakes for recreation and retirement, while people are attracted to the West for its varied topography.

Keywords: natural amenities, population change, retirement, recreation

Acknowledgments

This report summarizes work that was carried out over several years. Diane Bohlbach Ray and Kathleen Kassel worked with me to develop and validate a set of measures of natural amenities and a summary index as part of a study of rural job growth. They deserve considerable credit. This report draws on the earlier work, but the index presented is slightly different, a result of more extensive analysis. I thank Calvin Beale, Linda Swanson, and Kathleen Kassel for their comments on earlier versions of this report.

Data tables for this report can be found at http://www.ers.usda.gov/Data/naturalamenities/

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Summary

Population change in rural counties since 1970 has been strongly related to their attractiveness as places to live. Natural aspects of attractiveness can be summarized in three types of amenities: mild climate, varied topography, and proximity to surface water—ponds, lakes, and shoreline. Counties scoring high in a scale of these amenities had substantial population growth in the last 25 years. High-scoring counties tended to double their population, while the average gain for the low-scoring counties was only 1 percent, and over half lost population. Not all high-amenity counties had high growth, however.

Counties high in natural amenities and with strong population growth are found primarily in the West and Southwest, where the climate is mild, the topography varied, and lakes or the ocean are easily accessible. By contrast, many rural counties in the Midwest lack these amenities and have lost population in the past 25 years. County population change is more highly related to these natural amenities than to urban proximity, population density, or economic type, although these too play a role.

Natural amenities are related to an area's popularity for retirement or recreation. Nearly two-thirds of the nonmetro counties dependent on recreation industries and three-fourths of those classified as retirement destinations fall in the top quarter of counties in natural amenities. Recreation counties, however, are not necessarily attractive as places to live year-round. Although they do tend to have sunny winters, mild summers, mountains, and lakes or coastal settings, recreation counties are less characterized by warm winters than are areas of high population growth because the colder winters discourage year-round living.

The natural amenities index is related to population change across the country, but less so to population change within particular regions, such as the Midwest or Northeast. There are tiers of attraction for natural amenity areas. Some areas are attractive at the national level, drawing people from across the country—the Rocky Mountains or Florida, for example. Other areas have limited national attraction, but draw people from within the region for recreation and retirement—like the lake areas of the northern Midwest.

Employment change in rural counties over the past 25 years has also been highly related to natural amenities. Counties low on the scale had relatively little growth, while high-scoring counties had an average of three times as many new jobs in 1996 as in 1969. Employment change, however, varies across counties a great deal more than population change, particularly among higher-amenity counties. The accessibility of counties to recreational visitors is probably more critical for determining where employers go than where people move. County employment change has also been less related to warm county winters than has population change, probably because of the development of recreation industries in areas that are only seasonally attractive.

Natural Amenities Drive Rural Population Change

David A. McGranahan

Introduction

Natural resources have long been a major factor in rural population change. But where natural resources once attracted people seeking fertile land, minerals, and timber, they now attract people in search of a pleasant environment for recreation and residence. Extractive industries, long the major economic force in rural areas, have tended to lose economic importance or undergo technological transformation so that they now support ever smaller populations. At the same time, growth in recreation, retirement, and, more recently, information-based industries has induced many to move to areas high in natural amenities.

Galston and Baehler (1995) note that "the kinds of natural characteristics regarded as 'amenity values' by retirees, vacationers, and certain businesses have emerged as the chief new source of rural comparative advantage" (p. 15), but evidence of the importance of natural amenities has been largely indirect, based on analyses of recreation industry location and the growth of retirement-destination counties (see, for example, Beale, 1997; Johnson and Beale, 1999). Climate measures have been used in migration literature (Clark and others, 1996), but with mixed results, a result in part of ill-conceived measurement and a reliance on States as units of analysis (Cushing, 1987). This report develops an index of natural amenities and ties that index to changes in nonmetro population over the past 25 years.[1]

For purposes of this study, an amenity is an attribute that enhances a location as a place of residence. It may be quite distinct from an attribute attractive to tourists. While some tourism involves travel to places attractive for residence, tourism also involves travel to places that are seasonally attractive or somehow unique—caves, canyons, historic sites, theme parks, and, especially in more recent years, casinos. These unique places may or may not be attractive as places to live.

Natural amenities pertain to the physical rather than social or economic environment and are meant to exclude much of what is man-made, such as historical buildings or casinos. In this study, the measures include climate, topography, and water area. Physical beauty arising from combinations of topography, water, flora, and fauna is a natural amenity beyond the scope of this study. We can measure the basic ingredients, not how these ingredients have been shaped by nature and man.

[1]The measures have been available internally in ERS and used in analyses of population change (McGranahan, 1993), economic growth (Kusmin et al., 1996), and migration (Cromartie and Nord, 1996). The relationships between the measures of natural amenities and rural population change have not been explored nor has the rationale for scale construction been presented. The index presented here is slightly different, a result of more extensive analysis.

Measures of Natural Amenities

The six measures used in this study were selected on the basis of a conception of the environmental qualities most people prefer, availability of measures, simplicity, nonredundancy, and the correlation to population change (table 1). Hawaii and Alaska were not included, as data were not always available. Because it is difficult to handle a number of separate indicators in a given analysis, a simple additive scale was developed, with some adjustment for the interrelationships among the measures.

Warm winter (average January temperature). People are attracted to areas with warm winters. Southern areas of the country generally have the warmest winters, while the upper Midwest and the Rocky Mountains experience the coldest (see Map 1). Coastal areas are generally warmer than inland. This measure, and the others relating to climate, was drawn from the Area Resources tape issued at the time by the Center for National Health Statistics, U.S. Department of Health and Human Services.

Winter sun (average January days of sun). Brochures almost inevitably show sunny skies. The Southwest has the sunniest Januaries while the Pacific Northwest has the cloudiest (Map 2). Some areas around the Great Lakes also have frequent January overcast.

Table 1–Natural amenity statistics for nonmetro counties

Measure	Units	Average	Minimum	Maximum
January temperature	Degrees F	32.9	1.1	67.2
Days of sun in January	Days	15.2	4.8	26.6
July temperature	Degrees F	75.9	55.5	93.7
July humidity	Percent	56	14	80
Water area	Percent	3.2	0	75
Topography	Scale	8.9	1	21

Sources: Calculated by ERS from sources described in text.

Temperate summer (low winter-summer temperature gap). While less so with the widespread use of air conditioning, summer heat is still a drawback. Places warm in the winter tend to be hot in the summer: the correlation coefficient between average January and average July temperatures is 0.74 for counties. What seems most desirable is a temperate climate, with relatively little temperature gain between January and July.

One possible measure of temperate climate would be the gain in temperature between January and July, with a low gain indicating a more favorable climate. However, places cold in the winter tend to have greater gains in temperature between winter and summer. The size of the variance in average July temperature across counties is only 20 percent of the size of variance in average January temperature. This means that the temperature difference between January and July is largely redundant with the January temperature measure.

To solve this problem, the residual of a simple regression of July temperature on January temperature was used to reflect low gain in temperature, i.e., a temperate climate. In effect, we asked how much higher or lower the July temperature is, given what one would predict on the basis of the January temperature. Since residuals are not correlated with independent variables, this produced a measure of temperate climate not at all redundant with the January temperature measure.

Mountainous areas and areas along the west coast tend to have the most temperate summers according to this measure (Map 3). The Central and Southern Plains, southern Arizona, and the Imperial Valley in California have the least temperate summers.

Summer humidity (low average July humidity). Humidity, which adds to summer discomfort, is relatively low in the West, except along the coast (Map 4). July humidity is high in much of the Southeast (although humidity tends to be lower in southern Florida than in northern Florida and southern Georgia.).

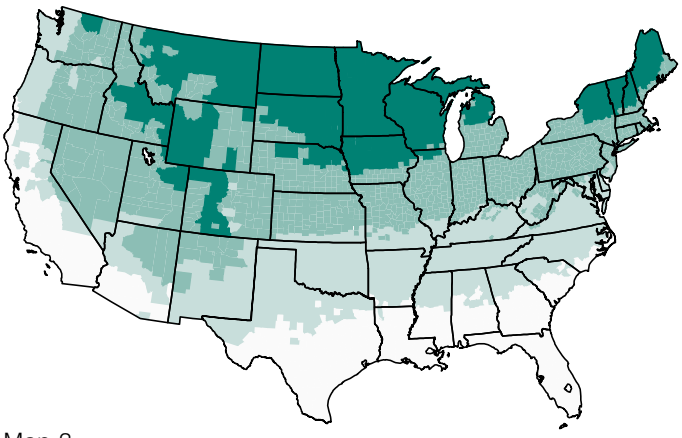
Topographic variation (topography scale). In general, the more varied the topography, the more appealing the setting. To measure topography, we

Figure 1

Maps of natural amenity measures

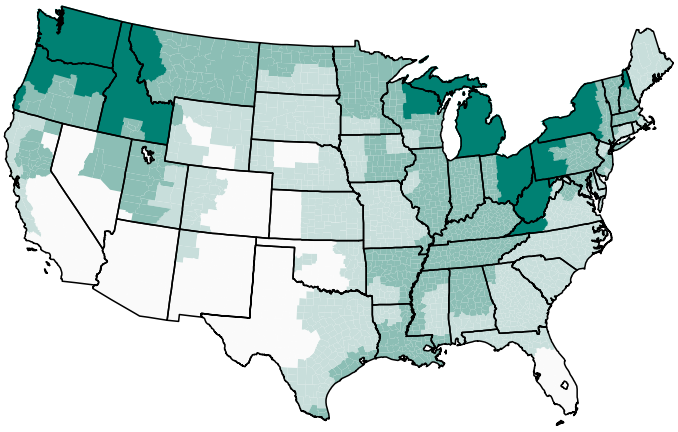
Map 1

Warm winter



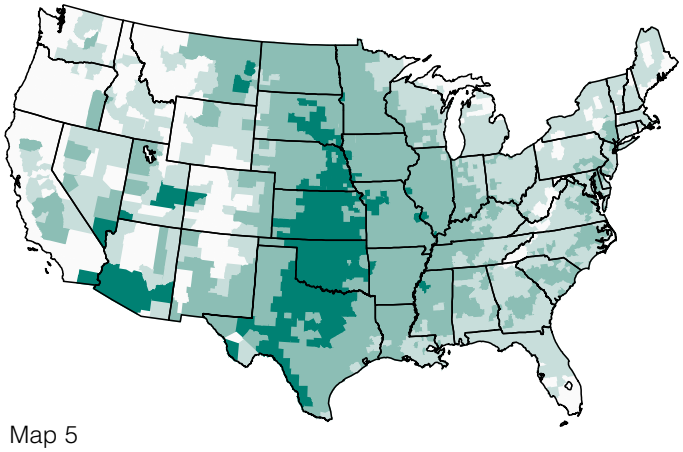
Map 2

Winter sun



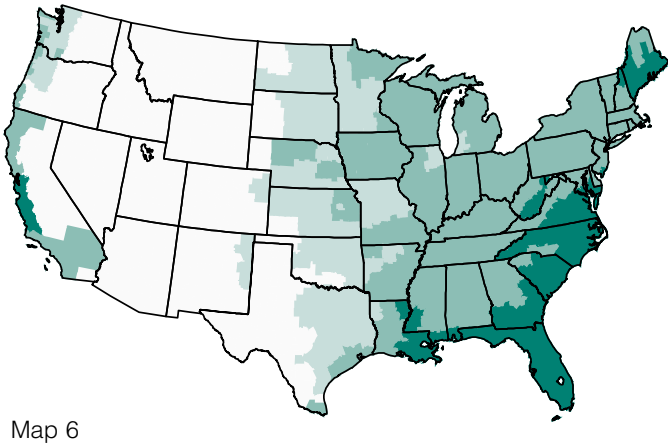
Map 3

Temperate summer



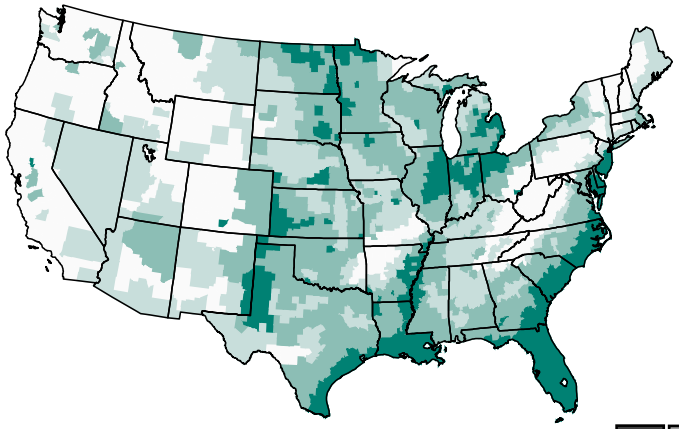
Map 4

Low summer humidity



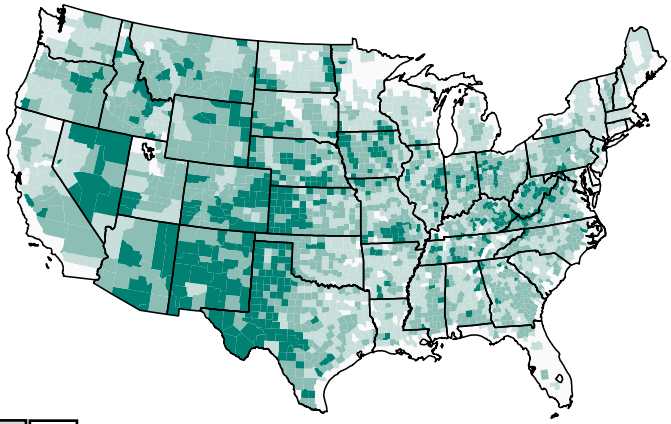
Map 5

Topographic variation



Map 6

Water area



Note: Maps are standard deviation (s.d.) units from mean, with darkest color over 1 s.d. below mean and lightest over 1 s.d. above. Lighter colors indicate higher scores.

drew on a topographic map in *The National Atlas of the United States of America* (1970). This map delineated five basic land formations: plains, tablelands, plains with hills or mountains, open hills or mountains, and hills and mountains. Within each of these broad categories, land was distinguished by its degree of variation. For example, the "plains" category ranged from "flat plains" to "irregular plains," and the "hills and mountains" category ranged from "hills" to "high mountains." A total of 21 categories were delineated. We created a county map overlay and mapped the topography onto the county map. Where a county had more than one type of land formation, we assigned the highest of the categories that applied, provided this higher category appeared to apply to at least 25 percent of the county area. At the high end of the scale, the resulting county map reproduces the principal mountain ranges in the country and, at the low end, the coastal plains (Map 5).

Water area (water area as proportion of total county area). Coastal areas and areas with lakes are more pleasant than areas lacking surface water. Coding water area proved a problem, however. In this data tape, from the Bureau of the Census, coastal waters, because the boundaries extend out 3 miles, are inevitably large and dwarf inland lakes in their surface area. The problem is particularly distorting in the Great Lakes, as the entire water area within U.S. boundaries is assigned to counties along the shores. Two adjustments were made to reduce what seemed to be the undue influence of coastal waters. First, we limited the amount of water area measured to a maximum of 250 square miles. This reduced the outlier problem in the Great Lakes, but still left the measure as one that discriminated coastal from inland counties but gave inland lakes and ponds little weight. The second adjustment was to take the logarithm of the percentage of county area in water, a transformation that accentuates differences at the low end and reduces them at the high end. Implicit in the transformation is the assumption that a difference between 5 percent and 10 percent in water surface area improves the attractiveness of an area as much as a difference between 10 and 20 percent.

A mapping of this measure shows some broad regional variations (Map 6). For instance, lakes and ponds are relatively rare in the Southwest and the Western Plains, particularly compared with the lakes areas of Minnesota and Wisconsin.[2]

[2] The above set of measures was culled from an original 12. We initially considered land in forest and (low) elevation as measures. Land in forest had no relationship with population change, however, either alone or in combination with other measures. The low elevation was included in the original scale and is discussed in Appendix 2 along with the original scale. Four other available climate measures–January precipitation and humidity and July precipitation and days of sun–were less intuitive amenities than the ones selected, highly related to the measures included, and less effective in predicting population change.

Relationships Among Measures

The resulting natural amenity measures are interrelated, but not so much so that any are redundant (table 2). Often, there are tradeoffs. Areas with more extensive water area, for instance, tend to have less winter sun and greater summer humidity. In other cases, the amenities tend to go together—areas with more winter sun also tend to have warmer winters, for instance. The highest correlation among the measures (r = 0.44) is between topographic variation and temperate summer. Mountainous areas tend to have cooler summers than plains areas with the same winter temperatures.

Average correlations among the natural amenity measures is near zero. No measure is consistently related, either positively or negatively, to the other measures. The low and inconsistent correlations suggest that most counties have some negative and some positive aspects to their amenities.

Table 2–Correlations among natural amenity measures, nonmetro counties

Amenity	Warm winter	Winter sun	Temperate summer	Low summer humidity	Water area	Topographic variation	Natural amenity scale
Warm winter	1.00	0.26	-0.04	-0.28	0.01	-0.14	0.36
Winter sun	0.26	1.00	-0.40	0.20	-0.29	-0.25	0.25
Temperate summer	-0.04	-0.40	1.00	-0.09	0.13	0.44	0.41
Low summer humidity	-0.28	0.20	-0.09	1.00	-0.28	0.22	0.40
Water area	0.01	-0.29	0.13	-0.28	1.00	-0.13	0.19
Topographic variation	-0.14	-0.25	0.44	0.22	-0.13	1.00	0.52
Average correlation with other measures	-0.04	-0.09	0.01	-0.04	-0.11	0.03	

Population Change

Average rural county population growth was high in the 1970's, tapered off to only 1 percent in the 1980's, and then rebounded in 1990-96. The actual average rural growth in the 1970's is underestimated as we used a constant 1983 definition of rural (nonmetro) for all the analyses: one consequence of rapid rural growth in the 1970's was a reclassification of many nonmetro counties as metro based on the 1980 census.

Rural county population change during 1970-96 has been highly uneven across counties (table 3). In any decade, while many counties lost population, others grew by a third or more. Over the past 25 years these differences have accumulated. The county with the greatest growth over the period, Flagler County, Colorado, had nine times as many people in 1996 as in 1970. It was classified as a metro county based on the 1990 Census of Population. The county with the greatest decline, Burke County, North Dakota, lost nearly half of its population during the same period.

The shape of the distribution of population change during 1970-96 is "log normal," generally rounded but with a tail to the right (fig. 2). The distributions for each period—1970-80, 1980-90, and 1990-96—have similar if less pronounced patterns. For this reason, we used the natural log transformation of population change as the dependent variable in our statistical analyses.

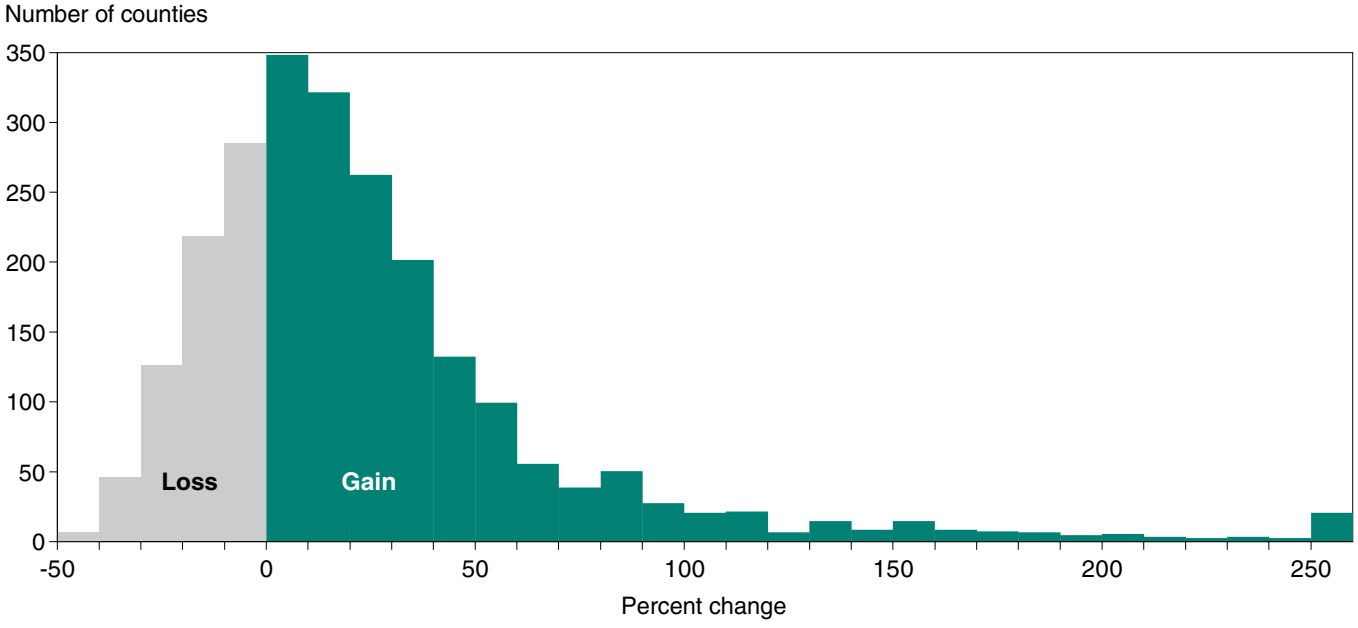
Table 3–Population change statistics for nonmetro counties (N=2,358)

	Population change			
Statistics	1970-80	1980-90	1990-96*	1970-96
	Percent			
Mean	14.2	1.2	9.2	25.8
Standard deviation	20.8	14.5	15.1	55.5
Minimum	-44.5	-32.0	-37.5	-55.1
Maximum	232.0	163.0	132.8	846.2

*10-year rate.

Source: Calculated by author from Census of Population STF3 data tapes and Bureau of the Census 1996 population estimates.

Figure 2
Frequency distribution of 1970-96 population change



Other Measures in Population Change Analysis

Settlement, economic base, and poverty measures are used in the analysis both as control measures and as means of assessing the relative importance of amenities for county population change. The main settlement measure used is the urban influence code developed by Ghelfi and Parker (1997), an adaptation of a scale originally developed by Hines, Brown, and Zimmer (1976) and Butler and Beale (1994). The urban influence code comprises two aspects of the urban-rural continuum: proximity to urban areas and size of largest settlement within the county.

In general, the share of population has been decreasing in rural counties that are remote from metropolitan areas and increasing in rural counties adjacent to major metropolitan areas, although the strength of this population shift has varied from decade to decade. As a supplement, to reflect possible lower inmigration to very densely settled areas and net outmigration from sparsely settled areas, the density of population in 1990 and its square were also used in the analysis.

Another set of measures used is county economic base—whether a county specializes in agriculture, mining, or manufacturing. The residual group either specializes in services or has a mixed economic base. This set is drawn from the ERS economic typology and has been used frequently in its reports on socioeconomic change, in *Rural Conditions and Trends* (1997), for instance. Finally, whether a county has had persistent poverty, also drawn from the ERS typology, is used to reflect economic opportunities.

The amenity measures do not have equally strong relationships with population change. Temperate summer is consistently the most highly correlated with population change, with coefficients ranging from 0.31 (1980-90) to 0.38 (1970-96) (table 4). On the other hand, winter sun generally is related only weakly to population change. We saw earlier, however, that the amenities themselves are interrelated and that often there are tradeoffs, with high values on one measure often associated with lower values on another. The question is then whether a given measure is related to population change when differences in the other amenity measures—and the economy and settlement pattern measures—are taken into account statistically.

Each of the amenity measures is related to population growth when other measures are held constant through statistical controls. Winter sun is important in the context of other variables. Winters tend to be sunniest where summers are least temperate and water area is lowest. For any given summer climate and extent of water area, however, population has tended to move to where winters are sunnier. In several cases, the standardized coefficients are strongest for change over the entire 1970-96 period, suggesting that the long-term influence of amenities is dissipated in the short term by episodic disturbances that may be related to general business cycles and booms and busts in particular sectors, such as agriculture, mining, and manufacturing. As shown in the next section, the amenity measures together add considerably to our understanding of where population is growing in rural areas and where it is declining.

Table 4–Correlations and standardized regression coefficients reflecting relationships of amenity measures to population change [1]

Statistics and measures	1970-80	1980-90	1990-96	1970-96
Correlations:				
Warm winter	0.22	0.29	0.19	0.27
Winter sun	-0.03	0.07	-0.02	0.01
Temperate summer	0.36	0.31	0.34	0.38
Low summer humidity	0.10	-0.01	0.13	0.08
Water area	0.16	0.21	0.12	0.20
Topographic variation	0.28	0.12	0.25	0.24
Standardized coefficients: [2]				
Warm winter	0.23	0.24	0.23	0.27
Winter sun	0.12	0.24	0.11	0.18
Temperate summer	0.28	0.32	0.29	0.33
Low summer humidity	0.27	0.23	0.31	0.30
Water area	0.19	0.19	0.13	0.20
Topographic variation	0.18	0.07	0.16	0.16

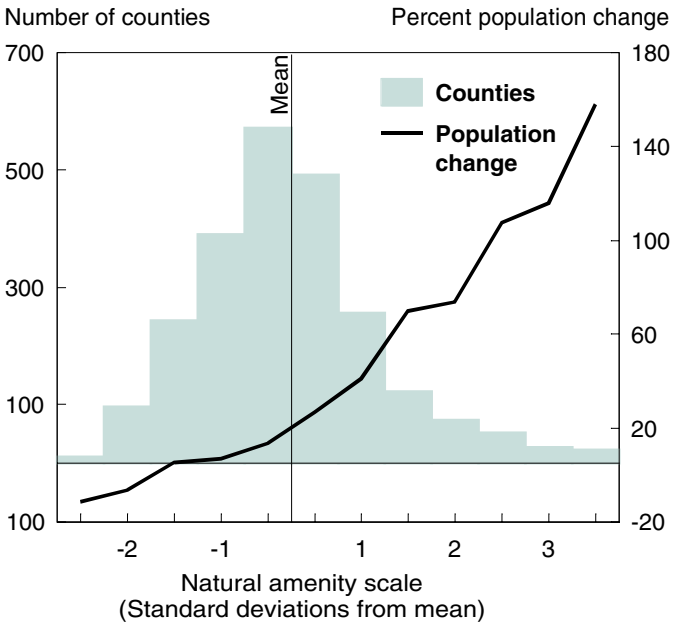
[1] Population change computed as $\log_e$ (100*population t1/population t0).

[2] From OLS regression analysis, controlling for county economic type, high poverty, and urban influence code (expressed as dummy variables) as well as the other amenity measures.

Can these measures be summarized in a scale of natural amenities so that we can conceive of areas as differing in their levels of "natural amenities"? We created the simplest type of scale and tested its ability to predict county population change against the combined predictive ability of the six separate items. Because each item had different scales, the amenity measures were standardized so each had a mean of zero and a standard deviation of one. The combined scale was created by summing those standardized measures.

Although each measure has an equal direct influence on the resulting scale, their correlations with the natural amenity scale differ because the measures themselves have different correlations with each other (table 2). Measures having strong positive correlations with the other amenity measures (topographic variation, for instance) are more strongly related to the scale than measures that tend to be weakly or even negatively associated with other amenities (water area, for instance).

Figure 3
Number of counties and mean nonmetro county population change, by natural amenities



The amenity scale itself has a bell-shaped distribution, which makes it appropriate for statistical analyses without further transformations (fig. 3). The higher the score on the scale, the higher the level of average population growth during 1970-96. The relationship is quite strong: counties with extremely low scores on the scale tended to lose population over the 1970-96 period, while counties with extremely high scores tended to double their populations over the period. High-amenity counties have accounted for much of the rural population growth. The counties in the top quarter of the natural amenities scale, with only 22 percent of the nonmetro population in 1970, had over half of the gain in nonmetro population between 1970 and 1996. At the same time, a high score on the scale does not guarantee growth: much of the variation in population growth occurs at the high end of the scale (see appendix fig. 1).

How well does the scale predict population growth compared with using the scale items separately? Regressions on rural county population change indicate that the scale captures much of the variance explained by the individual measures.[3] For 1970-96, the individual amenity measures added 24 percentage points to the variance "explained" by the economic base, poverty, population density, and urban influence—more than doubling the total variance explained (table 5). Using the natural amenity scale instead of the individual measures reduced the additional variance explained by less than 8 percent, so not much

[3] If we were able to predict population change exactly on the basis of the measures used in the analysis, the variance explained would be one. If the measures used were of no use in predicting change, the variance explained would be zero. While the natural amenities scale improves our ability to estimate population change, and thereby understand its bases, the measures used in the present analysis leave much of their change unexplained.

predictive ability is lost by combining the items into a single scale—at least for long-term population change.

For the shorter time periods, neither the set of individual items nor the index are as effective in predicting population change, because of other influences unique to each decade. The amenity scale is less able to capture the variance in population change associated with the set of amenity items in the 1980's and early 1990's than in the 1970's or over the entire 1970-96 period, but still the proportion captured remained above 85 percent. No matter what the time period, the amenity scale explains about as much (and sometimes much more) of the variance in population change as all the economic base and settlement pattern variables combined. The amenity measures, whether in a scale or considered separately, were least effective in 1980-90, a period of net outmigration from rural areas, suggesting that natural amenities are more relevant for rural county inmigration than for outmigration. This suggests that the pull of high amenities is greater than the push of low amenities.

To explore the contributions of the individual items to the scale, the analyses were rerun, each time with a different item removed from the scale. For some time periods, one or another item contributed little to the predictive ability of the scale, but in no case was the overall amenity scale less effective in predicting population growth than a reduced scale. For population change, temperate summer and topographic variation are the most central items in the scale. Their removals reduce the effectiveness of the scale the most.

Table 5–Comparison of county population change regression results using the natural amenity items individually and as a scale [1]

Statistic	Formula	1970-80	1980-90	1990-96	1970-96
A. Adjusted R^2					
1 Base measures only		0.163	0.213	0.119	0.193
2 Six amenity items added to base		0.363	0.401	0.320	0.437
3 Amenity scale added to base		0.351	0.375	0.290	0.418
B. Addition to adjusted R^2					
1 All measures individually	(A2-A1)	0.201	0.188	0.201	0.244
2 Amenity scale	(A3-A1)	0.188	0.162	0.171	0.225
3 Difference	(B1-B2)	0.013	0.026	0.030	0.019
C. Percent loss in additional variance explained when scale is used, rather than individual items	(100xB3/B1)	6.3	13.8	14.9	7.7

[1] Other measures in the analysis include county economic type, high poverty, population density and its square, and the urban influence code.

Figure 4

Amenity scale by county, 1970-96

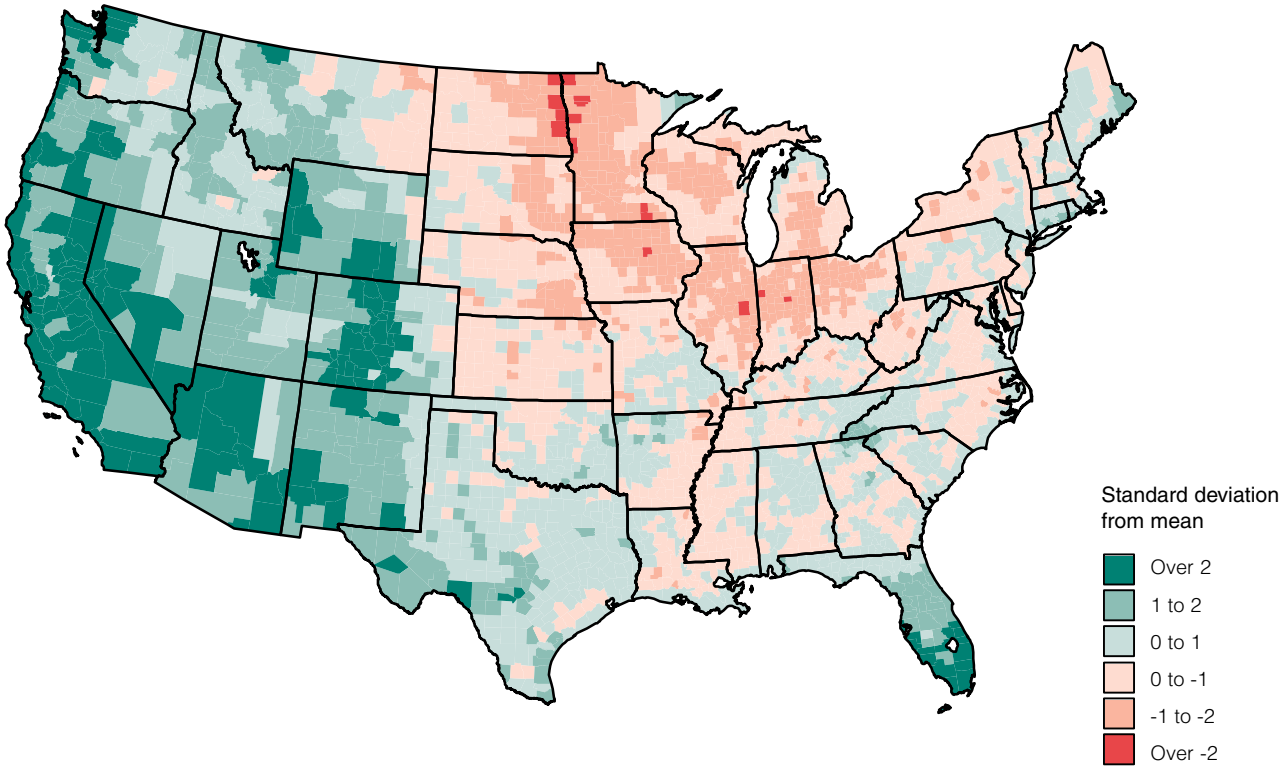
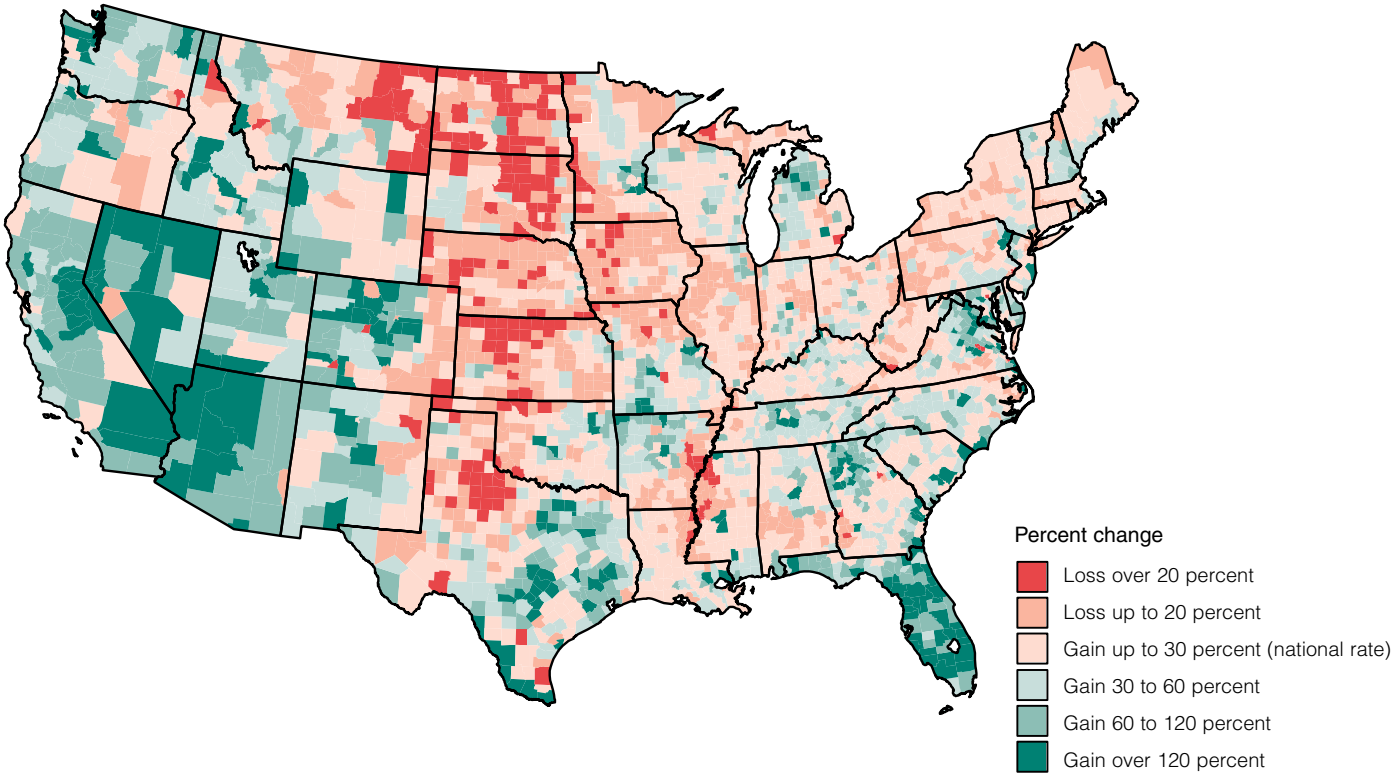


Figure 5

Population change by county, 1970-96

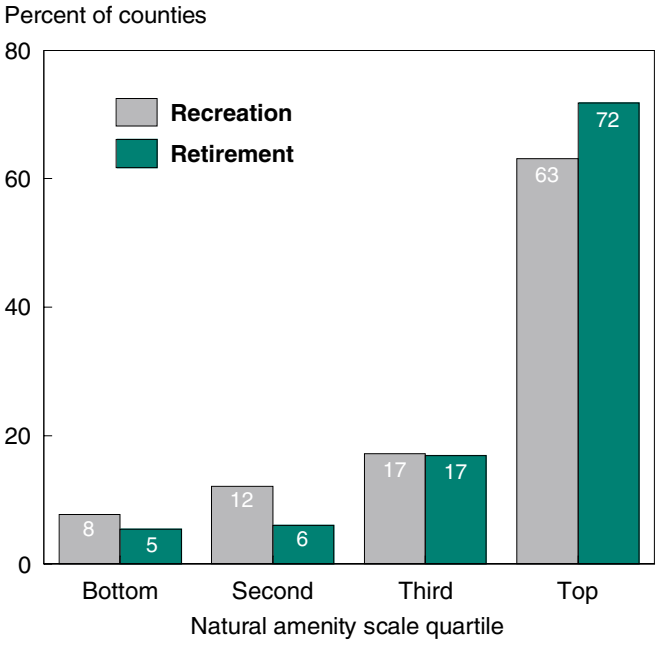


Recreation and Retirement Counties

Rural counties specializing in recreation or attracting retirees have considerably higher rates of population growth than other rural counties (Beale and Johnson, 1998). For a significant number of these counties, natural amenities are probably major factors underlying their development. However, vacationers and retirees are not always drawn to areas with the same types of natural amenities. Only a third of the 282 recreation counties had enough net inmigration in 1980-90 of people age 50 and over (in 1980) to be considered one of the 191 retirement-destination counties.

According to the natural amenity index, amenities are conducive to the development of retirement and recreation counties, but not required. More than 70 percent of the retirement counties and about 63 percent of the recreation counties are among the top quarter of counties in natural amenities (fig. 6). At the same time, nearly 20 percent of the recreation counties are in the bottom half of the counties in natural amenities.

Figure 6
Distribution of rural recreation and retirement counties by level of natural amenities



But does the amenity index, validated on the basis of its ability to predict population change, completely capture the relationships between natural amenities and the development of these two county types? For each type, we repeated the analyses described, substituting recreation or retirement for population change. The natural amenities scale works as well as the individual measures in the case of retirement counties—little explanation of variance is lost (table 6). But the scale falls short by over a third in capturing the relationships between the natural amenity measures and designation as a recreation county.[4] The major source of the discrepancy is that recreation counties are associated more with cold winters than with warm, other things being equal.

Part of the explanation may lie in the seasonality of recreation activities in many areas. Recreation industries, which deal more with transient than permanent populations, seem more likely to dominate in areas that are seasonally attractive rather than in areas that are attractive year-round. The lake regions of Minnesota and Wisconsin, for instance, have a number of recreation (and retirement) counties even though most have low scores on the natural amenity scale. These areas have cold winters but fairly temperate summers, when vacationers are drawn to the lakes. Except for people who work in recreation industries, people and businesses moving to the periphery of the Minneapolis-St. Paul regional influence, and people (usually from the region) who retire to their vacation homes, few are attracted to these regions as permanent residents—at least compared with regions in the South and West. Cold winters thus discourage many permanent residents but, in the context of other amenities, encourage recreational visitors.

[4] For consistency, OLS regression analysis was used here, as elsewhere. Logistic regression is more appropriate in this case, however, given that the dependent variables (recreation and retirement counties) are dichotomous--either a county is or is not one of these types. A repetition of the analysis using this alternative form of regression analysis yielded the same essential pattern of results.

Table 6–Regressions of recreation and retirement county status on amenity measures[1]

Measures and results	Formula	Dependent variables		
		Recreation county	Retirement county	Population change (1970-1996)
A. Standardized regression coefficients:				
Warm winter		-0.08	0.16	0.25
Winter sun		0.23	0.2	0.15
Temperate summer		0.33	0.22	0.33
Low summer humidity		0.11	0.11	0.22
Water area		0.26	0.24	0.2
Topographic variation		0.19	0.12	0.16
B. Adjusted R^2:				
1 Base measures only		0.027	0.02	0.193
2 Six amenity items added to base		0.248	0.161	0.437
3 Amenity scale added to base		0.172	0.153	0.418
C. Addition to adjusted R^2:				
1 Amenity measures individually	(B2-B1)	0.221	0.141	0.244
2 Amenity scale	(B3-B1)	0.145	0.133	0.225
3 Difference	(C1-C2)	0.076	0.008	0.019
D. Percent loss in additional variance explained when scale is used, rather than individual items		34.4	5.7	7.7

[1] In addition to the amenity measures, the analyses include county economic type, high poverty, population density and its square, and the urban influence code.

Natural Amenities and Employment

Rural development efforts and measurement often focus on job creation. Changes in county employment and population over the past 25 years are related, but the correspondence is less than complete. The correlation between employment change during 1969-96 and population change during 1970-96 (both measures in $\log_e$ terms) was 0.86 for nonmetro counties, indicating that they have been subject to somewhat different influences.

Over the past 25 years, employment, like population, has tended to expand more rapidly in nonmetro counties with higher scores on the natural amenities scale (fig. 7). Employment growth was particularly large at the highest end of the amenities scale—three standard deviations above the mean. Employment in the 25 rural counties at this amenity level grew an average of over 350 percent over this period, far exceeding this group's average population growth of 150 percent.

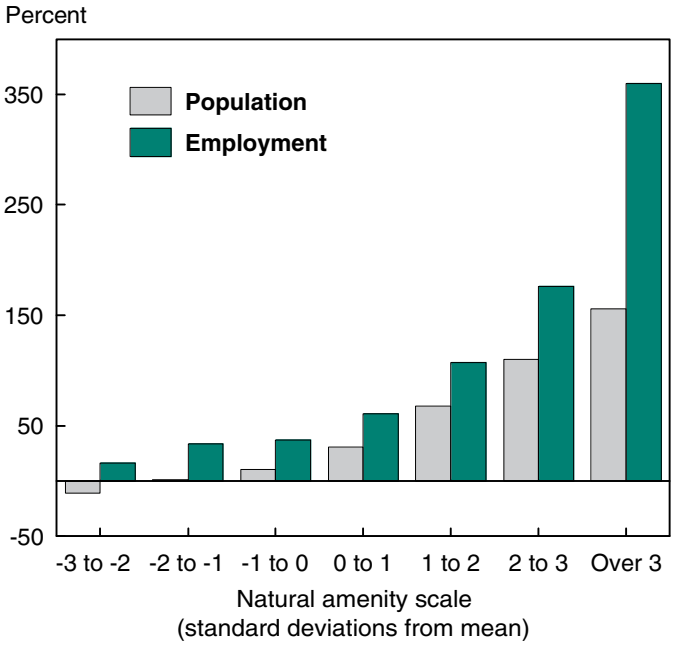
But not all high-amenity counties experienced these rates of growth. Employment change was quite uneven across counties, much more so than population change (see appendix fig. 2).[5] At any amenity level, no matter what the prevailing employment growth rates, 10 percent or more of the counties either had almost no growth or had lost jobs. The variation was particularly high at the highest end of the amenities scale. Summit and Gilpin, two Colorado recreation counties immediately west of Denver, had around 20 times as many jobs in 1996 as in 1969. Over the same period, employment in Lake County, a mining county adjacent to Summit County, fell by a quarter.

More generally, major rural employers—manufacturers, mining concerns, and, recently, prisons and casinos—are motivated by a number of factors in choosing their locations, including the availability of low-cost labor, natural resources, and access to cities. The opening and closing of these enterprises may create major changes in county employment without commensurate changes in population. People may enter or drop out of the labor force depending on job availability. And workers may commute rather than move to the counties where their jobs are.

Consistent with the wider variation in employment change, regression analysis of 1969-96 employment change (log-transformed) shows it to have a weaker association with the amenity measures than does population change (table 7). The addition to the variance explained by the individual measures is 0.17 for employment change, compared with 0.24 for population change (table 5). The (unstandardized) regression coefficients for the amenity index, however, are 0.74 in the population change analysis and 0.66 in the employment change analysis, a difference of only about 11 percent. This indicates that the weaker association with amenities found for employment stems largely from the greater variability in employment growth across rural counties.

Contributing to the weaker overall association between natural amenities and employment change is a lack of association of warm winters with employment change.

Figure 7
Mean changes in nonmetro county employment, 1969-96, and population, 1970-96, by natural amenity level



[5] This variability extends across time as well. Employment change in the 1970's, 1980's, and 1990's had intercorrelations of 0.30–0.35, meaning that knowing a county's employment change in one decade is of little help in predicting its employment change in another. In contrast, the corresponding coefficients for population change were all above 0.60, indicating much greater continuity.

In this, the results are similar to those for the recreation counties, and may reflect the development of recreation activities in many counties high in natural amenities except for their cold winters. Thus, counties attractive to visit in the winter or to spend the summer, but not the most comfortable to live in year-round, have had considerable job growth (although much of the job growth is likely to be seasonal). As a result, the natural amenities scale explains 17 percent less of the additional variance than the set of individual amenities measures. If we drop the warm winter measure from the scale, the resulting shorter scale has a stronger association with employment growth.[6]

The natural amenity measures, whether combined in a scale or not, are only weakly related to employment change during 1989-96. Although removing warm winter from the scale makes it more reflective of employment-amenities relationships, natural amenities (and the other measures in the analysis) still had little bearing on employment change in the early 1990's, much less than for the entire 1969-96 time period. These results are particularly perplexing, as the relationships are not correspondingly weak for population change in the 1990's.

One factor that may help explain why natural amenities do not seem to influence recent employment change is the development of casinos and prisons in rural counties in the early 1990's. These operations could add a great deal of employment without immediately affecting population. Tunica County (MS) is perhaps the most extreme case. It lost population between 1990 and 1996, but the development of a casino complex caused county employment to rise from 3,000 in 1989 to 16,000 in 1996. It seems likely that rural county employment statistics are generally more affected by individual casinos, manufacturers, and mines in a short time period (1989-96) than over a longer period. Employment related to population growth and natural amenities-based recreational activities is likely to accrue, in this region and others like it, over the long run.

[6] The same effect is obtained for the recreation county analysis, reducing the gap in explained variance between the scale and individual measures from 44 percent to 16 percent.

Table 7–Regional regression results for employment change, 1969-96 and 1989-96 (log_e)

Statistic	Formula	1969-96		1989-96	
		All measures	Exclude warm winter	All measures	Exclude warm winter
A. Adjusted R^2:					
1 Base measures only[1]		0.162	0.162	0.058	0.058
2 Six amenity items added to base		0.327	0.327	0.135	0.133
3 Amenity scale added to base		0.297	0.322	0.098	0.124
B. Addition to adjusted R^2:					
1 All measures individually	(A2-A1)	0.165	0.165	0.076	0.075
2 Amenity scale	(A3-A1)	0.135	0.160	0.039	0.066
3 Difference	(B1-B2)	0.030	0.005	0.037	0.009
C. Percent loss in additional variance explained when scale is used rather than individual items	(100xB3/B1)	18.1	2.9	48.3	11.6
D. Standardized coefficients[1]:					
Warm winter		0.01		-0.05	
Winter sun		0.13	0.19	0.06	0.04
Temperate summer		0.20	0.28	0.17	0.16
High humidity		0.14	0.18	0.16	0.17
Water area		0.17	0.18	0.13	0.13
Topographic variation		0.14	0.16	0.08	0.09

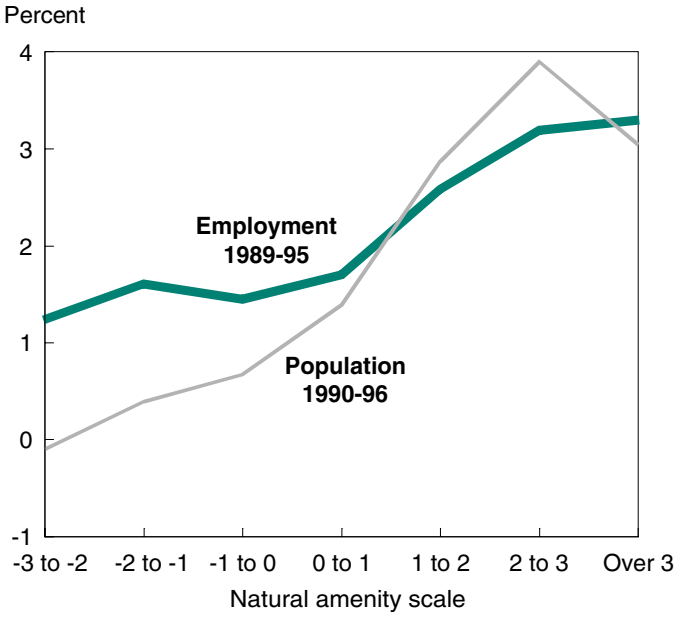
[1] In addition to the amenity measures, the analyses include county economic type, high poverty, population density and its square, and the urban influence code.

But this does not appear to be the whole story. Even if we use the median county employment growth, which gives a better picture of central tendencies than the mean when there are extreme outliers, it is apparent that the natural amenities scale, with or without the warm-winter measure, is much less related to employment change during 1989-96 than to population change over the same period (fig. 8).

Another development that probably weakened the relationship between amenities and employment growth in the 1990's was a greater shift of manufacturing to high-education areas than in the previous decades. These high-education areas—many of them in the Midwest—are typically low in natural amenities. The change in jobs in these areas has not been associated with a commensurate gain in population.

Finally, Beale (1998), in conversations with local officials in Western counties beginning to gain population in the 1990's, found that people were moving in without any commensurate gain in jobs. This is consistent with the greater growth rates for population than employment near the high end of the amenities scale (although not at the highest end, where high housing costs discourage unemployed inmigration). The correlation coefficient between population and employment change (both in $\log_e$ terms) dropped from over 0.75 in the 1970's and 1980's to 0.58 in the 1990's, suggesting a general disjuncture between population growth and employment change in the 1990's that deserves further investigation.

Figure 8
Median average annual rates of change in nonmetro county employment and population, by natural amenity level



Is the relationship between the amenity scale and population growth simply another way of capturing the broad movement of population out of the Northeast and Midwest to the South and West over the past 25 years, a movement that could be ascribed to a number of factors—such as a desire on the part of industry for lower labor costs and less unionization—in addition to natural amenities? To address this question, the four census regions (Northeast, Midwest, South, and West) were introduced into the analyses of population change.

The results showed that the amenity scale captures far more than the simple broad population movement from north to south and west. Introducing region into the analysis (as a set of dummy variables) added substantially to the variance explained by the base model and raised the (adjusted) R^2 from 19 to 33 percent (table 8). But this was far short of the net additional contribution of the amenity scale to the base model, which raised the R^2 to 42 percent. Moreover, when both the regions and the amenity scale were included, the region variables added little beyond what was explained by the amenity scale alone. Thus, the natural amenity scale alone captures much of the interregional variation in population change.

These relationships between the amenity scale and regional population change are evident in figure 9. Average population growth during 1970-96 was about the same across all the regions with counties at the same level on the amenity scale, with one exception—the high-amenity counties in the South. The rural West had the highest amenity scores, and the Midwest had the lowest. Population growth during 1970-96 was correspondingly much higher in the rural West (65 percent) than in the rural Midwest (5 percent). Differences in rural population growth among regions are almost entirely accounted for by differences in their levels on the amenity scale.

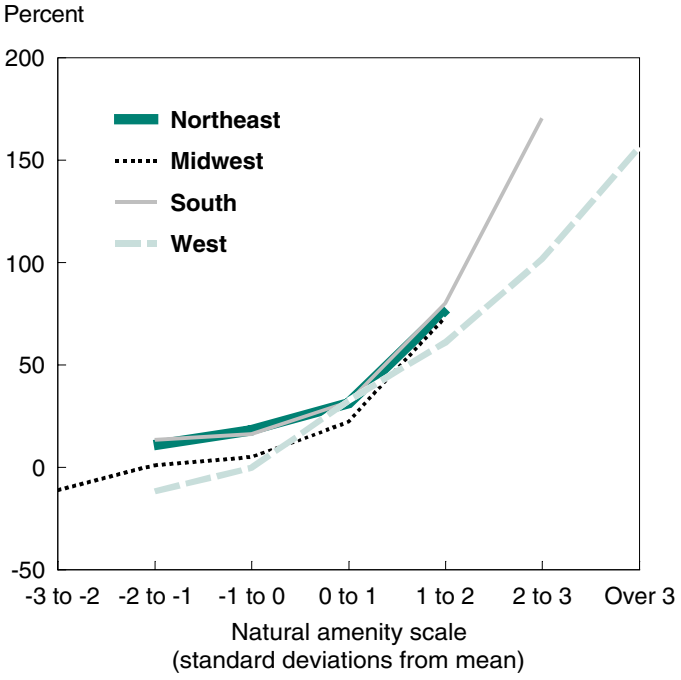
The amenity scale is not as strongly related to population growth *within* regions as it is to growth *between* regions. Even when the measures are treated separately, the net additions to the variance in county population change "explained" (R^2) for the individual regions, while substantial, are still much lower than for the country as a whole (table 9).

Some reduction in the strength of the association between amenities and population growth is to be expected. Natural amenities differ across the country as a whole more than across any individual region, except the West. In the rural Northeast, an extreme case, over 95 percent of the counties are less than one standard deviation unit above or below the national average amenity score. This range is not only narrow, but it is at a point in the scale where it has relatively little relationship with population growth even at the national level. At the same time, other factors influencing population change, such as urban proximity or specialization in manufacturing, are often more influential within regions than across the country as a

Table 8–Results of regression analyses of population change, 1970-96 (log_e), on base variables, natural amenity scale, and four census regions

Analysis	Adjusted R^2
Base measures only	0.193
Base and region	0.329
Base and amenity scale	0.416
Base, region, and amenity scale	0.424

Figure 9
Mean nonmetro population change, by natural amenity level and region



whole. As a result, although still quite relevant to population change, the amenity measures are generally less dominating within regions than absolutely and relative to other factors.

But this is not the whole story. In the Northeast and Midwest, the overall amenity scale does not adequately reflect differences in the relative attractiveness of areas within these regions, at least to the extent that population change in the regions is sensitive to attractiveness. In each case, about 40 percent of the additional variance in population change explained by the individual measures is lost when the overall scale is substituted for the individual measures. In the Northeast, analysis of the individual measures shows that winter sun and water area are highly related to 1970-96 population change, but that winter temperature, temperate summers, and low summer humidity have little net bearing on population change across the region (table 9).

These last measures vary less in the Northeast than in other regions, perhaps so little as not to affect the relative attractiveness of Northeast counties as places to live.

In the Midwest, winter temperature, temperate climate, and water area are the only amenity measures fairly highly associated with population growth. As an experiment, these three measures were combined into an abbreviated amenity scale for the Midwest. This abbreviated measure has a stronger correlation with 1970-96 population growth in the region than the larger scale ($r = 0.53$ vs. $r = 0.26$). This measure is also more highly correlated with status as a recreation county than is the full scale ($r = 0.34$ vs. $r = 0.20$). In the Midwest, it is the lakes, not hills or mountains, that tend to attract vacationers.

However, despite the short scale's relevance to the Midwest, the levels of population growth in the high-

Table 9–Nonmetro county population change, 1970-96 (log_e): Descriptive statistics and regression results by region

		Region			
Statistic	Formula	Northeast	Midwest	South	West
A. Adjusted R^2:					
1 Base measures only [1]		0.284	0.343	0.193	0.259
2 Six amenity items added to base		0.392	0.427	0.371	0.379
3 Amenity scale added to base		0.352	0.391	0.345	0.352
B. Addition to adjusted R^2:					
1 Amenity items individually	(A2-A1)	0.108	0.084	0.179	0.120
2 Amenity scale	(A3-A1)	0.068	0.048	0.153	0.093
3 Difference	(B1-B2)	0.040	0.036	0.026	0.027
C. Percent loss in additional variance explained when scale is used, rather than individual items	(100xB3/B1)	37.2	42.6	14.6	22.4
D. Standardized coefficients:					
Warm winter		0.08	0.15	0.35	0.13
Winter sun		0.27	0.06	0.15	0.23
Temperate summer		0.03	0.26	0.26	0.23
Low summer humidity		-0.07	0.02	0.25	0.26
Water area		0.18	0.20	0.21	0.13
Topographic variation		0.12	0.09	0.34	0.11
E. Amenity statistics:					
Mean		-0.11	-1.76	0.26	3.22
Standard deviation		1.07	1.45	1.37	2.33
F. Population statistics (not log transformed):					
Mean population change		25.2	5.4	30.2	64.5
Standard deviation		31.1	27.9	52.9	86.1

[1] In addition to the amenity measures, the analyses include county economic type, high poverty, population density and its square, and the urban influence code.

amenity counties in the region according to the short scale are far below the levels shown for the country as a whole with the overall scale.

The analysis suggests a two-tiered influence of natural amenities on population movement: a national level of influence, affecting the movement of people across States and regions for both residence and recreation; and a more regional influence, affecting migration and recreation patterns within regions. The qualities of attractive areas within regions appear to vary from one region to another, depending on the regional endowments. Thus, within the Midwest, much of which is relatively flat compared with the West and parts of the Northeast and South, lake areas are the primary attraction.

Conclusion

Rural county population change—as well as the development of rural recreation and retirement-destination areas—are all highly related to natural amenities, much more so than to other locational measures such as the rural-urban continuum code. The index of natural amenities developed in this study can capture much of each of these relationships, but the index serves best as a summary of factors associated with broad shifts in U.S. population over the past 25 years. The characteristics attractive to vacationers are somewhat different from the characteristics associated with population movement. Moreover, within any region, the movement of population and the development of recreation areas may be associated with a somewhat different mix of characteristics than found for the population change across the United States as a whole.

As noted in the introduction, this report considers only the basic ingredients of natural amenities, not how they have been shaped by nature and man. Land cover—the extent of land in crops, grass, or forest—also has a bearing on the attractiveness of an area. And land use regulation, including public parkland, national or State forests, and other designations, can at once make an area more attractive and stimulate growth while limiting its location. The shaping of amenities is what policy—and markets—can do. The challenge is to better understand how areas can best take advantage of the amenities they have.

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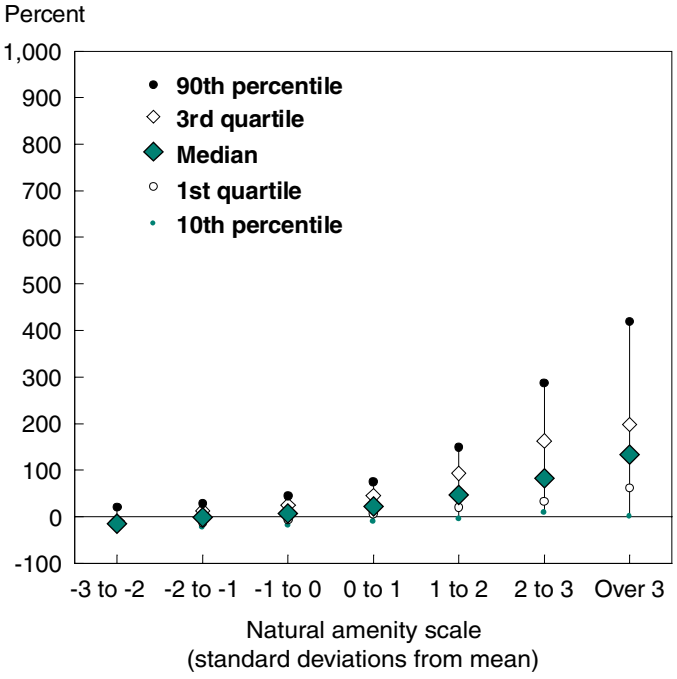
Appendix Figures

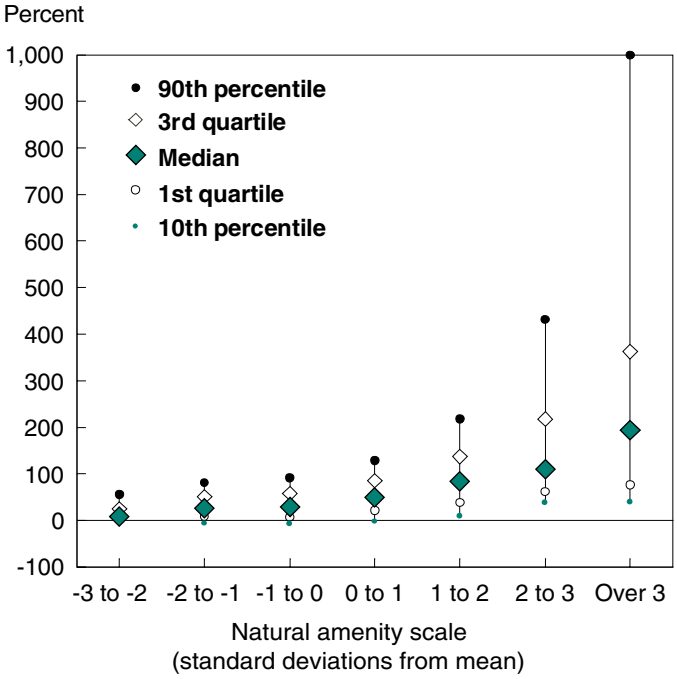
Appendix figure 1

Distribution of population change, 1970-96, by natural amenity level



Appendix figure 2

Distribution of employment change, 1969-96, by natural amenity level



Appendix I
Categories of Variables Used in Regression Analyses

Urban influence code (1993)

1. Part or all of a metropolitan area with at least 1 million residents in 1990.

2. Part or all a smaller metropolitan area.

3. Adjacent to a large metropolitan area:
   a. With city of at least 10,000 residents in 1990.
   b. Without city of 10,000.

4. Adjacent to a small metropolitan area:
   a. With city of at least 10,000 residents in 1990.
   b. Without city of 10,000.

5. Not adjacent to a metropolitan area:
   a. With city of at least 10,000 residents in 1990.
   b. With town of 2,500 to 9,999 residents in 1990.
   c. Rural (no town of 2,500 or more in 1990).

6. County nonmetropolitan in 1980, reclassified as metropolitan as of 1993.

County economic type

Manufacturing: Manufacturing contributed a weighted annual average of 30 percent or more labor and proprietor income over the 3 years from 1987 to 1989.

Farming: Farming contributed a weighted annual average of 20 percent or more labor and proprietor income over the 3 years from 1987 to 1989.

Mining: Mining contributed a weighted annual average of 15 percent or more labor and proprietor income over the 3 years from 1987 to 1989.

Poverty county: Persons with poverty-level income in the preceding year were 20 percent or more of total population in each of 4 years, 1960, 1970, 1980, and 1990.

Appendix II
Comparisons With the Original Scale

The original amenity scale also included county center elevation level as a variable. Analysis of population change during 1980-90 indicated that elevation had a negative association with population growth, once the other amenity variables had been taken into account. The analysis suggested that mountains and plains were most attractive at lower elevations, although this was not what we had anticipated. The original scale had a higher zero-order correlation with population change 1970-80 (0.46) than does the scale developed in this report (0.43). That was the basis for adopting the original scale.

Three further analyses have led to the adoption of the shorter scale, however. First, the original amenity scale was not as highly correlated with population growth in either the 1970's or the 1990's, periods of net inmigration to rural areas. Second, when the relationships of population growth with settlement pattern and economic base are netted out, population growth is more strongly related to the new scale than to the old scale across all time periods. Finally, the elevation measure is very strongly related to other natural amenity measures, making it somewhat redundant. Its highest correlation is with humidity ($r = -0.71$), and its multiple correlation with the other amenity variables is 0.83.

While it would have been possible to adjust for the redundancy as was done for July temperature, there is no compelling a priori reason for including this measure in addition to topographic variation. The rationale for its original consideration was as an alternative to the topographical variation measure, not as an independent quality that otherwise clearly added to or detracted from the attractiveness of the location.