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A SPATIAL ANALYSIS OF AMENITY AND REGIONAL ECONOMIC GROWTH IN NORTHEAST REGION

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Amenities are expected to impact regional economic growth by affecting growth in population, employment, income, and house values. This study assesses whether the 299 counties in the Northeast (NE) region of the US can build and pursue a growth strategy that depends on their local and neighborhood amenities (natural and built). It extends previous studies by estimating a simultaneous spatial Durbin model (SDM) using the two stages least square method. Historical and cultural amenities and water based recreational amenities are found to play a positive role in shaping the growth of population in the northeast region of the US. The role of natural amenities, land and winter based amenities is found to be negative or insignificant. One of the important findings of the study is the positive role of surrounding counties' historical and cultural amenities in the growth of population and employment densities. Overall there is no evidence of a consistent and strong relationship between amenities and regional economic growth, and the results can be termed "mixed and inconclusive".

1. Introduction

There are multiple options available to local policy makers to develop the economy of their region. They may build on natural resources, cultural resources, human resources, local amenities, institutional facilities, or location advantages. The specific growth strategy followed by a specific region depends on the social, economic, political, and environmental dynamics of the region in question. In order to select and pursue a development strategy, policy makers must first understand the possible growth paths that may be relevant for their region.

The loss of natural resource and manufacturing based jobs in recent decades has forced local policy makers to look for new sources of growth within their communities. Local and regional amenities, by boosting the quality of life of regions, have become major forces behind the rural turnaround of the last decade. Now, we see different faces of rural America: on one hand, there are those areas that still depend on declining extractive resources such as agriculture, mining, and manufacturing. On the other hand, we find those that are within commuting distance to larger growing cities, which are benefiting from agglomeration spillovers. Others have also transformed their economies by developing amenity based service industries (Power, 1996; Deller, et al. 2005).

Conceptually, amenities impact regional growth by affecting growth in population, employment, income, and housing values (due to changes of land use for housing and recreational development). In the amenity and regional economic growth relationship, the distinction between the economic supply and the physical availability of amenities is becoming important (Deller, et al. 2008). The economic supply (accessibility) of amenities and its impact on regional growth vary significantly over space and are not clearly understood. The different results seem to emanate from ambiguity in the definition of amenity, the stated objectives, and the method of analysis applied in the previous studies. These findings have created doubts about the overall impact of amenities on regional economic growth (Dissart, 2007; Waltert and Schläpfer, 2010).

This study attempts to assess whether the 299 counties (148 are non-metropolitan) in the Northeast[1] (NE) region of the US can build and pursue a growth strategy that depends on the local and neighborhood amenities (natural and built). Unlike most past studies that ignore the spatial interdependence of county characteristics, this study identifies the spatial distribution of amenities and other local characteristics in regional economic growth. The relationship of amenities and regional economic growth indicators is specified by taking into account the spatial distribution of the variables. Following Kirby and Lesage (2009), a spatial Durbin model (SDM) is estimated to assess the direct and indirect effects of all the regional growth factors. Given the endogenous nature of the regional growth indicators, a two stage least square method is used in the estimation process.

2. Literature Review

The contribution of past studies in terms of refining the definition of amenities, measuring amenities and evaluating their direct effects on a regional economy is enormous. Previous studies by Liu (1978), Morris (1979), Becker et al. (1987), Myers (1988), Todaro (1989), Elkan (1995), Gwartney et al. (1996), and Gyourko et al. (1999), examined methods for measuring quality of life with respect to regional variations and city growth. The works of Power (1988, 2005), Roback (1988, 1982), McGranahan (1999), and Deller et al. (2001, 2005, 2007, 2008), Florida (2002), Glaser (2003), Carruthers et al. (2008), Mulligan et al. (2004), Lambiri et al. (2007), are also some of the major contributions to our understanding of the role of amenities in urban and regional development.

[1] The Northeast region of the US is defined here following the Northeast Center of Rural Development. It consists, the 9 New England states and Delaware, Maryland, and West Virginia.

Measuring amenities has been a challenge to researchers. The main problem is that there is no market to derive a dollar value. Three approaches can be identified in the literature in measuring amenity attributes: single factor, a summary index (single index) approach, and Principal Component Analysis (PCA). The single factor approach tries to include all relevant amenity attributes in the model estimation. Duncombe, Robbins and Wolf (2000) applied this approach by including five amenity variables in their analysis of elderly migration. The advantage of the method is that it is straightforward for doing marginal analysis and interpreting the results as for any other variable in the model. Its drawback is that all the relevant variables cannot be included, which may lead to bias due to omitted variables; on the other hand, trying to include all variables may lead to multicollinearity problems.

The summary index approach defines natural amenities as a single index of different amenity attributes. McGranahan (1999) used six amenity measures to study the population and employment changes in rural America during the 1970–1996 period. The natural amenity index is generated by summing six amenity measures: average January temperature, average January days with sun, low winter-summer temperature gap, low average July humidity, topographic variation, and water areas. Even though it is a broader measure than the single factor, the single index is criticized for being unidimensional in representing the very diverse nature of amenity distributions (it ignores built recreational amenities and historical amenities, among others) and for the subjectivity incorporated in the decisions about which amenity attributes should be included to develop the index. But despite this weakness, McGranahan's (1999) natural amenity index is the most widely used amenity measure in empirical studies.

The Principal Component Analysis (PCA) is another method used to create the amenity index. Several recent studies have evaluated the economic impacts of natural amenity attributes using PCA (Goe and Green, 2002; Monchuk, 2007; Deller et al., 2005, 2007, 2008). In all these studies, there is no uniformity in including or grouping the different attributes to create an index. For example, in developing the land index, Goe and Green (2002) used four different attributes while Deller et al. (2008) used sixteen. This approach is also subjective as is the single index approach, and the final measures (principal component scores) may not be easy to interpret. The use of PCA, however, can allow researchers to examine multidimensional aspects of natural amenity attributes (English et al., 2000; Deller et al., 2005; Marcouiller et al., 2004).

Regional economic models that are specified as simultaneous equations are usually used to estimate the direct and indirect effects of amenities on change in population, employment and income. Models of this type have traditionally been used to explore empirically whether people follow jobs or jobs follow people. The model was first developed by Steinnes and Fisher (1974) who used it in their classic study to explain the intra-urban location of residents and employment in a two-equation microeconomic model. The models were further refined and operationalized by Carlino and Mills (1987) and others (Duffy-Deno,1997; Rudzitis, 1999; Vias, 1999; Deller et al., 2001, 2005, 2007).

In terms of population growth, amenities have been found to contribute to rather than detract from it (Deller et al., 2001, 2005, 2007, 2008; Goe and Green, 2005; McGranahan, 1999; Nzaku and Bukenya, 2005). Furthermore, the extent to which an amenity exerts a positive effect on the local economy, both in terms of attracting people to that county and its economic development depends heavily on people's preference for a particular amenity (Rudzitis, 1999; Vias, 1999; Delbert et al., 2001). The direct impact of amenities on employment and income growth is mixed. In most studies the impact on employment is positive but small (Deller et al., 2001). In others, it is found to have no effect (Rudzitis, 1999; Vias, 1999; Duffy-Deno, 1997).

Theoretically, the impact on income is expected to be negative (Roback, 1982, 1988) which is explained in part by the desire of people to forego income and employment benefits in higher amenity areas. But some empirical studies (Wu and Mishra, 2008; Deller and Leldo, 2008) found a positive relationship that is not consistent with the theoretical expectations.

The works of Bernat (1996) and Rey and Montouri (1999) attempted to inspect the role of space in regional growth. Prior to Nzaku and Bukenya (2005) and Deller et al. (2005), in most past studies spatial autocorrelation is not controlled. Ignoring spatial autocorrelation and estimating using OLS leads to inefficient standard errors which in turn affects the significance levels of the variables (Wooldridge, 2002, pp.6, 134). Predictions made based on this can be misleading and may have undesired policy implications. Nzaku and Bukenya (2005) introduced a spatial lag of the dependent variables to capture spatial dependence and extended these models. Recent works of Deller et al. (2005, 2007), Monchuk and Miranowski (2007), Carruthers et al. (2008) and Royuela et al. (2010) also used a spatial model to control for the unobserved spatial distribution of amenities in the region. With the exception of Monchuk and Miranowski (2007), all these extended works never tried to estimate the spatial impacts of surrounding county amenities on regional economic growth. Thus, their studies reflect only the direct effects of local amenities on the regional growth indicators ignoring the spillover effects coming from surrounding counties. This study extends past studies by capturing the total effects of amenities (direct and indirect) by explicitly evaluating the role of own and surrounding county amenities in regional economic growth using the SDM.

3. Spatial Model

In the amenity and regional growth literature, the role of spillover effects is recognized in only a few studies. The empirical model developed in this study is different from Deller et al. (2005), Nzaku and Bukenya (2005), Monchuk and Miranowski (2007), Carruthers et al. (2008), and Royuela et al. (2010). Our spatial model developed below accounts for the spatial dependency and mismatch of amenities by adapting SDM.

Each of the three equations in the model are specified as a function of endogenous dependent variables – growth in population density (LPOPD), growth in employment density (LEMPD), and growth in per capita income (LPCI), Amenities (A), other exogenous variables (X), and spatially weighted dependent variables (WLPOPD, WLEMPD, and WLPCI), amenities (WA), and independent variables (WX).

$$\begin{aligned} LPOPD = {} & \rho^{*}WLPOPD + \beta_{1p}(1+W)LEMP + \beta_{2P}(1+W)LPCI \\ & + \gamma_{\partial p}(1+W)PCI_{t-1} + \gamma_{1P}(1+W)POPD_{80} + \pi_{IP}(1+W)A \\ & + \sum \delta_{ip}(1+W)X^{\mathrm{P}} + u_p \end{aligned} \tag{1}$$

$$\begin{aligned} LEMPD = {} & \rho^{*}WLEMPD + \beta_{1e}(1+W)LPOPD + \beta_{2e}(1+W)LPCI \\ & + \gamma_{\partial e}(1+W)PCI_{t-1} + \gamma_{1\theta}(I+W)EMPD_{80} + \pi_{ie}(I+W)A \\ & + \sum \delta_{ie}(I+W)X^{e} + u_e \end{aligned} \tag{2}$$

$$LPCI = \rho^{*}WLPCI + \beta_{1y}(1+W)LPOPD + \beta_{2y}(1+W)LEMPD$$
$$+ \gamma_{\partial y}(1+W)PCI_{t-1} + \gamma_{1y}(I + W)POPD_{80} + \pi_{iy}(I+W)A$$
$$+ \sum \delta_{iy}(I+W)X^{y} + u_{y} \quad (3)$$

Where ρ(rho) is a measure of strength of the spatial dependence and is the coefficient of the spatial lag of the dependent variable in each of the equations. W is a 299 $\times$ 299 (n $\times$ n) row–standardized weight matrix constructed from the nearest neighbors (the number of the nearest neighbors differs from one study to another) and I is an identity matrix. The residuals of the growth in population, employment, and per capita income equations are $u_P, u_E,$ *and* u_Y, respectively.

Each variable in the model is multiplied by *(I + W)* to reflect the own county values and the average of the surrounding counties. For example, in the population equation, *(I + W) LEMPD* represents county *i* employment growth *(LEMPD)* and the weighted average of the nearest neighbors *(WLEMPD)*. Note that because each dependent variable depends on its value in neighboring counties, *WLEMPD, WLPOPD, WLPCI* are endogenous to *LPOPD, LEMPD,* and *LPCI*, respectively. That is, the growth in population density, employment density, and per capita income in county *i* depends on the contemporaneous levels of these variables in surrounding counties. This condition creates an additional endogeniety problem that needs to be solved before estimating the parameters in the model. For this reason, the study follows the traditional approach of instrumenting the dependent variables. First, a reduced form will be estimated to generate the fitted values of the dependent variables. These estimated dependent variables are then included as any other independent variable in estimating SDM.

The estimation and interpretation of the coefficients in SDM are not straightforward. According to Kirby and LeSage (2009), in SDM, changes in the independent variable x_i leads to a direct impact (effect) on a county's marginal regional economic growth as well as a spatial spillover (indirect) impact on neighboring counties' marginal regional economic growth. Thus, the spatial derivative of this direct and indirect effect takes the form of n x n matrix. Assuming Y_i as a measure of regional growth, the partial derivative takes the form of

$$\frac{\partial Y_l}{\partial X_i} = (I_n - \hat{\rho}W)^{-1}(I_n\hat{a}_{1i} + W\hat{a}_{2i}) \quad (4)$$

Where $\hat{\alpha}_{1i}$ and $\hat{\alpha}_{2i}$ are the coefficient estimates associated with the independent variable x_i and $Wx_{i,}$ respectively. The coefficient $\hat{p}$ measures the strength of the spatial dependence. LeSage and Pace (2009) developed a scalar summary measure for the n x n partial derivative of direct and indirect effects arising from the change in the independent variable. This study will follow their approach and present the direct, indirect, and total effects alongside the estimated coefficients of the model.

4. Types and Sources of Data

The study area is the Northeast region of the US. It is composed of twelve states and consists of all the counties in the states of Connecticut, Delaware, Massachusetts, Maine, Maryland, New York, New Jersey, New Hampshire, Pennsylvania, Rohde Island, Vermont, and

Table 1. Northeast Economic Growth, 1980–2005

	Northeast Region			Non-metro Northeast Region		
		Growing			Growing	
Growth Indicator	Declining	Below US Average	Above US Average	Declining	Below US Average	Above US Average
Population	35.1%	45.5	19.4	44.5	40	15.5
Employment	6.7	61.2	32.1	7.4	64.2	28.4
Per capita income	0	46.8	53.2	0	52.0	48.0

West Virginia. It covers 6% of US land area, 25% of total population and 11% of the non-metro population. The region is appropriate for assessing the role of amenities and regional growth due to its diverse spatial variation in economic growth and economic geography. According to the USDA-ERS County Typology 1993, the region is highly urbanized with 50.5% of its 299 counties considered metro areas. The non-metropolitan areas are divided between 84 (28.1%) counties considered as adjacent to metro areas and 64 (21.4%) counties considered as non-adjacent and completely rural. The spatial distribution of population growth is not uniform. An estimated of 35.1% of the counties lost population, 45.5% recorded growth but below the national US average, and only 19.4% grew above the US average (Table 1). Most of the population loss counties are found clustered in the Appalachian part of the region. A spatial distribution of the regional economic indicators is shown below.

Employment growth in the region is not as low as population growth. Only 6.7% of the counties show negative growth. More than 60% of the counties grew below national average while 32.1% grew above national average (Table 1). The most encouraging regional growth indicator is the growth in per capita income. An estimated 46.8% of the counties grew below the US average and 53.2 grew above the US average (Table 1). The spatial distribution of the regional growth indicators in the non-metro counties in the region is not that much different from the region as a whole.

Secondary data, including the endogenous variables, initial conditions of the endogenous variables, amenities and local county characteristics (fiscal, human capital, market structure, and economic geography) are collected for the 299 counties of the Northeast region. Table 2 presents the definition of the variables and the data sources used in this study.

The data used in the study covers the 1980–2005 period. All the dependent variables are expressed as growth rates of the period 1980–2005. Most of the independent variables take the 1980 values[2] to avoid simultaneity and to help in isolating the direction of causation. With the exception of the amenity variables, the rest of the variables are expressed as location quotients or the ratio of the local value to the national mean. This transformation ensures that each observation is pegged to the US economic system as a whole (Carruthers et al., 2006). The result is unit free and enables direct comparison of growth in population density, employment density, and per capita income.

The study constructs and uses growth (logarithmic growth rates) in population density (LPOPD), employment density (LEMPD), and per capita income (LPCI), from 1980 to 2005 as

[2] The exception are fiscal policy variables which are of 1982, creative class 1990, urban influence codes of 1993, and amenity variables which are reported as 1997 but the data reflects the 1980s up to mid 1990s.

Table 2. Definition and Data Sources

Variable Name	Variable Definitions	Data Source
Endogenous variables		
LPOPD	Growth in population density from 1980 to 2005	REIS and US Census/computed
LEMDP	Growth in employment density from 1980 to 2005	REIS and US Census/computed
LPCI	Growth in per capita income from 1980 to 2005	REIS and US Census/computed
Initial Condition Variables		
POPD80	Population density 1980	REIS and US Census
EMPD80	Employment density 1980	REIS and US Census
PCI80	Per capita income 1980	REIS
Amenity Variables		
CLIMATE	Climate index	NORSIS 1997 / computed
NAMIX	Natural resource amenity index	NORSIS 1997 / computed
LANDREC	Land based outdoor recreational facilities index	NORSIS 1997/computed
WATREC	Water based outdoor recreational facilities index	NORSIS 1997/computed
WINREC	Winter based outdoor recreational facilities index	NORSIS 1997/computed
HAMTY	Historical and cultural amenity index	NORSIS 1997/computed
Fiscal, Human Capital, Market Structure, and Economic Geography		
DGLEXP	Per capita direct local government expenditure, 1982	CENSUS
PCTAX	Per capita tax, 1982	CENSUS & REIS/computed
PCPTAX	Property tax per capita, 1982	CENSUS
NRSD	Percentage of earnings in natural resource sector, 1980	REIS/computed
MFG	Percentage of earnings in manufacturing, 1980	REIS/computed
SRV	Percentage of employment in finance services, 1980	REIS/computed
UNEMPR	Percentage of employment whole and retail trade, 1980	REIS/computed
CREATIVE	Percentage of the creative work force, 1990	
EDU	Persons over 25 years and over, % of college degree or above 1980	C & CDB
MHV	Median value of owner occupied housing, 1980	C & CDB
UIFC	Urban influence code 1993 scale 1 to 9	USDA (ERS)

endogenous variables. The initial condition variables reflect the beginning period for the value of population density, employment density, and per capita income. These variables are collected from Regional Information Services (REIS) and the Census Bureau (Table 2).

As shown in Tables 2 and 3, six amenity indices are constructed from the USDA Forest service database of National Outdoor Recreation Supply Information System (NORSIS, 1997)[3].

Using PCA and following the National Outdoor Recreation Supply Information System (NORSIS, 1997), Goe and Green (2002), and Deller (2001, 2005, 2007), the groupings included in this study are Natural Resource Amenities, Historical and Cultural Amenities, and built-in outdoor recreational facilities (land based, water based, and winter based). More than 35 county-level attributes are used to construct these six amenity indices (Table 3). Even though the standard convention in principal component analysis is to retain components with eigenvalues greater

[3] The amenity data is drawn from the NORSIS (National Outdoor Recreation Statistical Information System) compiled by the USDA Forest Service, which contains a wide range of data on outdoor recreational facilities, natural resources and cultural/historical attractions, among other variables. The NORSIS data set contains over three hundred separate variables ranging from population density, the proportion of county acres in each cropland, forest, pasture/rangeland, mountains and water surface, employment and income levels in recreational industries, to the number of public libraries.

Table 3. Natural and Built Amenities

Amenity Attribute	Eigenvector
1. Natural Amenities	
1.1 Climate Index	
Average January temperature	0.545
Average precipitation	0.529
Average July temperature	0.476
Average humidity	0.432
Average January sunshine	0.099
Total variability explained	**48.70%**
1.2 Natural Resource Amenity Index	
AWA total whitewater river miles	0.417
BLY acres of mountains	0.414
USDA-FS forest and grass land acres	0.403
NRI total river miles outstanding value	0.383
NRI forest acres	0.339
Wild and scenic river miles	0.308
Birch: acres of private forest land	0.307
Coast	0.020
FWS refuge acres open for recreation	0.005
Total variability explained	**35.76%**
2. Built-in Outdoor Recreational Facilities	
2.1 Land Based Recreational Amenity Index	
ABI number of private and public tennis courts	0.444
ABI number of parks and recreation departments	0.438
ABI number of private and public golf courses	0.421
ABI number of playgrounds and recreational centers	0.409
ABI number of organized camps	0.394
ABI number of private and public swimming pools	0.317
ABI number of hunting, fishing preserves, lodges, and clubs	0.103
Total variability explained	**56.40%**
2.2 Water Based Recreational Amenity Index	
ABI number of fish camps, private and public fish lakes, piers and ponds	0.663
ABI number of marinas	0.640
ABI number of canoe outfitters, rental firms, raft trip firms	0.316
ABI number of diving instructors, tours, and snorkel outfitters	0.224
Total variability explained	**31.04%**
2.3 Winter Based Recreational Amenity Index	
ABI number of skiing centers and resorts	0.512
Cross country ski firms and public ski centers	0.501
ISS skiable acreage	0.403
RTC rail-trail miles for x-c skiing	0.336
RTC rail-trail miles for snowmobiling	0.325
State park number with snowmobiling available	0.293
Total variability explained	**40.86%**
3. Historical and Cultural Amenity Index	
Historical / cultural / arts / festivals	0.443
Other unclassified attractions	0.431
Natural resource based attractions (zoos, aquarium)	0.415
Museums	0.413
Amusement / entertainment / sports	0.392
Government / civic / monuments / memorials	0.287
Historical places (ABI)	0.197
Total variability explained	**56.20%**

Table 4. Summary Descriptive Statistics

Variable	Mean	Median	Maximum	Minimum	Std. Dev.
LEMPD	0.782	0.698	3.353	−2.248	0.639
LPOPD	0.409	0.315	4.197	−2.784	0.844
LPCI	1.007	1.010	1.240	0.682	0.098
EMPD	8.354	1.583	325.164	0.033	29.469
PCI	0.887	0.861	1.542	0.508	0.185
POPD	8.992	1.776	495.356	0.045	35.550
NAMTY	0.259	0.056	8.884	−0.715	0.875
HAMTY	−0.065	−0.360	10.132	−0.489	0.912
LANDREC	1.181	0.217	15.664	−0.899	2.635
WATREC	0.271	−0.219	11.961	−0.421	1.456
WINREC	1.236	0.409	13.589	−0.506	2.429
DLGEXP	0.864	0.768	2.044	0.436	0.304
PCTAX	0.922	0.891	3.671	0.156	0.479
PCPTAX	1.028	1.015	4.405	0.196	0.594
NRSD	1.740	0.651	20.511	−1.157	3.079
MFG	1.130	1.113	3.222	0.015	0.586
SRV	0.861	0.837	2.268	0.000	0.343
UNEMPR	1.201	1.169	2.938	0.292	0.394
CREATIVE	0.176	0.168	0.397	0.071	0.059
EDU	0.835	0.735	2.642	0.272	0.367
MHV	0.870	0.803	2.059	0.336	0.276
UIFC93	4.058	3.000	9.000	1.000	2.738

than one, the study retains only the first component. This is done to increase the degrees of freedom in the estimation process. In most cases, the first component is the best summary of the entire data set and accounts for most of the variance. The eigenvector loadings of the first component of each of the amenity indices are included in Table 3. All the amenity attributes are expected to have positive impacts on growth in LEMPD and LPOPD by either attracting business or people to the region. The effect on change in per capita income (LEMPD) is expected to be negative, reflecting the willingness to substitute high amenities for lower wages.

The other exogenous variables are county characteristics that describe fiscal policies (taxes and local government expenditures), human capital, market structure, and economic geography (level of urbanization) as shown in Table 2. These variables are collected from Bureau of Economic Analysis (BEA-REIS), City and County Data Book (C & CDB), the Census Bureau, and the Economic Research Services (ERS) of USDA. The summary of descriptive statistics of the variables are presented in Table 4.

5. Empirical Results and Analysis

An SDM is applied to estimate the spatial distribution of amenities and regional economic growth (Lesage and Pace, 2009). To account for the simultaneity in the dependent variables, first a reduced form[4] is estimated to generate the fitted values of the dependent variables. These estimated dependent variables are then included as any other independent variable in estimating

[4] The reduced form is estimated using all the exogenous variables in the model.

Table 5. Spatial Durbin Estimation Results of Population Growth and Amenities

	Model results		Direct effect		Indirect effect		Total effect	
Variable	Coeffi	t-prob	Coeff	t-prob	Coeffi	t-prob	Coeff	t-prob
LEMPD	0.220***	0.03	0.209**	0.08	−0.355	0.41	−0.146	0.75
LPCI	0.936***	0.00	0.960***	0.00	0.748	0.48	1.707	0.14
POPD80	−0.001	0.14	−0.001	0.22	−0.003	0.14	−0.004*	0.07
DLGEXP	−0.261*	0.09	−0.262	0.18	−0.038	0.95	−0.3	0.63
PCTAX	0.001	0.51	0.003	0.99	0.061	0.9	0.064	0.9
NRSD	−0.018*	0.09	−0.026**	0.06	−0.242***	0.00	−0.268***	0.00
MFG	−0.250***	0.00	−0.278***	0.00	−0.906**	0.01	−1.184***	0.00
UNEMPR	0.047	0.35	0.035	0.77	−0.376	0.38	−0.341	0.43
MHV	1.085***	0.00	1.087***	0.00	0.058	0.94	1.145	0.16
UIFC	0.034**	0.04	0.031	0.1	−0.096	0.17	−0.065	0.36
LANDREC	−0.075***	0.00	−0.077***	0.00	−0.084	0.29	−0.161**	0.05
WATREC	0.023	0.20	0.024	0.37	0.024	0.84	0.048	0.69
HAMTY	0.076**	0.01	0.087**	0.01	0.380**	0.04	0.467**	0.02
NAMTY	−0.145**	0.01	−0.134**	0.02	0.357*	0.06	0.223	0.16
WINREC	0.016	0.18	0.016	0.37	−0.01	0.85	0.005	0.93
WLEMPD	−0.316	0.14						
WLPCI	0.186	0.39						
WPOPD80	−0.002*	0.09						
WDLGEXP	0.063	0.44						
WPCTAX	0.041	0.45						
WNRSD	−0.158***	0.00						
WMFG	−0.531**	0.01						
WUNEMPR	−0.272	0.18						
WMHV	−0.33	0.28						
WUIFC	−0.077*	0.06						
WLANDREC	−0.032**	0.27						
WWATREC	0.009	0.47						
WHAMTY	0.232**	0.02						
WNAMTY	0.292**	0.02						
WWINREC	−0.012	0.37						
Rho	0.328***	0.00						
Constant	0.548	0.33						
R^2	0.682							
N	299							

Note: *, **, and *** indicate a coefficient is significant at 10%, 5%, and 1% level, respectively.

the SDM. Therefore, each of the three equations in the model is estimated as a function of the fitted endogenous dependent variables (LPOPD, LEMPD, and LPCI), spatially weighted fitted dependent variables (WLPOPD, WLEMPD, and WLPCI), independent variables (vector X), and spatially weighted independent variables (WX). This method helped to examine not only the strength of the spatial dependence but also to estimate the direct impacts of local factors on a county's marginal economic growth as well as a spatial spillover or indirect impact from neighboring counties.

Table 5 presents the results of the SDM for the growth in population density equation. The statistically significant value of the spatial dependence measure (rho) shows a strong spatial interdependence among regions. The model explains an estimated 68.2% of the variation in the growth of population density. The estimated results show that growth in employment density has a positive direct effect on population growth, which indicates an increase in labor demand. This job opportunity attracts new in-migrants to the region, which leads to growth in population and implies people follow jobs. The direct effect of growth in per capita income is also positive and suggests that people migrate to earn higher incomes. However, the indirect effects of employment and per capita income growth are not significant and imply that the growth of employment and per capita income in surrounding counties does not have an impact on population growth in the study area. The value of rho, which is also the coefficient for growth in population density in surrounding counties, is positive and significant indicating growth in population in surrounding counties has a positive spillover effect.

Turning to the amenity variables, the direct effect of NAMTY is negative and significant while the indirect effect is positive. This implies that a county that lacks natural attractions of its own can still benefit from high amenities in its surrounding areas. From the built-in amenities, the direct, indirect, and total effect of historical and cultural amenity is positive and significant while the direct and total effect of land based recreational facilities (LANDREC) is negative. There is no theoretical justification for this negative relationship of LANDREC with population density growth. This index is driven mainly by the availability of parks and recreation departments, private and public tennis courts, recreational centers, and golf courses. One possible reason for the negative relationship could be the construction and developments of land based recreational facilities reduces land available for growth in population.

The total effect of the initial population density is negative indicating convergence in population growth within the region. Counties with high population density in 1980 were growing slower compared to those with low population density. The direct, indirect, and total effects of NRSD and MFG are negative and significant. Natural resource and manufacturing dependent counties are associated with population loss. McDowell County of West Virginia, which depends on coal (extractive resource), is a good example. The county lost 52.1% of its population during the study period. The strong positive direct effect of median value of owner occupied housing suggests that increases in population density is high in areas where the median housing values are high as in Vermont and New Hampshire.

The relatively weak statistical significance of rho for employment growth (Table 6) shows a weak spatial interdependence among regions in the estimated employment density growth equation. The model explains 65.9% of the variation in the growth of employment density. In terms of magnitude, per capita income growth followed by population density growth has the highest direct positive effects. County employment density growth is significantly driven by growth in population density and per capita income. The growth in per capita income and population density together indicate a potential increase in the demand for goods and services. This increase in demand for goods and services increases the demand for factor inputs including labor, which leads to employment growth.

The direct relationship of amenities with employment growth generally is either negative or insignificant. Consistent with the findings of Monchuk and Miranowski (2007) we find no positive and direct effect relationship. For the amenity variables, the direct impacts of LANDREC and NAMTY are negative. But there is no theoretical justification for the negative relationship between employment growth and land based recreational facilities. The historical and cultural amenity variable is the only amenity variable with a positive spatial spillover. This finding supports the finding of Monchuk and Miranowski (2007) who found that several recreational amenities in surrounding counties have had a positive effect on employment growth in the US

Table 6. Spatial Durbin Estimation Results of Employment Growth and Amenities

	Model results		Direct effect		Indirect effect		Total effect	
Variable	Coeffi	t-prob	Coeff	t-prob	Coeffi	t-prob	Coeff	t-prob
POPD	0.460***	0	0.461***	0	0.068	0.72	0.529***	0
LPCI	0.661***	0	0.661***	0	−0.027	0.97	0.635	0.37
EMPD80	0.00001	0.5	0.00003	0.97	0.001	0.64	0.001	0.66
DLGEXP	−0.443***	0	−0.444***	0	−0.033	0.93	−0.477	0.23
PCPTAX	0.328***	0	0.330***	0	0.118	0.74	0.448	0.23
NRSD	−0.044***	0	−0.046***	0	−0.140***	0	−0.185***	0
MFG	−0.322***	0	−0.329***	0	−0.388	0.07	−0.716***	0
SRV	0.109	0.17	0.105	0.34	−0.271	0.46	−0.166	0.68
EDU	−0.018	0.44	−0.018	0.88	−0.007	0.98	−0.025	0.94
UIFC	0.058***	0	0.058***	0	−0.029	0.5	0.029	0.5
LANDREC	−0.025**	0.04	−0.026*	0.08	−0.049	0.25	−0.075*	0.09
WATREC	−0.018	0.2	−0.019	0.38	−0.062	0.44	−0.081	0.31
HAMTY	0.025	0.19	0.029	0.32	0.216**	0.04	0.244**	0.03
NAMTY	−0.154***	0.00	−0.151***	0.00	0.155	0.19	0.004	0.97
WINREC	0.014	0.17	0.014	0.34	−0.008	0.79	0.005	0.86
WPOPD1	−0.016	0.45						
WLPCI1	−0.128	0.41						
WEMPD80	0.001	0.32						
WDLGEXP	0.042	0.46						
WPCPTAX	0.049	0.44						
WNRSD	−0.112***	0.000						
WMFG	−0.279**	0.05						
WSRV	−0.249	0.21						
WEDU	−0.005	0.49						
WUIFC	−0.034	0.18						
WLANDREC	−0.038	0.15						
WWATREC	−0.05	0.23						
WHAMTY	0.180**	0.01						
WNAMTY	0.157*	0.07						
WWINREC	−0.009	0.36						
Rho	0.147*	0.09						
Constant	0.884	0.13						
R^2	0.659							
N	299							

Note: *, **, and *** indicate a coefficient is significant at 10%, 5%, and 1% level, respectively.

Midwest counties during the 1969–2000 period. This implies that a county that lacks human attractions of its own can still benefit from high amenities in its surrounding counties.

Local factors such as earnings in the natural resource and manufacturing sectors, direct local government expenditures, and per capita taxes also play a role in influencing employment growth. Percentage earnings in manufacturing exerted the greatest direct impact in reducing employment growth.

Table 7 presents the estimated results of the SDM for per capita income growth. The estimated model explains 56.4% of the total variation in per capita income growth. Surprisingly, the coefficients of the population and employment density variables are not significant. Growth in per capita income in the region is not directly or indirectly associated with population and employment growth. But the growth in per capita income of surrounding counties is positive

Table 7. Spatial Durbin Estimation Results of Income Growth and Amenities

	Model results		Direct effect		Indirect effect		Total effect	
Variable	Coeffi	t-prob	Coeff	t-prob	Coeffi	t-prob	Coeff	t-prob
LPOPD1	−0.031**	0.04	−0.029	0.11	0.070	0.30	0.042	0.56
LEMP1	0.027*	0.07	0.025	0.19	−0.070	0.37	−0.045	0.59
PCI80	−0.184***	0.00	−0.194***	0.00	−0.322	0.10	−0.516**	0.01
PCTAX	−0.004	0.39	−0.005	0.72	−0.033	0.51	−0.038	0.46
NRSD	−0.005**	0.01	−0.006***	0.01	−0.007	0.33	−0.013	0.11
MFG	−0.028**	0.01	−0.030**	0.01	−0.052	0.28	−0.082	0.12
SRV	−0.018	0.16	−0.014	0.47	0.132	0.10	0.118	0.17
UNEMPR	0.008	0.33	0.004	0.80	−0.129**	0.04	−0.125**	0.05
EDU	0.096***	0.00	0.099***	0.00	0.104	0.30	0.203*	0.06
MHV	0.184***	0.00	0.176***	0.00	−0.282*	0.08	−0.107	0.52
LANDREC	0.002	0.19	0.003	0.24	0.027**	0.02	0.030**	0.01
WATREC	0.009**	0.02	0.008**	0.05	−0.023	0.18	−0.015	0.40
HAMTY	−0.004	0.22	−0.004	0.39	−0.014	0.54	−0.019	0.46
NAMTY	−0.002	0.43	−0.001	0.90	0.017	0.50	0.016	0.48
WINREC	0.000	0.44	−0.001	0.82	−0.008	0.27	−0.009	0.26
WLPOPD	0.058	0.10						
WLEMP	−0.056	0.14						
WPCI80	−0.153	0.12						
WPCTAX	−0.020	0.27						
WNRSD	−0.003	0.27						
WMFG	−0.025	0.20						
WSRV	0.095**	0.03						
WUNEMPR	−0.090**	0.01						
WEDU	0.037	0.29						
WMHV	−0.254**	0.01						
WLANDREC	0.017***	0.00						
WWATREC	−0.019*	0.06						
WHAMTY	−0.008	0.29						
WNAMTY	0.012	0.25						
WWINREC	−0.005	0.14						
Rho	0.333***	0.00						
Constant	1.041***	0.00						
R^2	0.564							
N	299							

Note: *, **, and *** indicate a coefficient is significant at 10%, 5%, and 1% level, respectively.

and highly significant. The initial level of per capita income is also negative and significant indicating that counties with lower incomes initially experienced greater income growth than counties with higher incomes in the earlier period.

Only two of the amenity variables are found to be significant in the income equation. County per capita income growth is directly affected by water related recreational facilities within the county and land based recreational facilities of surrounding counties. Areas with higher levels of water based recreational facilities are associated with high levels of per capita income. The spillover effect of land based recreational facilities is positive which highlights the importance of amenities of surrounding counties in income growth. This positive relationship of water and land related recreational amenities with income growth support the arguments of Wu and Mishra

(2008) and the findings of Deller and Leldo (2008). Wu and Mishra (2008) argue that, "because amenities attract human capital, which in turn attracts firms, locations with superior amenities tend to have a higher demand for labor and thus higher wage rates" (p.98).

This finding is not consistent with the assumptions of Roback (1982, 1988) and it can be stated that there is ambiguity in the relationship between amenities and income. According to previous studies (Glaser et al., 1995; Royuela et al., 2010), it has not always been the case that the influence of amenities on income growth has to be positive. However, a positive result would occur from an increase in productivity or high-quality goods and services, if amenities or quality of space attract highly skilled labor (Florida, 2002). The rest of the amenity variables do not directly or indirectly affect per capita income growth.

Earnings in the manufacturing and natural resource sectors, median housing values, and college education are the major local and nonlocal factors affecting income growth. Even though the direct effect of the unemployment rate is insignificant, the indirect effect is negative and significant. This finding suggests that a county surrounded by other counties with high unemployment rates is likely to have low income growth.

6. Concluding Summary

The current study used a spatial Durbin model (SDM) to estimate the spatial distribution of amenities and regional economic growth (Lesage and Pace, 2009). This spatial method helped to examine not only the strength of the spatial dependence but also to estimate the direct impacts of local factors on a county's marginal economic growth as well as spatial spillover or indirect impact from neighboring counties. The study is unique and differs from previous studies in that it employs the SDM in assessing the relationship between amenities and regional economic growth. This is one of the major contributions of the study to the amenity and regional growth literature.

The results of the spatial impact of amenities on regional economic growth are mixed. Amenities within a county and/or surrounding counties play a significant role in the process of population growth. Historical and cultural amenities like museums, historical sites, zoos, and other attractions, play a positive direct and indirect role in attracting new immigrants. While the direct effect of natural amenities was negative, the indirect effect coming from surrounding counties was positive. This is an important finding, and one that has major policy implications. This implies that a county that lacks natural or historical attractions of its own can still benefit from the rich natural amenities of its surrounding counties. Regional cooperation in preservation and management of natural resources and recreational facilities should be one of the main focuses in developing an amenity-led development strategy; policy makers then have to address how these resources are managed and funded. Generally, natural amenities are public goods. If the cost of maintenance and development is left to the county within which the amenities reside, they would tend to be underfunded and underdeveloped. Regional internalization of this positive externality is required to take full advantage of the natural amenities in the regional economic growth process.

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