THE ROLE OF AMENITIES IN A REGIONAL ECONOMY: A META-ANALYSIS APPROACH

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Abstract
This paper seeks to address whether and how amenities are related to regional economic growth by using meta-analysis. Findings imply which amenity-related economic growth strategy should be taken into consideration when interpreting research results from diverse studies. Research results are summarized as follows. First, research methodologies do not deviate much from the mainstream. Second, spatial autocorrelation correction components seem to yield contradictory results to a conventional logic but they in fact restore neighborhood effects. Last, different types of amenities (natural v.s. man-made) have distinctive relationships with economic growth. Natural amenity growth derives lower-wage employment growth, while man-made amenities drive creative class growth. The results from meta-analysis on amenity-related economic growth provide policy decision makers with more consistent understanding than each literature's various political implication.

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1. Introduction

This paper seeks to address whether and how amenities affect regional economic growth by using meta-analysis. Amenities were first theoretically discussed as a quality-of-life factor (Roback 1982). Since then, they have been found to be a key factor in a firm's location decision and people's migration decisions (Dissart and Deller 2000; White and Hanink 2004).

The role of amenities in regional development has recently been regarded as important as other economic factors in local areas. In literature from regional science, there is a notion that amenities in general are playing an increasingly important role in migration decisions (Greenwood 1985). Since there has appeared the first argument by Graves about a significant relationship between amenities and migration patterns (Graves 1983), a growing number of studies have evaluated the important role of an amenity as a deterministic role of migration (Deller, et al. 2001; Knapp and Graves 1989; Nord and Cromartie 1997; Porell 1982). In addition to relationships between amenities and migration, there are literature about relationships between amenities and wages or housing rents (Hoehn, et al. 1987; Roback 1988), and literature about amenities and unemployment (Deller and T.S.H.Tsai 1999). Arguably, not all studies provide an implication that a natural amenity has a positive correlation with rural economic development (Duffy-Deno 1998; Keith and Fawson 1995; Lewis, et al. 2002). A probable reasoning of these conflicting results is that each individual research used different methodologies, various temporal/spatial units, and diverse economic variables.

A meta-analysis on amenities can statistically summarize empirical results of past research and provide objective implications that underlie the research topics (Lipsey and Wilson 2001). One of the advantages of using the meta-analysis is to identify which methodological approach is meaningful by an integrated statistical analysis on various research results. A meta-analysis is performed to identify the key elements that underlie the connection between amenities and economic development. The key elements that I will be focused on are socio-economic factors considered influential in the research literature on amenities.

Since a meta-analysis summarizes results of past research in a statistical manner and tests sensitivities of them with regard to each methodological

specification, a meta-analysis on amenities can provide an intermediate consensus on point estimates of amenities and suggest an ideal direction of using proper methodologies for the research (Jeppesen, et al. 2002).

In regional science, there are multiple contributions that have applied meta-analysis: deterministic relationships between human behaviors and demand for recreational site decisions (Smith and Kaoru 1990), a relationship between the marginal willingness to pay for reducing particulate and hedonic property values (Smith and Huang 1995), an analysis on different methodological implications on a study of residential property values in the United States (Simons and Saginor 2006), as well as the relationships between environmental regulations and new plant location decisions (Jeppesen, et al. 2002).

Summarizing implications of the past literature having used the meta-analysis, comparing and contrasting diverse types of results from alternative empirical studies can be challenging because of varying model specification, researchers' subjective judgment, or data uniqueness with respect to spatial and temporal perspectives. The above meta-analytic studies in environmental and regional studies tried to overcome this vulnerability of individual empirical estimation and found more differentiated and sophisticated findings than conventional review procedures which rely on qualitative summaries.

This paper uses parameter estimates of natural (or man-made) amenities obtained from ten research studies. By applying meta-analysis which incorporates the parameter estimates of the aforementioned studies, this paper seeks to find an answer to whether and how amenities impact local economic development, and in particular, induce a more consistent economic policy implication of amenities on rural development.

The findings of the meta-analysis in this paper suggest that little methodological diversity exists among researchers in the field of amenities. However, I find an importance of considerations of amenities' spatial boundaries in research on amenities, particularly for amenity research on rural areas. Additionally, as an economic growth specification, employment growth is more likely related to man-made amenities even in research on rural areas than natural amenities.

The remainder of the paper will begin with a theoretical/empirical consideration of meta-analysis followed by a discussion about empirical results. The paper will end with the key conclusions of the analysis.

2. Method and Data

2.1. Method: Meta-analysis

The methodology this paper uses is meta-analysis. Known as an analysis on analysis, "meta-analysis provides a statistical synthesis of empirical research focused on a common hypothesis or model" (Cook, et al. 1992). In the social and behavioral sciences, research cannot be executed in an organized and predicted way as the biological, physical, and natural sciences, because it is quite often difficult and complicated to understand human behavior. Therefore, research environments are difficult to control, typical definitions are not available, and methods, techniques, or variables change from study to study. It is rare for a single experiment or study to provide sufficiently definitive answers on which a political implication is to be based (Hedges and Olkin 1982). As a result, conflicting results are likely to be obtained and these conflicting results can lead to non-acceptable answers to guide policy for the problems posed (Wolf 1986).

Meta-analysis is one approach to accumulate knowledge: a culmination of results across studies to establish facts. Therefore, it is the resolution of the basic facts from a set of studies that all bear on the same relationships (Hunter and Schmidt 1990). Most such analyses have summarized empirical results or have evaluated the evidence from test results across a variety of different types of experiments. The empirical results or test results of diverse research are compared in the meta-analysis and, therefore, they should take standardized units such that meta-analysts can compare diverse literature: effect-size. According to Hunter and Schmidt (1990), an effect-size is a standardized unit such that meta-analysts can compare diverse literature.

2.2. Data

I use parameter estimates reported in the past literature concerning econometric relationships that represent the effect of an amenity on economic growth. Variables representing economic growth are growth rates of population, employment, and income. In sum, I gathered parameter estimates from ten articles that provide 637 observations. These ten articles were obtained through an on-line search engine for academic literature in economics, 'EconLit'. Originally,

forty three articles were searched by three key words: 'rural', 'amenity,' and 'development.' Out of forty three articles, thirteen articles providing parameter estimates[1] that can be used as effect-sizes or can be transformed to be an effect-size were filtered and chosen. As a further sorting step, the literature generating unclear region-specific effect-sizes were deleted, because they do not help in explaining whether rural areas' amenities are more influential on economic growth than urban areas' amenities. For example, Marcouiller, et al. (2004)'s study region is the US lake states (Minnesota, Wisconsin, and Michigan) but parameter estimates from this study do not specify whether they are for rural areas or urban areas. A brief summary of important features of the literature from which the meta-data were obtained is presented in Appendix 1.

In order to perform an appropriate understanding of the relationships between amenities and economic factors, I adopted an unbalanced panel-data regression model based on Jeppesen et al. (2002). The estimated model[2]

$$E_{ij} = \alpha_i + \beta X_{ij} + \varepsilon_{ij} \tag{1}$$

E_{ij} denotes elasticities which were transformed from study i's jth parameter estimate of the effect of an amenity on macroeconomic variables and X_{ij} is a set of explanatory variables[3]. The parameter estimates of amenities on right hand side of the original equations are moved to left hand side of the equation (1)

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[1] Parameter estimates of amenities of the regression equations in research literatures are percentage change in each category (for example population, employment, income, etc.) with respect to amenities. As described below, these parameter estimates have different measuring scales. The issue of measurement scale is solved by transforming those into scale-free elasticities.

[2] This analysis uses a subset of literature introduced at Appendix 1, because the subset of literature provides proper mean-values which can be used in a calculation of parameter estimates into the elasticity-type effect-size. This subset does not include all literature which used amenity index created by using the aggregate factor score approach. It is not possible to analyze how the aggregate factor score approach plays in amenity research in this elasticity-type comparison regression. However, since the next regression equation does not require the dependent variable to be an elasticity-type effect-size, it may be useful to keep in mind that some past research used the aggregate factor score approach.

[3] Explanatory variables are mostly binary variables exhibiting methodological specifications in each literature.

in this study. In addition to an explanation where the elasticities come from and where they are analyzed in our equation in this paper, it should be noted that the elasticities are a scale-free unit for a legitimate comparison among various amenities in past literature.

Next, I supplement a limited dependent variable model in order to investigate whether each methodological specification meaningfully generates significant estimates of amenities' effect on economic growth. The estimated model, the dPROBIT model, is given by

$$B_{ij} = \delta Z_{ij} + \varepsilon_{ij} \qquad (2)$$

B_{ij} denotes whether study i's jth parameter estimates of amenities are significantly different from zero at the $p < 0.10$ level. If it is significantly different from zero, then $B_{ij} = 1$, otherwise $B_{ij} = 0$. Here, δ are estimated response coefficients; Z_{ij} is identical to X_{ij} in equation(1), and ε_{ij} are *i.i.d.* error term with zero mean and constant variance σ_{ε}^2.

Dependent variable (E_{ij} and B_{ij})

Effsz (effect-size: E_{ij}), the dependent variable of equation (1), denotes elasticities which were transformed from study i's jth parameter estimate of the effect of an amenity on the percentage change in the respective macroeconomic variable in the i's study. Bi-effsz (B_{ij}), a dependent variable of equation (2), denotes binary variables whether parameter estimates in the literature of Appendix 1 are significant at 10 % confidence level or not. In this study, if the parameter estimates are significant at 10 % confidence level, Bi-effsz has a value of unity(1). If not, it has a value of zero(0). Their basic descriptive statistics are presented at Table 1.

TABLE 1. Descriptive Statistics of Dependent Variables in Each Regression Equation

Dependent Variable	Number of Observations	Mean	Standard Deviation	Min	Max
Effsz (effect-size: E_{ij})	383	0.6457	19.4829	-24.97	378.17
Bi-effsz (B_{ij})	637	0.3799	0.4857	0	1

Independent variables (X_{ij} and Z_{ij})

This section describes explanatory variables of X_{ij} in the equation (1) and Z_{ij} in the equation (2). They are in fact identical and have been identified on the basis of a systematic examination of the literature where all parameter estimates were obtained. Except the fact that the number of observations for X_{ij} is smaller than that of Z_{ij} due to limitations in the ability to calculate an elasticity, model characteristics are identically classified into five categories: (A) model specification, (B) regional specification, (C) temporal specification, (D) amenity-index specification, and (E) economic growth specification. Descriptive statistics for these characteristics are presented in Table 2.

First, model specification denotes binary variables (zero or unity) whether each article chose indicated equations (Model3d, Model1d, and Modeletc) for empirical regression models, whether each article was published in a peer reviewed journal (Journal), or whether each article incorporated spatial autocorrelation correction components into its equations (Spatial). 'Model3d' is an extended version of Carlino-Mills growth model (Carlino and Mills 1987).

TABLE 2. Descriptive Statistics of Independent Variables in Each Regression Equation

		X_{ij} (Total Observations: 383)		Z_{ij} (Total Observations: 637)	
	Explanatory Variables	Mean.	Std. Dev.	Mean	Std. Dev.
Model specification	Model3d	0.2845	0.4518	0.4160	0.4932
	Model1d	0.7154	0.4518	0.4866	0.5002
	Modeletc	0	0	0.0973	0.2966
	Journal	0.7493	0.4339	0.7519	0.4322
	Spatial	0.2950	0.4566	0.2040	0.4033
Regional specification	Rural_spec	0.4751	0.5000	0.4709	0.4995
	US	0.3446	0.4758	0.4756	0.4998
Temporal specification	Age	22.6997	7.7784	21.5416	6.4328
	Duration	1.3473	0.7358	1.2088	0.5951
Amenity -index specification	Indxsum	0.1932	0.3953	0.1538	0.3610
	Indxfactor	0	0	0.1224	0.3280
	Indxetc	0.8067	0.3953	0.7237	0.4475
Economic growth specification	Population	0.7571	0.4293	0.6750	0.4687
	Employment	0.1462	0.3537	0.1773	0.3823
	Income	0.0966	0.2958	0.0989	0.2987

It is a simultaneous equation system looking at growth in population, employment, and per capita income (Deller and Lledo 2007). 'Model1d' is an equation explaining the change of one economic factor as a function of diverse socio-economic variables such as demography, human capital, or amenity. 'Modeletc' indicates a simple linear equation in which only one study was selected (Bosker and Marlet 2006).

Second, regional specification denotes what regions were identified in each study. 'Rural_spec' indicates whether the original study obtained data from a rural area or urban area (1 for urban areas, and 0 for rural areas). In addition to rural/urban division, I specified whether each literature's research region is the United States or outside the United States in 'US' (1 for the United States, and 0 for foreign countries).

Third, temporal specification represents time or year period from which each research study has obtained data. 'Age' represents how many years old that each study analyzes. For example, Beckstead, et al. (2008) analyzes total paid employment growth from 1980 to 2000; hence, 'Age' takes a value of 28 if that study's beginning year is twenty eight years old compared to the meta analysis study year (2008). The 'Duration' represents a categorical variable representing how many years time duration occurred in the study itself. If the duration of interest is from zero years to fifteen years, the categorical variable is '1'. If the time-period of interest is between sixteen years to twenty five years, the categorical variable is '2'. If the time-period of interest is longer than twenty five years, the categorical variable takes a value of '3'. For example, the time-period between 1980 and 2000 in Beckstead, et al. (2008) is 21 years and takes a value of 2 for this duration variable.

Fourth, the amenity-index specification denotes what method was used in each study when creating the amenity index. Amenity index types are divided three sub-groups according to the methods each study adopted for creating the amenity index: the summary index approach (Indxsum), the aggregate factor score approach (Indxfactor), and all other approaches (Indxetc). The most popular summary index approach is the one of McGranahan's ERS index (McGranahan 1999). This variable (Indxsum) takes the value of '1' only when the study explicitly described that it used the summary index approach or McGranahan's ERS index. The aggregate factor score approach is a method of compressing a set of related variables into a single scalar measure. The most popular of these approaches, the principal component approach (PCA), creates

an index of linear combinations of the original amenity variables where the linear weights are the eigenvectors of the correlation matrix between the set of factor variables. In fact, this variable (Indxfactor) takes the value of '1', when the study explicitly describes that it used amenity index created by the principal component analysis method. Other approach (Indxetc) takes the value of '1' when the effect sizes are coefficients of each individual amenity, and the effect size is a coefficient of other amenity index except the two explained above[4].

In addition to a diversification in the method of creating amenity index, I attempted to divide the original parameter estimates of amenities into two groups - natural amenities and man-made amenities - in order to search for probable differential linkages to economic growth according to different types of amenities. The entire dataset of parameter estimates is segmented according to the two amenity types and then it is analyzed which economic factors (population, employment, or income) were impacted differentially. Natural amenities comprise climate, land, water, winter, and recreation facilities[5]. Man-made amenities include police, hospital, police, school, and hotel/restaurant[6].

Lastly, economic growth specification denotes a binary variable that indicates in which equation the parameter estimates are obtained from: a population growth equation, an employment growth equation, or an income growth

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[4] There is only one amenity index in this category of other approach, and the other amenity index is created by the inverse hedonic pricing equation in Beckstead, et al. (2008).

[5] As examples for natural amenities, climate includes heating degree days (thirty-year average), cooling degree days (thirty-year average), precipitation, sunshine, temperature, or humidity. Land includes crop-land, conservation-land, pasture-land, and forested land. Water includes number of marinas, total river miles, or acres in streams. Winter includes international ski services, acres of mountains in counties with a given level of annual snowfall, or number of cross-country ski firms and public cross-country ski centers. Recreation facilities includes public spending on parks and recreation, entertainment establishments, developed recreational infrastructure, distance to nearest ski facility, sports and bicycle store jobs per capita.

[6] As examples of man-made amenities, police includes distance to police station. Hospital includes whether the regression model included distance to small acute hospitals or large hospitals, or the number of physicians. Police includes whether the regression model included distance to the nearest police station. School includes distance to the nearest school including university. Hotel/restaurant includes the number of hotels and restaurants, or the visits to hotels and restaurants.

equation. For example, 0.0224 is the parameter estimate of recreation amenity in an employment equation where employment is one dependent variable in a 3-D equation system in Nzaku and Bukenya (2005, pp 96). In this case, the dummy variable for employment takes on a value of '1'. This economic growth specification is included in order to analyze which economic factors are highly related to which amenities.

Since in many meta-analysis studies there is no *a priori* expectation of the sign of the parameter estimates from the covariates of which the meta-analysis is being conducted, there is no consensus in the literature on the research question. In this study, I put aside an argument about directional impact that amenities induce immigration or increase income, or whether the high incomes spends more on man-made amenities than the low incomes. Given the identification with which type of amenities out of natural amenities or man-made amenities are more likely related to one of three economic growth specifications, regional policy-makers are equipped with a broad implication to focus on which type of amenity to be invested.

3. Estimation and Results

In this section, I explain inter-relationships between amenities and methodological specification in research of amenities. Then, I divide amenities into two groups(natural v.s. man-made) and try to connect them to economic growth.

The fact that each original literature provides a different number of parameter estimates can justify the use of the panel-data regression model. Even though the parameter estimates are not exactly time-dependent variables, treating those variables as panel-data would generate more efficient estimators than as a series of cross-sections with the same number of observations (Nijman and Verbeek 1990). They are assumed to be *i.i.d.* error terms with zero mean and constant variance σ_{ε}^2. Additionally, $E[a_i] = 0$, $E[a_i^2] = \sigma_a^2$, $E[a_i a_h] = 0$ for $i \neq h$, and αi and ε_{ij} are orthogonal for all i and j .

The estimation procedure with panel data leads to a question of how to treat the first term in the right hand side of the equation, a_i. This term reflects the effect of explanatory variables that are typical of *i*'s study and that are constant within the study. Before explaining the decision procedures of

which model to use, it is worthy of mentioning the implication of a_i.

This unobserved individual heterogeneity represents a 'certain researcher's effect' (Jeppesen, et al. 2002, pp. 25), because it differs from literature to literature and, therefore, is considered to represent specific features that the researcher used within the literature. Jeppesen et al. (2002, pp27) made an emphasis on this researcher effect: "it probably provides insightful implications about, for example, selection of the data, treatment of outliers, publication habits, or the regression approach, because they control the commonality within each study." A Hausman contrast test[7] leads to a discussion whether to treat the constant term as a proper 'researcher effect', the discussion on whether to use panel-data regression or cross-sectional regression will be conducted.

Testing results whether to treat equation (1) as a panel data regression analysis are presented in Table 3. The most interesting issue in these tests

TABLE 3. Results of Fixed Effects Approach and Random Effects Approach in Panel Data Regression

	Hausman Test	F-test for Equality of Individual Differences	Breusch and Pagan Lagrange Multiplier Test for Random Effects
Model A	Chi2(2) = 0.07 Prob>chi2 = 0.7850	F(5,376) = 0.02 Prob>F = 0.9999	Chi2(1) = 1.06 Prob>chi2 = 0.3036
Model B	Chi2(2) = 0.07 Prob>chi2 = 0.9665	F(5,375) = 0.01 Prob>F = 0.9999	Chi2(1) = 0.07 Prob>chi2 = 0.3023
Model C	Chi2(4) = 0.12 Prob>chi2 = 0.9982	F(5,373) = 0.02 Prob>F = 0.9997	Chi2(1) = 1.07 Prob>chi2 = 0.2999
Model D	Chi2(5) = 0.28 Prob>chi2 = 0.9980	F(5,372) = 0.06 Prob>F = 0.9980	Chi2(1) = 1.07 Prob>chi2 = 0.3004
Model E	Chi2(6) = 0.06 Prob>chi2 = 0.9989	F(5,370) = 0.04 Prob>F = 0.9989	Chi2(1) = 1.07 Prob>chi2 = 0.3002

Note: Total number of observations is 383.

[7] The test compares the coefficient estimates from the random effects approach to those from the fixed effects approach. A basic logic underlying the Hausman test is that both random effects and fixed effects estimators are consistent if there is no correlation between individual error term and the explanatory variables (Verbeek, 2004.). If both estimators are consistent, both estimates from random effects approach and fixed effects approach should be similar. On the contrary, if individual error-terms are correlated with any explanatory variables, random effects estimators are inconsistent, whereas the estimators from fixed effects approach are consistent.

is to find unobserved individual differences that the ordinary regression approach would have not found and, then, how to treat those unobserved individual differences: all models with four sets of ascending explanatory variables (Model A, B, C, and D) through a pooled model with all the explanatory variables(Model E). Model E shows that random effects are inappropriate for this model. The conclusion from these statistics in Table 3 is that the random effects estimator is inconsistent and, therefore, it is better to use the fixed effects estimator or it is necessary to improve the model specification.

However, the results of the two tests – F-test for the equalities of the constant terms in equation (1) and the Breusch and Pagan Lagrange multiplier test – for the presence of individual researcher difference lead to a conclusion that it is better not to treat the constant term as a specific researcher's effect.

In sum, a combined result of the F-test and the Breusch/Pagan Lagrange multiplier test implies that researcher-specific factors are insignificant. This finding implies that researchers in the literature are not conducting research in a manner fundamentally different from one another. Based on three test results, this paper disregards researcher's effects and focuses on the results of OLS estimation.

The results of simple ordinary least squares estimations on different sets of variables for the equation (1) are presented in Table 4. The dependent variable of equation (1) was an effect-size representing how much the percentage change of macroeconomic variable such as income and employment is caused by one percentage change of the amenity. Therefore, positive coefficients of explanatory variables in OLS estimation of equation (1) imply that inclusion of a methodological specification variable contributes to an explanation of the change of macro-economic variables[8].

It is a category of a model specification that generates significant methodological specifications in a study of amenities. 'Model3d' is found to be significant in explaining amenity's role in economic growth[9]. It implies that the

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[8] A notable point which might attract readers' attention is the absolute value of coefficients, instead of the signs of the coefficients. Since some regions have a negative rate of economic growth, direction of explanatory dimension can be both positive and negative. Compared to the signs, the magnitude of absolute values of coefficients indicates how promptly or how sensitively economic impact of amenities responds to a selection of the methodological variables.

three dimensional simultaneous equation system from Deller, et al. (2001) capturing interdependent relationships among "people", "job", and "income" is proper estimation method in explaining the role of amenities in a context of economic growth. An emphasis on the simultaneous equation system in a study of amenities might be reasonable because amenities are not considered as a sole exogenous factor to economic growth.

The other variable that is found to be significant in explaining amenities' contribution to economic growth literature is 'Journal.' It might be a fair interpretation that peer-reviewed journals have more parameter estimates of amenities which had influential relationships to economic growth factors than unpublished/working papers.

TABLE 4. Results of Ordinary Least Squares Regression(Dependent variable is Effsz: X_{ij})

Specification	Model	(A)	(B)	(C)	(D)	(E)
	Variables	coefficients	coefficients	coefficients	coefficients	coefficient
Model specification	Model3d	26.2018***	26.5465***	23.0147***	24.4913***	21.1352**
	Model1d	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
	Modeletc	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
	Journal	27.1218***	27.2145***	19.1692*	16.6854*	16.3845
	Spatial	0.3793	0.3301	0.1130	-0.0171	-0.0057
Regional specification	Rural_spec		0.2061	0.0450	-0.3533	-0.3031
	US		-0.2092	5.2300	5.8258	11.5993
Temporal specification	Age			-1.0174	-1.2440	-1.1356
	Duration			5.5484	9.2916	8.6553
Amenity index specification	Indxsum				-7.6149	-7.5235
Economic growth specification	Population					6.4949
	Employment					(dropped)
	Income					1.6578
	Constant	-27.2468***	-27.4256***	-6.5045	-3.4689	-11.0044
Test for heteroskedasticity (Breusch-Pagan / Cook-Weisberg test)		Prob>X^2=0	Prob >X^2 =0	Prob>X^2=0	Prob>X^2=0	Prob >X^2 = 0
Multicollinearity test (VIF)		5.16	5.16	20.63	19.54	16.73
Prob > F		0.0000	0.0000	0.0007	0.0007	0.0011
R-squared		0.0621	0.0621	0.0647	0.0694	0.0752

Note: (1) 'Modeletc' was dropped out of regression to avoid perfect collinearity.
: (2) Total number of observations is 383.
: (3) *** indicates 1% significance level, ** indicates 5 % significance level, and * indicates 10% significance level

9 We cannot distinguish 'Model1d' or 'Modeletc' from 'Model3d' in the OLS estimation, because parameter estimates deleted from the OLS estimation belong to 'Model1d' and 'Modeletc'.

Next, in the dPROBIT model in equation (2), a dependent variable is a binary variable indicating either 1 or 0. It takes 1 for the case that parameter estimates of original regression equations are significant at 10 % confidence level and it takes 0 for otherwise. The coefficient (δ) in equation (2), as presented at Table 5, reflects a marginal effect of discrete changes of the explanatory variables calculated at mean. Positive values of parameter estimates of dPROBIT estimation indicate that the probability of significance increases with the particular methodological variables included.

Among model specifications, using 3-D equation in the research heightens the probability that amenity-driven economic growth rate is significant. This collateral relationship is likely true based on the same reasoning discussed in the OLS estimation. Another significant model specification factor is 'Spatial', which represents whether the research incorporates spatial autocorrelation correction components into the original regression model. On the contrary to expected positive coefficients, however, 'Spatial' shows negative coefficients in all five regression models. This negative marginal change of 'Spatial' contradicts to the conventional notion. It has been conventionally considered that incorporating spatial autocorrelation correction components into the regression model disentangles spatial inter-relationships among economic factors, because spatial components explicitly consider region-specific heterogeneity and spillover effect of those heterogeneous characteristics in the regression models. The problem of ignoring the region-specific characteristics and their diffusions to adjacent areas is that the ordinary standard estimator is likely to underestimate the true standard error (Marcouiller, et al. 2004). The distortion in measuring the true standard errors can impact on significance level and, therefore, may guide toward an inappropriate policy implication. As a consequence, the 'Spatial' term needs to be included in research on amenities and the reason is discussed in the next section.

With the regional specification included in model (B), a significant positive marginal change of 'Rural-spec' implies that if a research of amenities is focused on rural areas the possibility of obtaining significant estimates is approximately ten percent higher than research on urban areas.

The next category, temporal specification, allows us to understand its methodological specifications in a composite way. All three different modes of (C), (D), and (E) show both positive marginal changes of 'Age' and negative marginal changes of 'Duration.' This contrasting combination in signs may sug-

gest that there is a higher possibility for a research whose initial year is older to generate more significant parameter estimates of amenities. At the same time, it may imply that a smaller time-gap between initial year and the ending year of economic growth change would generate more significant estimates of amenities.

TABLE 5. Results of dPROBIT Regression Using Full Observations (Dependent variable is Bi-effsz: B_{ij})

Specification	Model	(A)	(B)	(C)	(D)	(E)
	Variables	Marginal change	Marginal change	Marginal change	Marginal change	Marginal change
Model specification	Model3d	0.4494***	0.4561***	0.4289***	0.2106	0.2039
	Model1d	0.2410**	0.2708***	0.1404	-0.3085	-0.3331
	Modeletc	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
	Journal	-0.1154	-0.1093	0.0340	0.3883**	0.4052**
	Spatial	-0.1068*	-0.1131**	-0.1221**	-0.1480**	-0.1572**
Regional specification	Rural_spec		0.0926**	0.1057**	0.0491	0.0483
	US		0.0547	-0.0810	-0.2703*	-0.2174
Temporal specification	Age			0.0191	0.0692***	0.0704***
	Duration			-0.1067	-0.4452***	-0.4613***
Amenity index specification	Indxsum				0.0085	0.0196
	Indxfactor				-0.3107***	-0.3266***
Economic growth specification	Population					0.2079**
	Employment					0.1830*
	Income					0.1104
Predicted probability at X bar		0.3720	0.3706	0.3706	0.3705	0.3707
Likelihood Ratio Test		chi2(4) = 51.21	chi2(6) = 56.40	chi2(8) = 57.84	chi2(10) = 75.05	chi2(13) = 80.50
Prob > chi2		0.0000	0.0000	0.0000	0.0000	0.0000
Pseudo R2		0.0605	0.0667	0.0684	0.0887	0.0952

Note : (1) dPROBIT is a Probit regression reporting marginal effects.
: (2) 'modeletc' was dropped out of regression to avoid perfect collinearity.
: (3) Total number of observations is 637. It could be possible because dependent variables in dPROBIT estimation are not required to be in the form of elasticities.
: (4) *** indicates 1% significance level, ** indicates 5 % significance level, and * indicates 10% significance level

Since an inclusion of additional type of amenity index ('Indxfactor') decreases the possibility of acquiring more significant parameter estimates of amenities in economic growth equations, there should be a doubt whether this amenity index is an appropriate method.

Last, growth changes in population and employment are more likely explained by inclusion of amenities than income growth. A simultaneous equation representing interdependence between "people" and "job" originates from Carlino and Mills (1987). An extended version of Carlino and Mills (1987) uses a three-dimensional simultaneous equation with "income" included ('Model3d') and an aggregate factor score approach ('Indxfactor') for creating the amenity index.

In addition to understanding factors explaining impacts on economic growth from an aggregate amenity index, I modified equation (2) and analyzed whether different types of amenities (natural amenities v.s. man-made amenities) would have differentiating effects on economic growth variables. The estimated model is given by equation (3),

$$B_{ij}^{k} = \gamma Z_{ij}^{k} + \varepsilon_{ij}^{k} \qquad (3)$$

where, B_{ij}^{k} denotes study *i*'s *j*th 10 percent confidence-level-parameter estimates of each amenity in each category for natural amenities (=natural) and man-made amenities (=manmade). It can be hypothesized that rural areas are more related to natural amenities than urban areas.

Alternatively, it can be hypothesized that spatial autocorrelation correction component is more powerful in explaining the relationships between economic factors. These interactive effects can be untangled by investigating linkages of dichotomous amenities to different economic factors and the results of the investigation are presented in Table 6 and Table 7.

First, overall model fitness is better in the man-made amenity regression than the natural amenity regression in OLS estimation. In addition to this, the issue of multicollinearity is alleviated in the man-made amenity regression. On the contrary to the OLS estimation, overall modeling tests in dPROBIT estimation indicate that the estimation using natural amenities shows better model fit than the estimation using man-made amenities[10].

Second, results of OLS estimation according to the two types of amenities (natural v.s. man-made) show that similar methodological specifications do

not have same influences on each amenity. There are two methodological specifications which show different directional influences depending on types of amenities: ‘Spatial’ and ‘Age’. The ‘Spatial’ variable increases a natural amenity’s impact on economic growth, while it dampens the degree of explanation of man-made amenities. The coefficient of 'spatial' in the natural amenity regression of Table 6 is 6.8756, while the coefficient of 'spatial' in the man-made amenity regression of Table 7 is -1.0670. Opposite signs of ‘Spatial’ of OLS according to amenity types might be due to different levels of geographic closeness of areas where either natural amenities or man-made amenities are abundant.

TABLE 6. Results of Natural Amenity Regression

	Natural amenity					
	OLS (total observations : 237)		dPROBIT (total observations : 237)		dPROBIT (total observations : 425)	
	Version 1	Version 2	Version 1	Version 2	Version 1	Version 2
Model3D		3.4480		0.2353		0.3123***
Spatial	6.8756*	0.0546	0.0435	-0.0528	-0.0679	-0.1007
Rural_spec	-4.1271	-3.7087	0.1548**	0.1413	-0.0446	-0.0334
US		36.7436***		0.0570		0.1065
Age	-0.3718	-2.9873***	0.0223***	0.0167	0.0138***	0.0103*
Indxsum		24.4284		-0.1077		-0.1554
Indxfactor						-0.2045***
Population	-0.0573	6.4677			-0.0754	0.2055*
Employment	0.7165	-1.6453	-0.0947	-0.1144	0.0200	0.1966
Income	(dropped)	(dropped)	-0.1939*	-0.2232**	-0.1862 *	-0.0121
Constant	9.9916	48.9974**				
Test for heteroskedasticity	chi2(1) = 575.38	chi2(1) = 2566.01				
Test for multicollinearity : mean VIF	2.04	10.58				
	Prob > F = 0.3488	Prob > F = 0.0020	LR Test, chi2(5)=24.95	LR Test, chi2(8)=28.47	LR Test, chi2(6)=25.22	LR Test, chi2(10)=60.12
	R-squared= 0.0237	R-squared= 0.0999	Pseudo R2= 0.0803	Pseudo R2= 0.0917	Pseudo R2= 0.0456	Pseudo R2= 0.1087

Note (1) All ‘dropped’ results are due to avoiding collinearity.
(2) *** indicates 1 % significance level, ** indicates 5 % significance level, and * indicates 10 % significance level.

[10] Likelihood ratio tests for the null hypothesis that all explanatory variables are equal to zero lead to a rejection of the null hypothesis at 1% significance level for all versions of natural amenity dPROBIT estimation, whereas none of man-made amenity dPROBIT estimations lead to a rejection of the same null hypothesis.

TABLE 7. Results of Man-made Amenity Regression

	Man-made amenity					
	OLS (total observations : 131)		dPROBIT (total observations : 127)		dPROBIT (total observations : 176)	
	Version 1	Version 2	Version 1	Version 2	Version 1	Version 2
Model3D		-16.3629***		-0.4085***		
Spatial	-1.0670*	0.1082	-0.1964	-0.1760	-0.2185*	-0.1724
Rural_spec	0.5395	0.2367	0.1844**	0.1735**	0.1349***	0.1274*
US						-0.8847***
Age	-0.0374	1.4218***	0.0154	0.2064	0.0395***	0.8102***
Indxsum						0.7616***
Population	(dropped)	(dropped)	0.0541	0.0001	0.0488	-0.2442
Employment	1.1695	6.2153***				
Income	-0.1056	1.2921	(dropped)	(dropped)	0.3633	-0.1733
Constant	0.3894	-25.7220***				
Test for heteroskedasticity	chi2(1) = 176.64	chi2(1) = 509.66				
Test for multicollinearity : mean VIF	1.89	3.96				
	Prob>F= 0.3280	Prob>F= 0.0000	LR Test, chi2(4) = 7.88	LR Test, chi2(5) = 8.31	LR Test, chi2(5) = 12.42	LR Test, chi2(7) = 3.67
	R-squared = 0.0447	R-squared = 0.4511	Pseudo R2 = 0.0493	Pseudo R2 = 0.0520	Pseudo R2 = 0.0544	Pseudo R2 = 0.0598

Note (1) All 'dropped' results are due to avoiding collinearity.
(2) *** indicates 1 % significance level, ** indicates 5 % significance level, * indicates 10 % significance level.

Furthermore, 'Age' shows conflicting influences on economic rate of changes between the natural amenity regression and man-made amenity regression. When the amenity-related research uses economic rate of change on the basis of older years, an impact of a man-made amenity is increased compared to a natural amenity. The coefficient of 'age' of the natural amenity OLS regression is -2.9873 in Table 6, while that of 'age' of the man-made amenity OLS regression is 1.4218 in Table 7. This leads us to imply that an area tends to experience more drastic changes due to man-made amenities in economies than due to natural amenities.

Third, employment is more likely related to amenity-driven economic growth pattern when the amenity is man-made. The coefficient of 'employment'

of the man-made amenity regression for the OLS full model is 6.2153 in Table 6. This result may be capturing the effect of tourism and recreation-based regions that employ measurable amounts of low-paying service jobs, thereby increasing the employment effect but not the income effect.

On the contrary, natural amenities are found to be less significant in explaining economic growth change as represented in the OLS model. The negative marginal effect of natural amenities in dPROBIT estimations does not necessarily imply that natural amenities decrease income growth in rural areas. However, it suggests that income changes in rural areas are not well explained by natural amenities. As stated previously, another explanation for lower income growth from natural amenities is that it brings in measurable low-wage, service-oriented employment growth to exploit the natural amenities, for example, a seasonal, temporary, and low-skilled employment in the tourism and recreation sector (Marcouiller, et al., 2004).

4. Discussion

From the meta-analysis of amenity's role in economic growth, I discovered three features which an amenity-driven economic growth strategy should take into consideration when interpreting research results from amenity-focused economic growth studies. First, research methodologies do not deviate much from the mainstream and each researcher follows the popular methodologies of the past literature. Second, in some of these confirmed methodologies, spatial autocorrelation correction components yield contradictory results to conventional expectations. Finally, man-made amenities are highly interconnected with economic growth, especially in employment growth and even in research focused on rural areas, and a rural area's income may not be well explained by increased natural amenities.

First, each researcher in the study area of amenities mostly follows the previous research methods. This result was, to a certain degree, expected from the beginning, because nearly ninety percent of effect-size was obtained from the parameter estimates of either the 3-D equation (41.6 %) or the 1-D equation (48.66%). Both 3-D and 1-D equations have their theoretic basis on endogenous growth theory. Marcouiller, et al. (2004) referred to Button's argument that

"economic growth tends to be faster in areas that have a relatively large stock of capital, a highly educated population, and an economic environment favorable to the accumulation of knowledge"(Button 1998). They extended the theory to include the natural amenity endowment in order for it to play an alternative and additional role in explaining the market force's aggregate effect. The 3-D equation, a simultaneous equation extended from Carlino and Mills (1987), explicitly addresses interacting relationships between "people", "income", and "jobs" (Marcouiller, et al. 2004; Steinnes and Fisher 1974). The 3-D equation as well as the 1-D equation is constructed on the hypotheses that were derived from endogenous growth theory: growth is conditional on initial conditions, and growth is conditional on regional amenity factors. Therefore, even though there is a history of amenity research in economics since Graves (1983), methodological variations are rarely found in this area.

Second, it is unexpectedly notable that spatial autocorrelation correction components (Spatial) show insignificant results which are contradictory to the conventional consensus in economic growth analyses. The signs of their coefficients in an estimation for the dPROBIT model using full observations are all negative. These negative coefficients imply that an inclusion of spatial autocorrelation correction components into the regression model weakens the significance of amenity factors. This conflicts with a conventional validity of spatial autocorrelation correction components; being distinctively distributed in one region, amenities are highly correlated with close neighboring areas due to regional indifference in climate, topography, and ecotype and this close proximity is successfully captured by employing geographically weighted components which correct spatial autocorrelation in the regression models (Kim, et al. 2005).

Ironically, the result of an unexpected insignificance of 'Spatial' might be consistent with a modeling strategy incorporating spatial autocorrelation correction components. That is, an inclusion of spatial autocorrelation correction components into the equations could restore an underestimation of standard errors that OLS generated to the robust level of the standard errors. In fact, I could confirm that levels of significance of each explanatory variable are quite different according to modeling strategies. From dichotomous results of a simple regression and of a spatially corrected regression in one literature, levels of significance of parameter estimates of amenities in a simple regression equation are stronger than those in a spatially weighted regression (Ferguson, et al. 2007;

Marcouiller, et al. 2004).

However, even in these literatures generating insignificant estimates from an equation which embeds spatial autocorrelation correction components, it is justified to include spatial components in the equation based on one indicator: a spatial autocorrelation coefficient measuring significance of spatial weight matrix[11]. All spatial autocorrelation coefficients of spatial weight matrix are positive and significant with t-test. Furthermore, Hong and Fannin(2009) and Hong(2010) compared two modeling strategies: one with spatial autocorrelation correction components and the other without spatial autocorrelation correction components. The results implied that inclusion of the spatial autocorrelation correction components helped socio-economic variables' statistical significance even though it weakened a statistical significance of amenity variables themselves. The results of empirical tests(Hong and Fannin 2009; Hong 2010) and past literatures(Ferguson, et al. 2007; Marcouiller, et al. 2004) confirm the legitimacy of using spatial autocorrelation correction components in amenity research, despite weak significance of either individual explanatory variables or overall model fitness.

Lastly, man-made amenities contribute to an explanation of economic growth more than natural amenities and the contribution is better ascertained in the employment growth equation. Furthermore, even though research analyzes economic growth for a relatively long period, the contribution of natural amenities to economic growth is not substantial compared to that of man-made amenities (Carruthers and Mulligan 2007; Deller and Lledo; 2007). Deller and Lledo (2007, pp. 18) found similar results that Appalachia rural areas are lagged behind the rest of rural America in job growth. Carruthers and Mulligan (2007) found contradicting influences of natural amenities and man-made amen-

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[11] There are two different modeling approaches in expressing spatial dependence. The one is spatial autoregressive model (SAR) and the other is spatial error modeling (SEM) (LeSage and Pace, 2009). SAR considers spatial relations in a way that dependent variable in a regression equation is spatially correlated, that is, spatially lagged dependent variable (LeSage and Pace, 2009, pp. 6). In this perspective, a spatial autocorrelation coefficient represents spatial relationships among those lagged dependent variables. SEM treats a spatial autocorrelation as a missing variable represented by the unobserved error terms and, therefore, the spatial autocorrelation coefficients are thought to represent the missing variables in error terms (Kim, et al., 2005, p. 277).

ities on employment growth. While natural amenities showed negative influences on employment growth, man-made amenities such as entertainment establishments and eating/drinking establishments are positively related to employment growth. Man-made amenities (sometimes called cultural amenities) such as hotel/restaurant, hospital, and school are more likely correlated with the emergence of high technology-based urban subpopulations, the so-called "bohemians" and "creative class" (Florida 2002).

The high correlation between man-made amenities and employment growth does not seem to be striking. Refined cultural amenities and their consumptions attract talented people and they, in turn, drive a creative classical economic growth process into a growth of cities (Clark 2004; Florida 2002).

Contrastingly, a contribution of natural amenities to employment growth is well identified in an area where tourism and recreation are main industries (Keith and Fawson 1996; Marcouiller, et al. 2004). Deller and Lledo (2007) found more employment opportunities in recreational industries in mountainous Appalachia areas. However, it should be noted that these opportunities are limited to part-time and low-skilled labors in recreational areas (Marcouiller, et al. 2004). Instead, overall employment opportunities are low in areas with high climate index such as warmer and wetter areas (Deller and Lledo 2007). Another implication related to high natural amenity areas is an immigration of retirees. Compared to urban subpopulations, retirees with high income levels are attracted to high-level natural amenities in rural areas (Deller and Lledo 2007; Nzaku and Bukenya 2005; Shields, et al. 1999). A differentiating result from the discussion can be derived: man-made amenities may be driving creative class growth, but natural amenity growth may be driving lower-wage employment growth.

5. Concluding Remarks

Deducting appropriate conclusions by filling a gap among a perplexing magnitude of literature is important for researchers and policy-makers. Under a circumstance that a theory is not yet clarified and theorists have plenty of previous studies on the subject of interest, meta-analysis can be useful in finding out what empirical relationships have been revealed in these studies so that they

can be taken into account in theory construction. Furthermore, it is invaluable for policy-makers to understand that consistent relationship can be obtained from meta-analysis beyond each literature's various political implications. (Jeppesen, et al. 2002).

This paper analyzed whether amenities have a consistently important role in regional economic growth by using a meta-analytic literature review. Using data from ten studies that provided approximately six hundred observations and their subset of observations, I suggest insights into possible explanations of diverse estimates reported in the literature.

Given that no random researcher effect was found in existing literature, a pooled regression model derived using a diverse set of meaningful methodological diversity covariates helped draw some interesting conclusions. Studies that incorporated spatial autocorrelation correction modeling might confuse readers and conflict conventional usages of spatial components, because there are reduced probabilities that amenity parameter estimates can significantly affect economic growth. However, the diffusion effects of amenities, especially natural amenities, are captured more significantly in explaining an effect of other variables except amenities themselves in the same regression equations. This compensating result suggests that research on amenities need to consider diffusion effects crossing jurisdictional boundaries and to include spatial autocorelation correction components.

Man-made amenity parameters in employment growth equations were significantly larger than their population and income growth counterparts, whereas natural amenities are less related to income growth. This contrasting result gives us an inference that man-made amenities provide more employment opportunities and natural amenities attract older generations with high income.

REFERENCES

Artz, G. M., and P. F. Orazem. 2006. "Reexamining Rural Decline: How Changing Rural Classifications Affect Perceived Growth." *The Review of Regional Studies* 36, no.2, pp. 163-191.

Beckstead, D., W. M. Brown, and G. Gellatly. 2008. "The Left Brain of North American Cities: Scientists and Engineers and Urban Growth." *International*

Regional Science Review 31, no.3, pp. 304-338.

Bosker, M., and G. Marlet. 2006. *Urban Growth and Decline in Europe*. Utrecht, Netherlands, Utrecht University, pp. 1-33.

Button, K. 1998. "Infrastructure Investment, Endogenous Growth and Economic Convergence." *The Annals of Regional Science* 32, no.1, pp. 145-162.

Carlino, G. A. and E. S. Mills. 1987. "The Determinants of County Growth." *Journal of Regional Science* 27, no.1, pp. 39-54.

Carruthers, J. I. and G. F. Mulligan. 2007. *Human Capital, Quality of Life, and the Adjustment Process in American Metropolitan Areas*. U.S. Department of Housing and Urban Development.

Clark, T. N. 2004. *The City as an Entertainment Machine*. Oxford, UK: Elsevier.

Cook, T. D., et al. 1992. *Meta-Analysis for Explanation: A Casebook*. New York: Russell Sage.

Deller, S., and V. Lledo. 2007. "Amenities and Rural Appalachia Economic Growth." *Agricultural and Resource Economics Review* 36(1): 107-132.

Deller, S. C., and T. S. H. Tsai. 1999. "An Examination of the Wage Curve: A Research Note." *Journal of Regional Analysis and Policy* 28(2): 3-12.

Deller, S. C., T. S. H. Tsai, D. W. Marcouiller, and D. B. K. English. 2001. "The Role of Amenities and Quality of Life in Rural Economic Growth." *American Journal of Agricultural Economics* 83(2): 352-365.

Dissart, J. C., and S. C. Deller. 2000. "Quality of Life in the Planning Literature." *Journal of Planning Literature* 15(1): 135-161.

Duffy-Deno, K. T. 1998. "The Effect of Federal Wilderness on County Growth in the Intermountain Western United States." *Journal of Regional Science* 38(1): 109-136.

Ferguson, M., et al. 2007. "Voting with Their Feet: Jobs versus Amenities." *Growth and Change* 38(1): 77-110.

Florida, R. 2002. "The Economic Geography of Talent." *Annals of the Association of American Geographers* 92(4): 743-755.

Graves, P. E. 1983. "Migration with a Composite Amenity: The Role of Rents." *Journal of Regional Science* 23(4): 541-546.

Greenwood, M. J. 1985. "Human Migration: Theory, Models, and Empirical Studies." *Journal of Regional Science* 25(4): 521-544.

Hedges, L., and I. Olkin. 1982. "Analyses, Reanalyses, and Meta-Analysis." *Contemporary Education Review* 1, pp. 157-165.

Hoehn, J. P., M. C. Berger, and G. C. Blomquist. 1987. "A Hedonic Model of Interregional Wages, Rents, and Amenity Values." *Journal of Regional Science* 27(4): 605-620.

Hong, J. P. and J. M. Fannin. 2009. "Meta-analytic Revelation of the Role of Natural Amenities on the Rural Economy." in 48th Annual Meeting of the Southern Regional Science Association, San Antonio, Texas.

Hong, J. P. 2010. "Three Essays on the Role of Amenities as an Economic Development Strategy." doctoral dissertation. Louisiana State University, USA.

Hunter, J. E., and F. L. Schmidt. 1990. *Methods of Meta-Analysis: Correcting Error and Bias in Research Findings*: SAGE Publications.

Jeppesen, T., J. A. List, and H. Folmer. 2002. "Environmental Regulations and New Plant Location Decisions: Evidence from a Meta-analysis." *Journal of Regional Science* 42(1): 19-49.

Keith, J., and C. Fawson. 1995. "Economic Development in Rural Utah: Is Wilderness Recreation the Answer?" *The Annals of Regional Science* 29(3): 303-313.

Kim, K. K., D. W. Marcouiller, and S. C. Deller. 2005. "Natural Amenities and Rural Development: Understanding Spatial and Distributional Attributes." *Growth and Change* 36(2): 273-297.

Knapp, T. A., and P. E. Graves. 1989. "On the Role of Amenities in Models of Migration and Regional Development." *Journal of Regional Science* 29(1): 71-87.

Lewis, D. J., G. L. Hunt, and A. J. Plantinga. 2002. "Public Conservation Land and Employment Growth in the Northern Forest Region." *Land Economics* 78(2): 245-259.

Lipsey, M. W. and D. B. Wilson. 2001. *Practical Meta-Analysis*. Applied Social Research Methods Series: SAGE Publications, 2001.

Marcouiller, D. W., K.-K. Kim, and S. C. Deller. 2004. "Natural Amenities, Tourism and Income Distribution." *Annals of Tourism Research* 31(4): 1031-1050.

McGranahan, D. A. 1999. "Natural Amenities Drive Rural Population Change." *Agricultural Economic Report No.781*(1999).

Monchuk, D. C. et al. 2007. "An Analysis of Regional Economic Growth in the U.S. Midwest." *Review of Agricultural Economics* 29(1): 17-39.

Nijman, T. E., and M. Verbeek. 1990. "Estimation of Time Dependent Parameters in Linear Models Using Cross Sections, Panels or Both." *Journal of Econometrics* 46, pp. 333-346.

Nord, M., and J. B. Cromartie. 1997. "Migration: The Increasing Importance of Rural Natural Amenities." *Choices*, pp. 31-32.

Nzaku, K., and J. O. Bukenya. 2005. "Examining the Relationship between Quality of Life Amenities and Economic Development in the Southeast USA." Review of Urban and Regional Development Studies 17(2): 89-103.

Porell, F. W. 1982. "Intermetropolitan Migration and Quality of Life." *Journal of Regional Science* 22(2): 137-158.

Roback, J. 1988. "Wages, Rents, and Amenities: Differences among Workers and Regions." *Economic Inquiry* 26(1): 23-41.

Roback, J. 1982. "Wages, Rents, and the Quality of Life." *Journal of Political Economy* 90(6): 1257-1278.

Shields, M., J. I. Stallmann, and S. C. Deller. 1999. "Simulating the Economic and Fiscal Impacts of High- and Low-Income Elderly on a Small Rural Region." *Review of Regional Studies* 14(1): 65-80.

Simons, R. A., and J. D. Saginor. 2006. "A Meta-Analysis of the Effect of Environmental Contamination and Positive Amenities on Residential Real Estate Values." *Journal of Real Estate Research* 28(1): 71-104.

Smith, V. K. and J.-C. Huang. 1995. "Can Markets Value Air Quality? A Meta-Analysis of Hedonic Property Value Models." *Journal of Political Economy* 103(1): 209-227.

Smith, V. K. and Y. Kaoru. 1990. "Signals or Noise? Explaining the Variation in Recreation Benefit Estimates." *American Journal of Agricultural Economics* 72(2): 419-433.

Steinnes, D. N. and W. D. Fisher. 1974. "An Econometric Model of Intraurban Location." *Journal of Regional Science* 14(1): 65-80.

Verbeek, M. 2004. *A Guide To Modern Econometrics*. 2ed. West Sussex, England: John Wiley & Sons, Ltd.

White, K. D. and D. M. Hanink. 2004. "'Moderate' Environmental Amenities and Economic Change: The Nonmetropolitan Northern Forest of the Northeast U.S., 1970-2000." *Growth and Change* 35(1): 42-60.

Wolf, F. 1986. *Meta-Analysis Quantitative Methods for Research Synthesis*. Vol.59. Newbury Park, CA: SAGE Publications Quantitative Applications in the Social Sciences.

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Appendix 1. Summary of the Articles Included for the Meta-Analysis Data Source

Article	Dependent Variable (Time-period analyzed)	Amenity Factors
Nzaku and Bukenya, (2005)	Regional changes in per capita income, employment, and population (1990-1999)	ERS's(1999) amenity scale, Developed recreation facilities, Land, Crime
Beckstead, et al., (2008)	Percentage change in employment in city(1980-2000)	Amenity index derived by inverse-hedonic pricing, Heating degree days, Cooling degree days
Ferguson, et al., (2007)	Percentage change of population (1991-2001)	Modern amenity(crime rate, distance to hospital, distance to school, distance to police station, distance to ski facility), Natural amenity(forest coverage, proximity to coast or lakes, characteristics of mountains or hills, precipitation, snowfall, January sunshine, January temperature, July humidity)
Monchuk, et al., (2007)	Growth rate of total county income(1990-2001)	Normalized combined amenity index (Rails-to-trails miles, National Resource Inventory recreational land acres, National Resource Inventory water acres, State park amenities, and Number of designated swimming areas on U.S. Army Corps of Engineers water projects)
Artz and Orazem, (2006)	Log differences of county employment, population, and average wages (1970 – 2000)	Topography, January average temperature, January average sunlight, July average temperature, July average humidity
Carruthers and Mulligan, (2007), Working paper	Log of rate of change for population density, employment density, and the average annual wage(1982-1997)	Natural amenity scores, Entertainment establishments, Public spending on parks and recreation, Eating and drinking establishments
Deller and Lledo, (2007)	Region's change in population, employment, and per capita income(1989-1999)	Climate, Land, Water, Winter recreation, Developed recreational infrastructure
Deller, et al., (2001)	Region's change in population, employment, and per capita income (1985-1995)	Climate, Developed recreational infrastructure, Land, Water, Winter
Kim, et al., (2005)	Change rates of population, retail and service employment, per capita income, and distributional profiles(Gini index) (1980-1990)	Land, River, Lake, Warm weather, Cold weather
Bosker and Marlet, (2006), Discussion Paper	Total population growth rate in EU and non-EU (1991-2001)	Sunny hours per day, Rainy hours per year, Average temperature in coldest month, average temperature in warmest month