Environmental Valuation: Connecting Theory, Evidence, and Public Policy

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1 Introduction

Over the past 25 years, researchers in the social sciences and public policy fields have grown increasingly interested in how environmental valuation affects human behavior and settlement patterns. Specifically, quality of life—broadly interpreted as the satisfaction a person derives from surrounding conditions—is understood to influence the economic decisions of households and firms alike, including where to locate, in what spatial configuration, and at what cost. While it is not clear that the two groups always value the same factors (Gabriel and Rosenthal 2004) it is well known that environmental conditions matter to both in important ways (Bartik and Smith 1987; Gyourko et al. 1999; Mulligan et al. 2004). In fact, quality of life is so fundamental that it has become a primary driver of the growth process and, as a result, helps to determine places' competitive advantage. What explains the role of environmental valuation in people's decision-making processes? How is it observed? And, what implications do the theory and evidence hold for planners and other policy makers responsible for guiding the path of urban and regional development?

This paper responds to these questions by: (1) describing, in plain terms, how quality of life is valued and reviewing some key pieces of supporting evidence; (2) using an econometric analysis to illustrate how environmental conditions affect place-to-place variation in the cost of living; and (3) suggesting how and why public policy should respond. While there is some discussion of firms and employment, the primary goal of the paper is to introduce the concept of environmental valuation and its implications for household behavior from an interregional perspective. The empirical component involves an analysis of the relationship between median household income and median housing value across the continental United States. In the first step, the error term from a bivariate regression equation is used to identify locations where people pay a premium (discount) to live due to a high (low) quality of life. In the second and third steps, an additional variable—the USDA's natural amenity index—is added into the original equation in order to examine how unexplained variation in the local cost of living is affected and then identify the areas of the country where the natural environment matters the most. The analysis, although only exploratory in nature, highlights the importance of quality of life to the contemporary economic landscape.

2 Background

The concept of environmental valuation is straightforward: Economic value, which is generated by competition over scarce resources, is placed on conditions that enhance the wellbeing of households and firms. And, because quality of life factors—including temperature, scenic beauty, access to public goods and services, and others—vary across space, the expense associated with occupying a given location does too. As a result, when viewed from both interregional and intraregional perspectives, households' decisions about where to live and the costs they incur to do so are partially attributable to the relative desirability of the surrounding environment. In other words, people gravitate toward nice places and pay more to live in them, mostly via housing prices[i] and/or forgone wages, than in less attractive areas. Ultimately, the process produces a state of spatial equilibrium where households are indifferent among locations because there is no benefit to be gained from moving from one location to another (Greenwood et al. 1991).

This analytical framework relies on *compensating differentials* to explain residential choice and place-to-place variation in the cost of living (Rosen 1974, 1979; Roback 1982, 1988). The basic idea is that location-specific amenities make up for affordability and/or wages, so that, other things being equal, living in an attractive, high-cost/low-wage area is equivalent to living in an unattractive, low-cost/high-wage area. Colloquially, people living in the Puget Sound region of Washington State, for example, refer to the *Mt. Rainier effect* to describe the area's high quality

of life and the hold it has on them. Moreover, residents commonly justify their dissatisfaction with the expense of housing and/or local wages on the basis of the Pacific Northwest's natural beauty, temperate climate, and abundant recreational opportunities. At the other end of the spectrum, less desirable areas leave their residents better off financially, so that an identical house is more affordable and/or the identical job pays higher wages.[ii] In this way, compensating differentials are fundamental to understanding why people choose to live where they do and the tradeoffs they make along the way (see Clark et al. 2003 for an analysis of the connection between the two decisions).

Several interconnected factors account for the rising importance of environmental valuation in the United States. In particular, advances in communications technology, the expansion of interstate transportation systems, economic restructuring, and far-reaching demographic trends such as the aging of the baby boom generation, have contributed to an interregional process of population deconcentration. These and other socioeconomic shifts have attracted widespread interest among researchers due to their role in facilitating the nonmetropolitan turnarounds observed during the 1960s, 1970s, and early 1990s (Frey 1993; Fuguitt and Beale 1996). Meanwhile, at the intraregional level, a similar process is driven by employment decentralization, falling commuting costs, and rising incomes—all of which provide people with greater access to new, low-density housing surrounded by natural open space and related amenities (Burchfield et al. 2006). Although the resulting pattern of urban sprawl is often faulted for being inefficient, inequitable, and environmentally insensitive, it is important to recognize that, in many ways, it represents the physical embodiment of people's environmental preferences (Bruegmann 2005). In short, Americans enjoy unprecedented residential choice and the impact is visible not only in households' wellbeing, but, also, in the overall distribution of the population and the underlying pattern of land use (Vias and Carruthers 2005).

An especially interesting application of the compensating differentials framework and its impact on residential choice is a study by Black et al. (2002) entitled *Why do Gay Men Live in San Francisco?* The research finds that gays sort into high-amenity cities because they face constraints that make having children costly and, as a result, have a comparatively low demand for housing and greater resources to put toward other forms of consumption. The results of the analysis—which show that local amenities are stronger predictors of the concentration of gays than gay friendliness—are especially compelling because they are readily generalizable to other households in similar, if not identical, circumstances. For example, people like Costa and Kahn's (2000) *power couples* and members of Florida's (2002a) *creative class* sort into large cities due in part to the availability of recreational activities and other quality of life related factors;

households that delay having children to pursue advanced degrees and/or career opportunities face constraints and have consumption patterns that are at least temporarily analogous to the gay households described by Black et al. (2002). Similarly, retired people live longer and have greater wealth than ever before, creating lifecycle-related differences in the demand for housing and local amenities (Graves 1979). The Black et al. (2002) study is important because it points to how quality of life influences the decisions of different demographic groups based on their specific economic circumstances. At a point in time where consumption of the natural environment is helping to push growth patterns nationwide toward greater dispersion, it is critical for quality of life analyses to recognize that considerable heterogeneity is embedded in aggregate trends in population redistribution and land use. In this case, it is of no small consequence for those involved in economic development policy and urban planning to know that—plus, how and why—many cities have become reoriented as centers for consumption rather than production (Glaeser et al. 2001).

Returning to the compensating differentials framework itself, the following discussion briefly reviews several key theoretical developments and pieces of empirical evidence on how quality of life is valued. Although no attempt is made to be comprehensive (Bartik and smith 1987; Gyourko et al. 1999; and Mulligan et al. 2004 for extended discussions) the summary provides a historical overview of some of the most influential research on how environmental valuation affects human behavior and settlement patterns.

2.1 Hedonic Price Analysis

The point of departure for nearly all contemporary research on environmental valuation is Rosen's (1974) famous paper, *Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition*, which shows that the price of complex commodities can be decomposed into component parts. Empirical applications of this, called *hedonic price analysis*, involve taking the price of a differentiated good, such as housing, as the dependent variable in a regression equation and measures of its characteristics as explanatory variables. The same can also be done with wages (the price of labor), where the explanatory variables include measures of personal characteristics, working conditions, and other relevant factors. It should be obvious from the discussion above that, because housing and wages are package deals, location-specific amenities and disamenities are a necessary component of both functions—that is, because it is impossible to buy a house or take a job that is not attached to a particular place, it is necessary to control for surrounding conditions. Failing to do so biases the results of the analysis in a way that causes

housing prices (wages) to be underestimated (overestimated) in desirable areas and overestimated (underestimated) in undesirable areas.[iii]

Because price is a monetary expression of value, the latent prices revealed by hedonic analysis provide a basis for creating interregional quality of life rankings. Rosen (1979) was the first to accomplish this, by regressing wages on household characteristics, such as education and race, plus several location-specific amenities, then calculating the total implicit value of each metropolitan area's characteristics. Roback (1982, 1988) then expanded on this work by integrating firms' production decisions into the theoretical framework and examining land prices in addition to wages. The analysis reveals clear, sunny days to be an amenity and inclement weather, measured via heating degree days, total snowfall, and cloudy days, to be a disamenity; crime and air pollution are also revealed to be disamenities, but the influence of these variables is not statistically significant across alternative specifications. Roback's (1982) results also produce quality of life rankings, with the Los Angeles, Anaheim, and San Francisco, California regions topping the list. Berger et al. (1987), Hoehn et al. (1987), and Bloomquist et al. (1988) further expanded the Rosen-Roback framework to include both interregional and intraregional variation of amenities with a larger data set containing 250 counties distributed across 185 metropolitan areas. The theoretical framework is more complicated than previous work because it links wages and rents (housing prices) to size, so that local amenities influence all three. Estimates from hedonic wage and housing price equations show, among other things, that sunshine and educational quality are substantial amenities and precipitation and humidity are substantial disamenities. The imputed quality of life rankings place counties located in the Denver, Colorado, Palm Beach, Florida, and Tucson, Arizona regions near the top of the list and counties located in the Detroit, Michigan, Milwaukee, Wisconsin, and St. Louis, Missouri regions near the bottom; in general, regions with the highest ratings tend to be small- to medium-sized places in the Sunbelt. Next, Gyourko and Tracy (1989, 1991) brought local fiscal conditions into the compensating differentials framework in an effort to uncover the influence of public finance decisions. These studies reveal that natural amenities account for 39% – 43% of the interregional variation in housing prices and 20% – 23% of the interregional variation in wages; public spending patterns account for 12% – 16% and 20% – 21% of variation, respectively. An important conclusion of this work, though, is that, due to problems with accuracy, great care needs to be taken when attempting to differentiate among areas with similar quality of life rankings (Gyourko 1991).

Finally, it is worth pointing out that that interregional hedonic analysis is not just applicable to conventional amenities and disamenities, such as weather and crime rates. For example, in an innovative analysis of cultural diversity, Ottaviano and Peri (2006) find that both

wages and housing prices grew faster for United States natives living in metropolitan areas that experienced an increase in the number of foreign-born immigrants between 1970 and 1990. While the latter finding is consistent with an amenity effect—due the presence of ethnic shops, restaurants, and other opportunities for consumption—the former is attributed to productivity gains attained through an influx of human capital. Overall, the study's findings suggest that foreign immigration continues to have a substantial positive influence on the United States economy (Ottaviano and Peri 2006).

2.2 Regional Development

Beyond measuring environmental conditions' impact on the cost of living, the compensating differentials framework provides a powerful explanation of the contemporary regional development process. The traditional neoclassical model of migration suggests that workers adjust to differences among labor markets by moving from one to region another, so people flow from low-wage areas with a surplus of labor to high-wage areas with a shortage of labor until the economy has a whole converges to a state of spatial equilibrium. A major shortcoming of this *disequilibrium* approach, which worked well when the American economy was structured primarily around locationally-constrained manufacturing activities, is that it fails to account for the role of lifestyle preferences and amenities. Responding to this, a more modern *equilibrium* approach that specifically accounts for alternative forms of compensation has emerged. In this view, which was pioneered by Graves (1976, 1979, 1980, 1983) and Graves and Linneman (1979), households are compensated by local amenities, so differences among labor markets do not always lead to migration. The amenities involved are the very same features priced by hedonic analysis—in fact, the choice not to move and, therefore, to overpay for housing and/or accept a lower wage is the larger decision that allows quality of life to be measured. Clark and Cosgrove (1991) extended work in this area by examining how households compare marginal benefits and costs in their locational decisions and whether or not their choices result in an optimal distance for migration. The first step of the analysis shows that households *are* compensated for quality of life factors and the second step shows that improvements positively affect how far they move; some site-specific amenities did not have an influence, likely because they can be obtained by moves within the same region. Clark and Hunter (1992) then revisited the disequilibrium *vs*. equilibrium question in an effort to gain greater insight into the kind of lifecycle-related differences identified by Graves (1979). This work reveals that an important part is played by both amenities and employment opportunities and that, as expected, the influence of the latter diminishes with people's age. Last, building on work done by Greenwood and Hunt

(1989), Mueser and Graves (1995) developed a formal model integrating equilibrium and disequilibrium conditions, where the latter occurs when households and firms face various adjustment costs. In this situation, people must form rational expectations about future benefits before making a relocation decision; the empirical component of the analysis, which deals with the 1950s, 1960s, and 1970s, reveals that amenities motivate moves between counties and that their influence was consistent over the 30-year timeframe. The Mueser and Graves (1995) study is noteworthy because it explicitly integrates the Rosen-Roback compensating differentials framework into a model of interregional migration.

This framework is increasingly used to examine intraregional and interregional development patterns via *regional adjustment models*, which account for the interaction between population and employment in the growth process. Work in this area originates from Borts and Stein's (1964) *Economic Growth in a Free Market*, which was apparently the first study to suggest that labor supply drives labor demand, in addition to the more traditional (disequilibrium) process where labor demand drives labor supply—or, in other words, that jobs follow people in addition to the other way around. Muth (1971) took the idea further and framed the premise of regional adjustment models in a paper entitled *Migration: Chicken or Egg?* The simultaneous equations approach to modeling population (employment) change as a function of lagged population (employment) and current employment (population) was introduced by Steinnes and Fisher (1974) and, finally, popularized by Carlino and Mills (1987) and Boarnet (1994a, 1994b). Since then, regional adjustment models have been used to study growth at the metropolitan (Boarnet et al. 2005), sub-national (Vias and Mulligan 1999; Henry et al. 1997, 1999, 2001; Carruthers and Vias 2005; McLaughlin et al. 2005), and national (Clark and Murphy 1996; Mulligan et al. 1999; Deller et al. 2001; Carruthers and Mulligan 2005, 2006; Mulligan and Vias 2006) levels. As a group, these and related studies demonstrate that population and employment are subject to a dynamic adjustment process and that, along the way, the two are jointly determined. Moreover, because they emphasize the role of both opportunity (a disequilibrium consideration) and preference (an equilibrium consideration) regional adjustment models specifically account for the importance of environmental valuation to the contemporary development process. The interplay between population growth and employment growth is contingent on the kind of quality of life differences originally measured by Rosen (1979) and Roback (1982) so they represent an important test of the compensating differentials framework. In addition, regional adjustment models are an empirical reconciliation of the longstanding debate over disequilibrium *vs*. equilibrium conditions in models of human migration (see Hunt 1993 for a useful summary).

Going forward, it may be possible to examine the process that regional adjustment models emulate via *cointegration*, a relatively new econometric technique for examining long run equilibrium relationships between trending variables (see Maddala and Kim 1998). Using this method for an analysis of Washington State's labor market, Yeo et al. (2005) find evidence that disequilibrium shocks lead to population growth, but—in spite of the study area's high quality of life—no evidence that population growth also drives employment growth. Even so, the cointegration approach offers considerable promise as a more parsimonious alternative to regional adjustment models' autoregressive approach, which is often hampered by multicollinearity and the challenge of developing appropriate instruments for the endogenous variables.

2.3 Urban Growth

Yet another interesting—and highly influential—dimension of the literature on quality of life is contained by work oriented toward human capital and the productivity gains achieved by cities (Glaeser et al 1992; Glaeser 1994; Gleaser et al. 1995; Glaeser 2005). One of the main objectives of this research is to explain alternative growth trajectories via initial conditions, including the size and the level of education in the labor force, plus location and amenities. Households are assumed to have free migration across cities and their utility is expressed as the product of wages and a quality of life index; further, quality of life declines with the rate of growth, so the incentive to move into an area does as well. Applications of this approach (see, for example Glaeser and Shapiro 2003) reveal an overall shift of the population away from cold, high-density areas of the Northeast and Midwest toward warm, lower-density areas located in the South and West. Related research on the concentration of human capital, though, shows that highly skilled individuals are drawn to vibrant and diverse urban environments offering opportunities for recreation and intellectual growth (Glaeser 1999; Costa and Kahn 2000; Glaeser and Maré 2001; Drennan 2002; Florida 2002b, 2002c). Other applications reveal that improvements to environmental quality, especially reduced air pollution, contribute positively to population growth (Kahn 2000, 2001). As a whole, research on urban growth makes clear that quality of life is so integral to regional development that, irrespective of geography, competitive advantage probably depends on it.

1.3 Empirical Analysis

The purpose of the empirical analysis is to extend the preceding discussion of the importance of quality of life to the contemporary economic landscape by exploring how environmental conditions affect place-to-place variation in the cost of living. Toward that end, Figure 1, a map

of population change by county in the continental United States between 1980 and 2000,[iv] shows the pattern of *population deconcentration* described in previous sections of this paper. The map reveals a very clear pattern of rapid growth in the South and West at the expense of the Northeast and Midwest and, to the extent that counties are small enough to register the change,[v] from the core to the periphery of metropolitan areas throughout the country. Note the vast areas of decline in the Great Plains and in rural portions of the Northeast, Midwest, and Southeast—even though the nation as a whole has witnessed a shift away from densely populated core areas, the movement cannot be characterized as unselective. This point is underscored by Figure 2, which shows that counties with a 2000 median housing value of $100,000 or more are mainly clustered in the Northeastern corridor running from New England to Washington, DC; in the urban centers of the Midwest and South; and in high-amenity counties spread throughout the West. Areas notable for having very high (>$200,000) median housing values include coastal counties in the East and West, along the Front Range in Colorado, and select nonmetropolitan areas like Teton County, Wyoming, where Jackson Hole is located.

The influence that quality of life has on these patterns is illustrated via a series of several steps, based on an *amenity scale* suggested by Glaeser et al. (2001).[vi] The first step is to create the scale by estimating a bivariate econometric model, where the natural logarithm of 2000 median housing value (mhv) is the dependent variable and the natural logarithm of 1999 median household income (mhi) is the explanatory variable:

$$\ln(mhv_i) = \alpha_1 + \alpha_2 \ln(mhi_i) + \varepsilon_i. \qquad (1)$$

In this equation, i ranges over all counties[vii] in the continental United States, α_1 and α_2 are estimable parameters, and ε_i ~N (0, σ) is the stochastic error term. The ordinary least squares (OLS) estimation results are shown in Table 1.1. The coefficient on the explanatory variable, median household income, carries its expected positive sign and is statistically significant at well over a 99% confidence interval and the adjusted R^2 shows that this simple model explains nearly 60% of place-to-place variation in median housing values. Because the model is estimated in *log linear* form, the estimated parameter on median household income, α_2, is interpreted as an elasticity—a coefficient that expresses the percent change in a dependent variable induced by a 1% change in an explanatory variable. So, in this case, the estimated coefficient suggests that a 1% increase in household income produces a 1.41% increase in housing value.[viii] Figure 3, a scatter plot measuring the natural logarithm of 1999 median household income on the x-axis and the natural logarithm of 2000 median household income on the y-axis, shows the relationship estimated by Equation 1.1. Since the trend line—which has a slope of α_2, or 1.41—represents the nationwide baseline, counties that place above it on the scatter plot are locations where people

spend a disproportionately high share of their income on housing; conversely, counties that place below the trend line are locations where people spend a disproportionately low share of their income on housing. The vertical distance between each individual point and the trend line, known as *residuals* in econometric analysis, comprise the error term, ε_i, in Equation 1.1. The value of the error term is positive (negative) when a model underestimates (overestimates) a county's median housing value, based on its median household income. In a very rudimentary sense, based on the theory of compensating differentials, the amount of overpayment (underpayment) for housing may be interpreted as a scale of the premium (discount) that people pay for a given county's relative endowment of natural and/or locally produced amenities. In other words, people live in homes valued higher than their incomes predict in places that are desirable to live in and in homes valued lower than their incomes predict in places that are undesirable to live in—in this way, housing values are observed to compensate for the level of amenities that people enjoy. The five counties registering the highest residual values are Pitkin, the location of Aspen, in Colorado, Nantucket, in Massachusetts, and Marin, San Mateo, and San Francisco, in California; the five counties registering the lowest are Fort Bend, King, Roberts, and Collin, in Texas and Manassas Park, an independent city, in Virginia.

Actual dollar values of the amenity scale are obtained by exponentiating the residuals from Equation 1.1—that is, by raising *e*, or 2.718, the base of the natural logarithm, to the power of ε_i, the vertical distance between county *i*''s position in the scatter plot and the trend line shown in Figure 3. The result, ε_i^*, is mapped in Figure 4, which shows the dollar values of each county's residual.[ix] Nearly all counties registering a large (>$25,000) premium are situated along the Eastern seaboard or in the West, and most counties registering a large (<-$25,000) discount are located in the middle of the country, mainly in the Great Plains. Figure 5, which maps each county's residual as a percentage of its median housing value, shows that, in much of the West, the amenity premium accounts for more than 25% of the median housing value and, in many cases, it accounts for more than 50%. At the same time, the discount is more than 25% of the median housing value throughout the interior of the country, plus in a number of very rural areas in Eastern and Western states. The patterns shown in Figures 1.4 and 1.5 line up well with intuition about the spatial distribution of desirable and undesirable environmental conditions and also strongly resemble those shown in Figures 1.1 and 1.2, which map the pattern of population change and the median housing values used in the analysis. What emerges, is a clear picture identifying locations where people pay more to live due to a high quality of life and less to live due to a low quality of life.

To examine the specific role of the natural environment, the next step of the analysis re-estimates the model with the USDA's *natural amenity index*[iix] (McGranahan 1993) included:

$$\ln(mhv_i) = \beta_1 + \beta_2 \ln(mhi_i) + \beta_3 \ln(amenity_i) + \upsilon_i. \quad (1.2)$$

Here, all notation is the same as before, except that βs are used instead of αs and υ_i is used to denote the error term instead of ε_i. The results, listed in Table 1.1 alongside those for Equation (1.1), show that including the natural amenity index raises the model's explanatory power substantially—the adjusted R^2 grows from 0.58 to 0.68—and that, with a *t*-statistic of 30.74, the variable is a very strong predictor of median housing value. Note, too, that the parameter estimate on median household income is basically unchanged—that is, $\beta_2 \approx \alpha_2$.

The exponentiated residuals from Equation 1.2, υ_i^*, are mapped in Figures 1.6 and 1.7 using the same classification schemes as Figures 1.4 and 1.5, respectively. The map of dollar values shows that, while most of the same counties continue to register a premium or discount, the absolute value has grown smaller, because the natural amenity index—which has an estimated elasticity of 0.60, meaning that a 1% increase produces a 0.60% increase in median housing value—accounts for a share of the variation. In other words, controlling for counties' endowment of natural amenities improves the model by correcting a form of omitted variable bias that causes housing values to be underestimated (overestimated) in environmentally desirable areas and overestimated (underestimated) in environmentally undesirable areas. This is even more visible in Figure 7, which shows that the new premium accounts for more than 50% of the median housing value in only a tiny minority of counties, such as Taos, New Mexico, and Pitkin, Colorado, both of which are known for their world class ski resorts; even in California's costal counties, the size of the amenity premium drops below 50%. At the other end of the spectrum, the discount accounts for more than 25% of median housing value in a far greater number of counties than before the amenity index was added in, revealing that, even after controlling for the (low) level of natural amenities in these places, the people living in them are compensated via a large discount in the value of housing.

The final step of the analysis examines where natural amenities matter the most by taking the absolute value of difference between the exponentiated residuals from Equations (1.1) and (1.2):

$$\delta_i^* = \left| \varepsilon_i^* - \upsilon_i^* \right|. \quad (1.3)$$

Doing this yields the absolute dollar value of the distance between the two residual terms for each county: For example, in a county where ε_i^* is \$25,000 and υ_i^* is \$15,000, δ_i^* is \$10,000; and, in a county where ε_i^* is \$15,000 and υ_i^* is -\$10,000, δ_i^* is \$25,000. The results, mapped in Figure 8,

show that—whether positive or negative—natural amenities matter most in particular areas of the country. Namely, the difference between the two terms is large (δ_i^* > \$10,000) in cold, flat areas with high humidity in the upper Midwest, where the two amenity scales (ε_i^* and υ_i^*) are mainly observed to be negative; sunny, mountainous areas with low humidity in the Rocky Mountain West, where the two amenity scales are mainly observed to be positive; and coastal areas in Florida and the West, where the two amenity scales are also mainly observed to be positive. Although other areas, such as lower New England, the New York metropolitan area, and the San Antonio-Austin, Texas region stand out, the value of δ_i^* is small throughout the entire rest of the continental United States.

What Figure 8 makes clear, is that natural amenities make a large difference in places known for having an abundance of them *and* in places known for having a deficit of them, but that are nonetheless attractive for other reasons. Many people continue to be drawn to Boston, Chicago, Minneapolis, New York and other cities in the Northeast and Midwest that lack the kind of natural amenities found in Miami, Phoenix, San Francisco, San Diego, and Seattle because of their importance as economic centers (Drennan 2002). Although communications technology, interstate transportation systems, economic restructuring, demographic shifts, and other far-reaching changes continue to drive the process of population deconcentration, history makes a difference (Fujita et al. 1999) and there is no evidence of an inexorable trend of abandonment in the nation's most important urban centers (Glaeser 1999). One reason for this may be that regions with a quality housing stock and/or an elastic supply of housing are less prone to economic decline (Glaeser et al. 2006). More specifically, the durability and availability of housing work to keep the processes of growth and decline asymmetric by ensuring that the people have an economic incentive to stay where they are (Glaeser and Gyourko 2005). So, even in an era of unprecedented locational flexibility, where environmental conditions matter to both households and firms more than ever before, there is no reason to believe that the future will bring the kind of permanent break from the past that some researchers predicted in the 1970s (see, for example, Vining and Strauss 1977). But, as the present analysis illustrates, environmental valuation has transformed the economic landscape of the United States in fundamental ways; while only exploratory in nature, it highlights the need for ongoing research aimed at understanding how and why quality of life affects human behavior and settlement patterns.

1.4 Summary and Conclusion

This paper began by asking three overarching questions: What explains the role of environmental valuation in people's decision-making processes? How is it observed? And, what implications do the theory and evidence hold for planners and other policy makers responsible for guiding the path of urban and regional development? The answers to these questions follow from a literature review and analysis of the relationship between median household income and median housing value across the continental United States.

The background discussion defined environmental valuation as the process of economic value being placed on conditions that enhance the wellbeing of households and firms. And, because quality of life related factors are distributed unevenly from place-to-place, the phenomenon is inherently spatial—people incur greater costs, primarily via housing prices and/or foregone wages, to occupy attractive locations than they do to occupy unattractive locations. This effect is explained via a compensating differentials framework, which suggests that, other things being equal, living in an attractive, high-cost/low-wage area is equivalent to living in an unattractive, low-cost/high-wage area. The influence of environmental features can be measured directly via hedonic analysis, which has been used extensively to develop quality of life rankings for different regions of the United States. Refinements to this methodology have produced increasingly accurate indices and have extended the application of the compensating differentials framework from purely natural features, such as climate, to other important factors, including public finance, the availability of locally produced recreational opportunities, and cultural diversity. Models of human migration also address environmental valuation, by incorporating both disequilibrium, or opportunity-related, and equilibrium, or preference-related, motivations. Residential choice is a complicated matter—especially when it involves moving great distances and/or balancing more than one career—and is subject to considerable heterogeneity across demographic groups. Regional adjustment models have emerged as a particularly useful tool for studying the complexity of the contemporary development process, because they explicitly account for the roles of both opportunity and preference. Additionally, because they rely on the compensating differentials framework, they represent a way of examining the extent to which quality of life matters. In particular, evidence of jobs following people in addition to the other way around—which most studies find—is contingent on the influence of desirable and undesirable environmental conditions. Last, new economic models of urban growth also explicitly recognize the importance of quality of life and its variation across space, and empirical tests show that improvements, such as decreased air pollution, raise the competitive advantage of

regions. Each of these strands of research has contributed to the steadily deepening pool of theory and evidence linking environmental valuation to human behavior and settlement patterns.

The empirical analysis contained in this paper highlights some of the ways in which quality of life has transformed the economic landscape of the United States by examining the extent to which people over- or under-pay for housing, based on their income. Although only exploratory in nature, the results mapped in Figures 1.4 – 1.8 illustrate that environmental conditions in general, and elements of the natural environment in particular, have a substantive influence on place-to-place variation in the cost of living. They also call attention to the need to study the kind of locally produced and cultural amenities found in many urban centers, plus the need to carefully consider the interaction between quality of life and history in the development process. While regions increasingly become winners or losers based at least in part on their relative attractiveness, other factors also make a difference, so it is important for future research to develop a cohesive view of the overall picture.

These findings suggest several general policy recommendations. Foremost, it should be clear that planners and other policy makers need to carefully consider quality of life—interpreted in the broadest possible sense—when making decisions affecting the outcome of urban and regional development. Many innovative tools for doing this have been proposed for rural areas (see, for example, Sargent et al. 1991) but, apart from strictly design-oriented exceptions (Calthorpe 1993 Duany et al. 2000), comparatively few comprehensive strategies exist for more urbanized areas. Local public policy is closely attuned to the value of individual homeowners' assets (Fischel 2001), but the growing importance of quality of life may mean that new frameworks are needed to shift to the focus more toward the community level. Second, the costs of growth need to be balanced with its inevitability. Toward this end, urban growth management policies are increasing oriented toward accommodating, rather than limiting, growth in a way that meets wider societal objectives (DeGrove 2005). Such policies hold considerable promise for enhancing quality of life by ensuring cost effective service provision, preserving open space, reducing traffic congestion, and producing other benefits, but they need to be *carefully* and *regularly* evaluated. Land market monitoring, for example, can help regions avoid many of the negative and/or unintended consequences of growth management, while at the same time helping to ensure that policies end up fulfilling their intended objectives (Knaap 2001). Third, as an extension, urban and regional policy needs to be sensitive to both supply- and demand-side effects, particularly in light of the long history of segregation in American cities (Jargowski 1997). As urban environments are transformed to be more desirable, competition over space can easily marginalize disadvantaged residents, who are often minorities and/or immigrants (Pendall

and Carruthers 2003). The ongoing redevelopment of the Bronzeville neighborhood in Chicago, for example, is doing away with one of the most blighted urban areas in the history of the United States, but as many as 17,000 people may be displaced as new, higher-income residents move in (Hyra 2006). Finally, given the magnitude of the amenity scales developed in the empirical analysis, a key issue that policy makers may have to contend with going forward is the extent to which location-specific environmental conditions influence regional economies. Important analytical tools, such as social accounting matrices (SAMs) provide viable points of departure for evaluating urban quality of life and making public policy more responsive (Isard et al. 1998). Urban policy makers are for the most part well aware of the importance of environmental conditions, but they should always seek to become better at developing and applying programs aimed at promoting quality of life.

Endnotes

The opinions expressed in this paper do not necessarily represent those of the U.S. Department of Housing and Urban Development.

[i] Housing is so important to the compensating differentials framework because it is the single largest investment that most people make.

[ii] Other costs of living are affected too, but this relationship has been studied less often, due to the difficulty of obtaining a consistent quality-adjusted measure; see Gabriel et al. (2003) for a state-level analysis.

[iii] Migration studies face a similar issue: Without controlling for amenities, people are observed to make highly irrational decisions, such as moving cross-country to places offering little in the way of economic opportunity (Geenwood 1985).

[iv] Specifically, the map shows: $((Population_{2000} / Population_{1980}) - 1) / 100$, or the percent population change between 1980 and 2000.

[v] One limitation of using counties as a unit of economic analysis is that their large size masks the area actually occupied, particularly in the West, where counties are sometimes as large or even larger than certain Northeastern states.

[vi] Glaeser et al. (2001) regress median housing value on median household income and use the error term from that equation as an amenity scale in an analysis of the distribution of population in the United States and England; to be clear, the authors do not explicitly suggest the more extensive analysis presented here.

[vii] Manhattan, New York and Loving County, Texas are dropped because the median housing value is over $1,000,000 in the former and there is no income figure for the latter.

[viii] This figure should not be taken literally as the income elasticity of demand for housing, which is much more complicated to estimate.

[ix] Note that, even to the naked eye, the map displays a clear pattern of *spatial autocorrelation*, which is symptomatic of processes—like environmental valuation—that play out across space (Anselin 1988).

[iix] This is a standardized statistic capturing January sun, January temperature, July humidity, July temperature, topography, and water.

References

Anselin, L. (1988) *Spatial Econometrics: Methods and Models*, Kluwer, Boston, MA.

Bartik, T., and Smith, K. (1987) "Urban amenities and public policy," in: Mills, E. (Ed.), *Handbook of Regional and Urban Economics: Volume 2, Urban Economics*: 1207 – 1254, North-Holland, Amsterdam, The Netherlands.

Berger, M., Blomquist, G., and Waldner, W. (1987) "A revealed-preference ranking of quality of life for metropolitan areas," *Social Science Quarterly*, 68: 761 – 778.

Black, D., Gates, G., Sanders, S., and Taylor, L. (2002) "Why do gay men live in San Francisco?" *Journal of Urban Economics*, 51: 54 – 76.

Blomquist, G., Berger, M., and Hoehn, J. (1988) "New estimates of quality of life in urban areas," *American Economic Review*, 1: 89 – 107.

Boarnet, M. (1994a) "An empirical model of intrametropolitan population and employment growth," *Papers in Regional Science*, 73: 135 – 152.

Boarnet, M. (1994b) "The monocentric model and employment location," *Journal of Urban Economics*, 36: 79 – 97.

Boarnet, M., Chalermpong, S., and Geho, E. (2005) "Specification issues in models of population and employment growth," *Papers in Regional Science*, 84: 21 – 46.

Borts, G. and Stein, J. (1964) *Economic Growth in a Free Market*, Columbia University Press, New York, NY.

Bruegmann, R. (2005) *Sprawl: A Compact History*, University of Chicago Press, Chicago, IL.

Burchfield, M., Overman, H., Puga, D., and Turner, M. (2006) "Causes of sprawl: A portrait from space," *Quarterly Journal of Economics*, forthcoming.

Calthorpe, P. (1993) *The Next American Metropolis: Ecology, Community, and the American Dream*, Princeton University Press, Princeton, NJ.

Carlino, G. and Mills, E. (1987) "The determinants of county growth," *Journal of Regional Science*, 27: 39 – 54.

Carruthers, J. and Mulligan, G. (2006) "Land absorption in United States metropolitan areas: Estimates and projections from regional adjustment models," *Geographical Analysis*, forthcoming.

Carruthers J. and Mulligan, G. (2005) "Human capital, quality of life, and the adjustment process in American metropolitan areas," working paper, U.S. Department of Housing and Urban Development.

Carruthers, J. and Vias, A. (2005) "Urban, suburban, and exurban sprawl in the Rocky Mountain West: Evidence from regional adjustment models," *Journal of Regional Science*, 45: 21 – 48.

Clark, D. and Murphy, C. (1996) "Countywide employment and population growth: An analysis of the 1980s," *Journal of Regional Science*, 36: 235 – 256.

Clark, D. and Hunter, W. (1992) "The impact of economic opportunity, amenities and fiscal factors on age-specific migration rates," *Journal of Regional Science*, 32: 349 – 365.

Clark, D. and Cosgrove, J. (1991) "Amenities versus labor market opportunities: Choosing the optimal distance to move," *Journal of Regional Science*, 31: 311 – 328.

Clark, D., Herrin, W., Knaap, T., and White, N. (2003) "Migration and implicit amenity markets: Does incomplete compensation matter?" *Journal of Economic Geography*, 3: 289 – 307.

Costa, D. and Kahn, M. (2000) "Power couples: Challenges in the locational choice of the college educated, 1940 – 1990," *The Quarterly Journal of Economics*, 115: 1287 – 1315.

Deller, S., Tsai, T., Marcouiller, D., and English, D., (2001) "The role of amenities and quality-of-life in rural economic growth," *American Journal of Agricultural Economics*, 83: 352 – 365.

DeGrove, J. (2005) *Planning Policy and Politics: Smart Growth and the States*, Lincoln Institute of Land Policy, Cambridge, MA.

Drennan, M. (2002) *The Information Economy and American Cities*, Johns Hopkins University Press, Baltimore, MD.

Duany, A., Plater-Zyberk, E., and Speck, J. (2000) *Suburban Nation: The Rise of Sprawl and the Decline of the American Dream*, North Point Press, New York, NY.

Fischel, W. (2001) *The Homevoter Hypothesis: How Home Values Influence Local Government Taxation, School Finance, and Land Use Policies*, Harvard University Press, Cambridge, MA.

Florida, R. (2002a) *The Rise of the Creative Class*, Basic Books, New York, NY.

Florida, R. (2002b) "The economic geography of talent," *Annals of the Association of American Geographers*, 92: 743 – 755.

Florida, R. (2002c) "Bohemia and economic geography," *Journal of Economic Geography*, 2: 55 – 71.

Frey, W. (1993) "The new urban revival in the United States," *Urban Studies*, 30: 741 – 773.

Fuguitt and Beale (1996) "Recent trends in nonmetropolitan migration: Toward a new turnaround?" *Growth and Change*, 27: 156 – 174.

Fujita, M., Krugman, P., and Venables, A. (1999) *The Spatial Economy*, MIT Press, Cambridge, MA.

Gabriel, S., Mattey, J., and Wascher, W. (2003) "Compensating differentials and evolution of quality of life among U.S. states," *Regional Science and Urban Economics*, 33: 619 – 649.

Gabriel, S. and Rosenthal, S. (2004) "Quality of the business environment versus quality of life: Do firms and households like the same cities?" *Review of Economics and Statistics*, 86: 438 – 444.

Glaeser, E. (2005) "Reinventing Boston: 1630 – 2003," *Journal of Economic Geography*, 5: 119 – 154.

Glaeser, E. (1999) "Are cities dying?" *Journal of Economic Perspectives*, 12: 139 – 160.

Glaeser, E. (1994) "Cities, information, and economic growth," *Cityscape*, 1: 9 – 47.

Glaeser, E. and Gyourko, J. (2005) "Urban decline and durable housing," *Journal of Political Economy*, 113: 345 – 375.

Glaeser, E. and Shapiro, J. (2003) "Urban growth in the 1990s: Is city living back?" *Journal of Regional Science*, 43: 139 – 165.

Glaeser, E. and Maré, D. (2001) "Cities and skills," *Journal of Labor Economics*, 19: 316 – 342.

Glaeser, E., Gyourko, J., and Saks, R. (2006) "Urban growth and housing supply," *Journal of Economic Geography*, 6: 71 – 89.

Glaeser, E., Kolko, J., and Saiz, A. (2001) "Consumer city," *Journal of Economic Geography*, 1: 27 – 50.

Glaeser, E., Scheinkman, J., and Shleifer, A. (1995) "Economic growth in a cross section of cities," *Journal of Monetary Economics*, 36: 117 – 143.

Glaeser, E., Kallal, H., Scheinkman, J., and Shleifer, A. (1992) "Growth in cities," *Journal of Political Economy*, 100: 1126 – 1152.

Graves, P. (1976) "A reexamination of migration, economic opportunity, and the quality of life," *Journal of Regional Science*, 16: 107 – 112.

Graves, P. (1979) "A life-cycle empirical analysis of migration and climate by race," *Journal of Urban Economics*, 29: 135 – 147.

Graves, P. (1980) "Migration and climate," *Journal of Regional Science*, 20: 227 – 237.

Graves, P. (1983) "Migration with a composite amenity: The role of rents," *Journal of Regional Science*, 23: 541 – 546.

Graves, P. and Linneman, P. (1979) "Household migration: Theoretical and empirical results, *Journal of Urban Economics*, 6: 383 – 404.

Greenwood, M. (1985) "Human migration: Theory, models, and empirical studies," *Journal of Regional Science*, 25: 521 – 545.

Greenwood, M. and Hunt, G. (1989) "Jobs versus amenities in the analysis of metropolitan migration, *Journal of Urban Economics*, 25: 1 – 16.

Greenwood, M., Hunt, G., Rickman, D., and Treyz, G. (1991) "Migration, regional equilibrium, and the estimation of compensating differentials," *American Economic Review*, 81: 1382 – 1390.

Gyourko, J. (1991) "How accurate are quality-of-life rankings across cities?" *Federal Reserve Bank of Philadelphia Business Review*, 3 – 14.

Gyourko, J. and Tracy, J. (1991), "The Structure of local public finance and the quality of life," *Journal of Political Economy*, 91: 774 – 806.

Gyourko, J. and Tracy, J. (1989) "The Importance of local fiscal conditions in analyzing local labor markets," *Journal of Political Economy*, 97: 1208 – 1231.

Gyourko, J., Kahn, M., and Tracy, J. (1999) "Quality of life and environmental comparisons," in Cheshire, P. and Mills, E. (eds) *Handbook of Regional and Urban Economics*, Volume 3: 1413 – 1454, Elsevier Science, Amsterdam, The Netherlands.

Henry, M., Schmitt, B., and Piguet, V. (2001) "Spatial econometric models for simultaneous equations systems: Application to rural community growth in France," *International Regional Science Review*, 24: 171 – 193.

Henry, M., Barkley, D., and Bao, S. (1997) "The hinterlands' stake in metropolitan growth: evidence from selected Southern regions," *Journal of Regional Science*, 37: 479 – 501.

Henry, M., Schmitt, B., Kristensen, K., Barkley, D., and Bao, S. (1999) "Extending Carlino-Mills models to examine urban size and growth impacts on proximate rural areas," *Growth and Change*: 30: 526 – 548.

Hoehn, J., Berger, M., and Blomquist, G. (1987) "A hedonic model of interregional wages, rents, and amenity Values," *Journal of Regional Science*, 27: 605 – 620.

Hunt, G. (1993) "Equilibrium and disequilibrium in migration modeling," *Regional Studies*, 27: 341 – 349.

Hyra, D. (2006) "Racial uplift: Intra-racial class conflict and the economic revitalization of Harlem and Bronzeville," *City and Community*, 5: 71 – 92.

Isard, W., Azis, I., Drennan, M., Miller, R., Saltzman, S., and Thorbecke, E. (1998) *Methods of Interregional and Regional Analysis*, Ashgate, Aldershot, UK.

Jargowsky, P. (1997) *Poverty and Place: Ghettos, Barrios, and the American City*, Russel Sage Foundation, New York, NY.

Kahn, M. (2001) "City quality-of-life dynamics: Measuring the costs of growth," *Journal of Real Estate Finance and Economics*, 22: 339 – 352.

Kahn, M. (2000) "Smog reduction's impact on California county growth," *Journal of Regional Science*, 40: 565 – 582.

Knaap, G. (ed.) (2001) *Land Market Monitoring for Smart Urban Growth*, Lincoln Institute of Land Policy, Boston, MA.

Maddala, G. and Kim, I. (1998) *Unit Roots, Cointegration, and Structural Change*, University of Cambridge Press, Cambridge, UK.

McGranahan, D. (1993) "Natural amenities drive rural population change," USDA Economic Research Service working paper #AER-781.

McLaughlin, R., Boarnet, M., and Carruthers, J. (2005) "The effects of growth management on equilibrium adjustments in Florida: Evidence from the 1990s," working paper, University of California, Irvine.

Mueser, P. and Graves, P. (1995) "Examining the role of economic opportunity and amenities in explaining population redistribution," *Journal of Urban Economics*, 37: 176 – 200.

Mulligan, G. and Vias, A. (2006) "Growth and change in United States micropolitan areas," *Annals of Regional Science*, forthcoming.

Mulligan, G., Carruthers, J., and Cahill, M. (2004). "Urban quality of life and public policy: A survey. In Nijkamp, P and Capello, R. (eds.) *Urban Dynamics and Growth: Advances in Urban Economics* Elsevier, Amsterdam, The Netherlands.

Mulligan, G., Vias, A., and Glavac, S. (1999) "Initial diagnostics of a regional adjustment model," *Environment and Planning A*, 31: 855 – 876.

Muth, R. (1971) "Migration: Chicken or egg?" *Southern Economic Journal*, 57: 295 – 306.

Ottaviano, G. and Peri, G. (2006) "The economic value of cultural diversity: Evidence from U.S. cities," *Journal of Economic Geography*, 6: 9 – 44.

Pendall, R. and Carruthers, J. (2003) "Does density exacerbate income segregation? Evidence from United States metropolitan areas, 1980 – 2000," *Housing Policy Debate*, 14: 541 – 590.

Roback, J. (1982) "Wages, rents, and quality of life," *Journal of Political Economy*, 90: 1257 – 1278.

Roback, J. (1988) "Wages, rents, and amenities: differences among workers and regions," *Economic Inquiry*, 26: 23 – 41.

Rosen, S. (1974) "Hedonic prices and implicit markets: Product differentiation in pure competition," *Journal of Political Economy*, 82: 34 – 55.

Rosen, S. (1979) "Wage-based indexes of urban quality of life," in Mieszkowski, P. and Straszheim, M. (eds.) *Current Issues in Urban Economics*, Johns Hopkins University Press, Baltimore, MD.

Sargent, F., Lusk, P., Rivera, J., and Varela, M. (1991) *Rural Environmental Planning for Sustainable Communites*, Island Press, Wasjington, DC.

Steinnes, D. and Fisher, W. (1974) "An econometric model of interurban location," *Journal of Regional Science*, 14: 65 – 80.

Vias, A. and Carruthers, J. (2005) "Regional development and land use change in the Rocky Mountain West, 1982-1997," *Growth and Change*, 36: 244 – 272.

Vias, A. and Mulligan, G. (1999) "Integrating economic base theory with regional adjustment models: The nonmetropolitan Rocky Mountain West," *Growth and Change*, 30: 507 – 525

Vining, D. and Strauss, A. (1977) "A demonstration that the current deconcentration of population in the United States is a clean break from the past," *Environment and Planning A*, 9: 751 – 758.

Yeo, J., Ahn, S., and Holland, D. (2005) "Labor market behavior in Washington: A cointegration approach," *Annals of Regional Science*, 39: 317 – 336.

Table 1.1 OLS Estimates of Amenity Models

	Equation (1):		Equation (2):	
	α:	*t-statistic:*	*β:*	*t-statistic:*
Constant	-3.45	-15.52	-4.99	-24.86
ln (Median Household Income)	1.41	66.16	1.42	76.34
ln (Natrual Amenity Scale)	-	-	0.61	30.74
n		3,107		3,107
Adjusted R^2		0.58		0.68

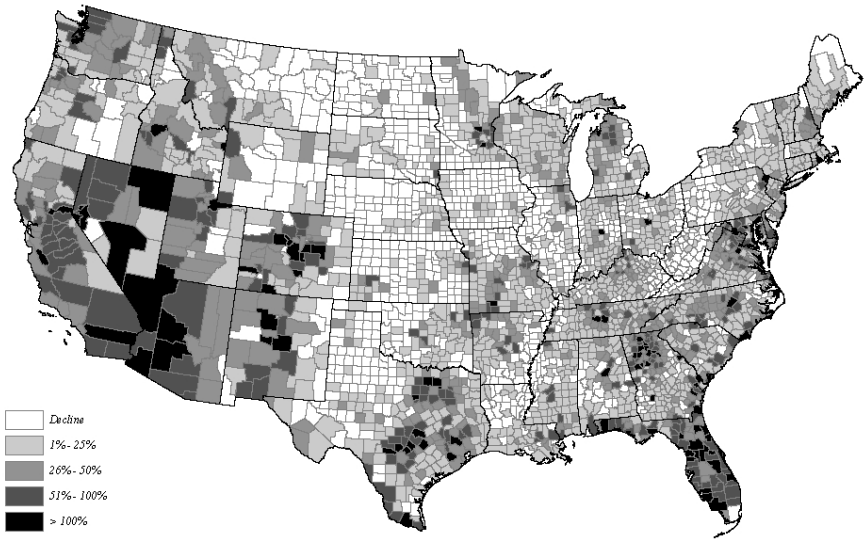

Figure 1 Population Change, 1980 – 2000

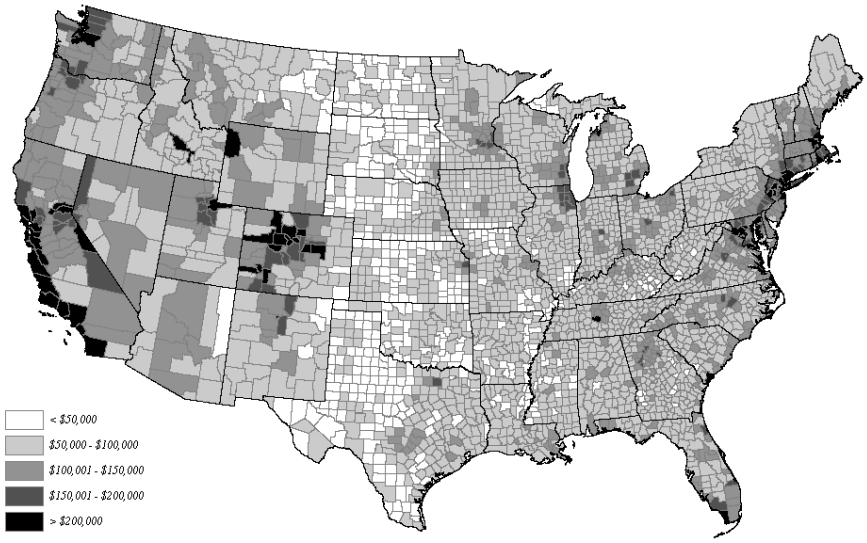

Figure 2 Median Housing Value, 2000

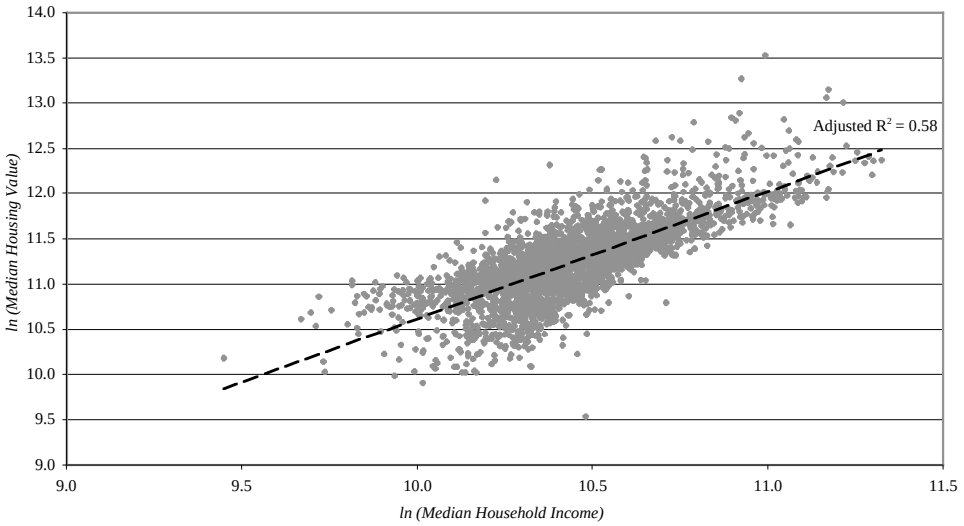

Figure 3 Relationship Between Median Household Income and Median Housing Value

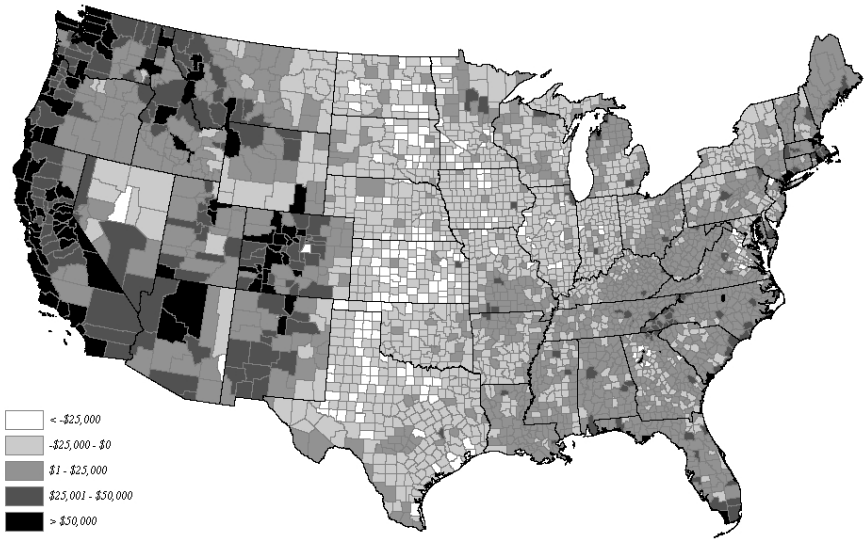

Figure 4 Spatial Distribution of ε_i^*

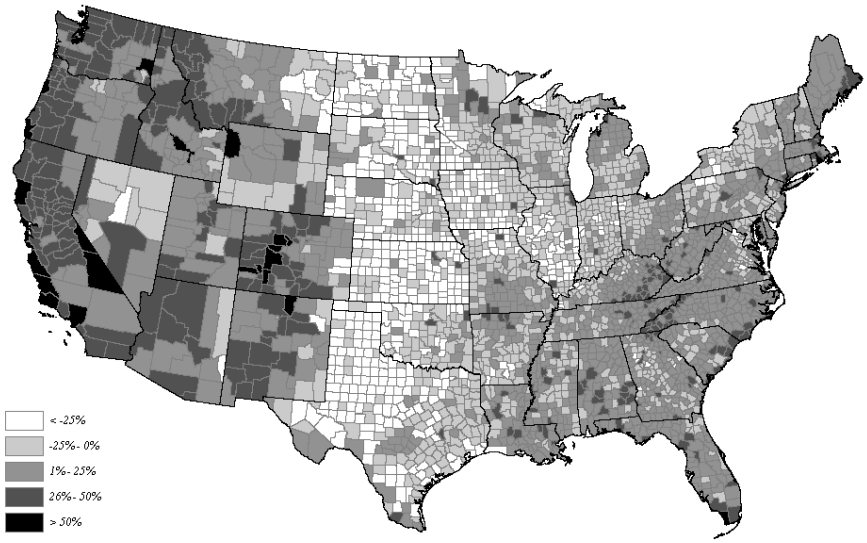

Figure 5 Spatial Distribution of ε_i^* as a Percentage of 2000 Median Housing Value

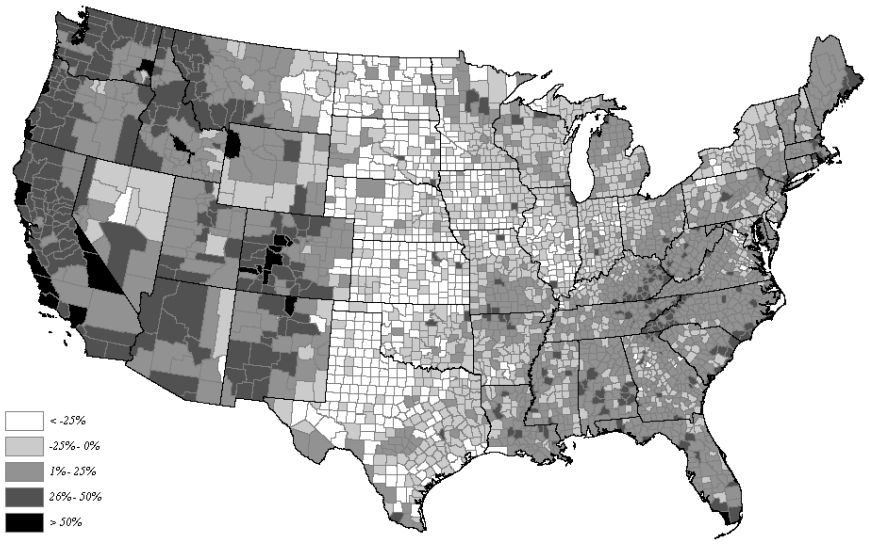

Figure 6 Spatial Distribution of v_i^*

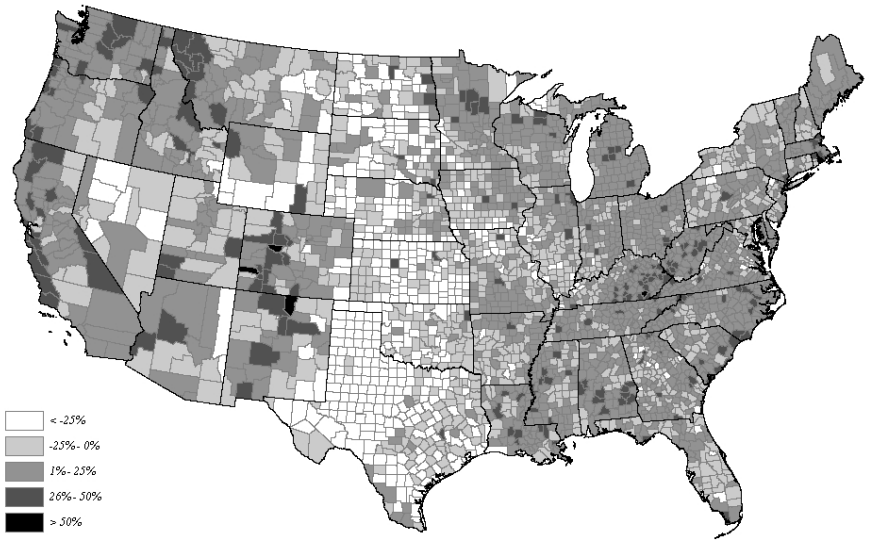

Figure 7 Spatial Distribution of v_i^* as a Percentage of 2000 Median Housing Value

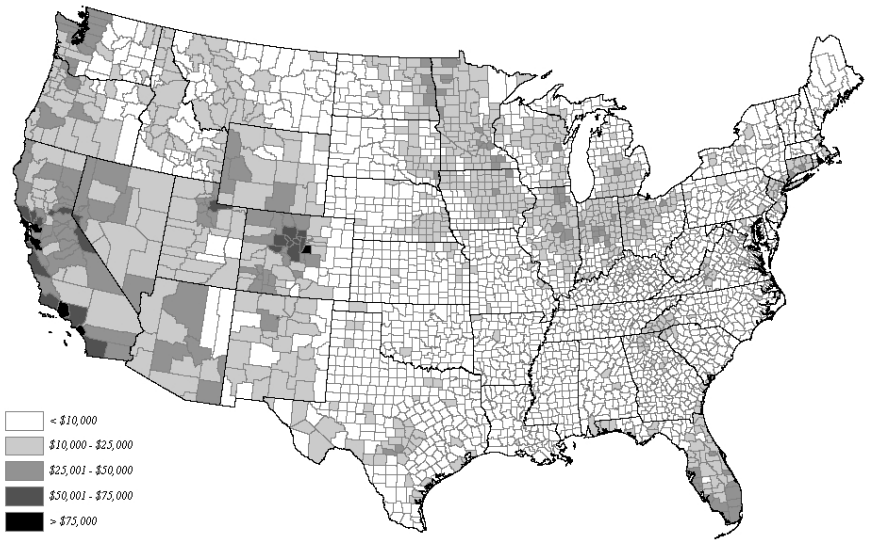

Figure 8 Spatial Distribution of δ_i^*