The Plane of Living and the Pre-crisis Evolution of Housing Values in the United States

John I. Carruthers ☆ The George Washington University, Sustainable Urban Planning Program; e-mail: *jic@gwu.edu*

Gordon F. Mulligan University of Arizona, School of Geography and Development; e-mail: *mulligan@u.arizona.edu*

☆ Corresponding author

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Abstract This paper explores the relationship between quality-of-life differentials and housing values in the run-up to the recent financial crisis in the United States. The analysis combines older spatial demographic methods (systematic mapping) with newer spatial econometric methods (autoregressive modeling) to deliver a panoramic view of the contemporary plane of living and an evaluation of its influence on housing values through time and across space. Housing values are inextricably bound to geography — both natural amenities and human amenities matter, but in somewhat different ways. The influence of natural amenities is growing more powerful, but human amenities offer important opportunities to address market conditions because they can more readily be enhanced via public policy. Several general observations for public policy follow from these findings. Keywords: amenities, quality-of-life, housing, spatial econometric analysis; JEL Classification: C21, Q51, Q56, R21, R23

"I wish I had been out in California, when the lights on all the Christmas trees went out…"

— The Rolling Stones, *Winter* (1973)

1. Introduction

Over 70 years ago, Goodrich et al (1935) advanced the concept of the "plane of living" to characterize quality-of-life differentials across the United States. At the time, the nation was in the grip of the Great Depression and policymakers had a pressing need to understand how the distribution the population had evolved to that point — and, going forward, how to influence migration flows in a way that enhanced economic opportunity and personal wellbeing (Goodrich et al 1936). The original plane of living map is reproduced in Figure 1, and it displays a composite index of three variables that reflects, as a percentage of the national average: (*i*) household income; (*ii*) the proportion of homes having radios; and (*iii*) the proportion of homes having telephones.[1] This map is one of the earliest examples of spatial demography — the demographic analysis of spatial aggregates (Voss 2007) — and, also, of research that explicitly connects place-to-place variation in quality-of-life to the greater economic landscape (Greenwood and Hunt 2003).[2] The work was exceptionally innovative for its time and it helped establish an enduring framework wherein living conditions are viewed as fundamental to a wide array of socioeconomic processes and outcomes.

Today, the United States is enduring the fallout from another economic dislocation that is widely considered to be the worst since that of the 1930s and, although the circumstances of the two eras are different, the plane of living is again central to understanding the nature of the crisis and, perhaps, its legacy. In particular, the recession that (according to the National Bureau of Economic Research[3]) commenced in December 2007 was brought on by the implosion of a massive bubble[4] in the housing market — a bubble that that extended nationwide but was unevenly inflated (see also: Gyourko and Sinai 2003; Glaeser et al 2008; Glaeser and Gyourko 2008; Martin 2010) due, in large part, to geographic quality-of-life differentials. Housing is a complex commodity and its consumption involves the concurrent consumption of any location-specific amenities and disamenities associated with it. When viewed across the nation as a whole, factors that contribute to (take away from) quality-of-life, like mild (harsh) weather and quality (poor) public services, raise (lower) housing values because they increase (decrease) the level of competition there is to occupy places that have (lack) them. In this way, households factor all kinds of living conditions into their calculus when deciding where to live and at what cost, meaning that the topography of housing values mirrors that of the plane of living. Although this relationship is widely known, its role in the run-up to the current crisis and its implications for future outcomes are not.

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[1] The plane of living was also reproduced in Hoover's classic (1948) text *The Location of Economic Activity* — which is where the present authors first discovered it.

[2] Ravenstein (1885) is generally acknowledged to be the very first.

[3] For information on NBER's recession dating procedure, see: *http://www.nber.org/cycles/recessions.html*.

[4] On December 15, 2008, the popular real estate website *Zillow.com* reported that, in that year alone, homes across the United States lost an estimated $2 trillion in value — an amount equal to about 20% of the nation's GDP. See: *http://zillowblog.com/2-trillion-in-home-values-lost-in-08/2008/12/*.

This paper addresses both dimensions of the question by examining the nation's contemporary plane of living and using it to explore how housing values evolved to their pre-crisis levels through time and across space. There are three specific objectives: (*i*) to illustrate how housing values vary from place-to-place and explain why quality-of-life differentials cause them to vary so dramatically; (*ii*) to estimate a series of income capitalization models aimed at weighing the relative importance of the plane of living in the recent evolution of housing values; and (*iii*) to identify some forward-looking observations, with a particular eye toward the dissolution of the crisis. The analysis, which covers the entire continental United States, provides a panoramic look at the housing value landscape in 1980, 1990, and 2000. Like Goodrich et al (1935, page 1), who observed that they "ought not try to say where people should move without first learning where they have moved," this work is concerned first-and-foremost with ascertaining the temporal and spatial trajectories of housing values vis-à-vis household income, housing-related debt, and quality-of-life differentials, and then with suggesting ways of interpreting that information in a forward-looking way. Because "past is prologue" — and because housing values are inextricably, and increasingly, bound to the plane of living — the experience of the last several decades holds valuable lessons for those yet to come.

2. Background Discussion

2.1 Regional Development and the Plane of Living

As early as the 1950s, Ullman (1954) — following an even earlier insight made by Hoover (1948) on the effects of both "physical" and "cultural" amenities — argued that "pleasant living conditions" contribute to differential rates of regional development, and that these differentials were likely to accelerate as the American population grew more footloose and wealthier. And, indeed, they have: households are evermore free to choose where to live on the basis of both economic opportunity and personal preference, and commonly exert their ability to do so (see Kahn 2006).[5] Accordingly, migration research now recognizes that models specified without measures of location-specific amenities suffer from omitted variable bias and, as a result, yield perverse results (Graves 1980; Greenwood and Hunt 1989; Clark and Hunter 1992; Hunt 1993; Mueser and Graves 1995; Clark et al 2003). Because of this changing balance between household income (opportunity) and quality-of-life (preference) there is every reason to expect that the resulting topography of housing values has shifted as well. Moreover, any nationwide recovery

[5] See, for example, Withers and Clark (2006), Withers et al (2008) and Blackburn (2010) for analyses of how these complex decisions impact the inner-workings of families.

from present circumstances in the housing market must ultimately confront the fact that different geographic segments of the population face big differences in the relative costs and benefits of homeownership — explicitly spatial differences that cannot be explained by income alone (Perloff et al 1960) — so it is important to know more about how those differences came to be in the first place.

The cross-national situation as it stood just prior to the 2007 collapse is illustrated in Table 1, which lists data for each of the 48 contiguous states plus Washington, DC in 1980 and 2005. In the earlier year, the median value (in 2010 dollars, rounded to the nearest $100) of owner occupied housing units ranged from a high of $270,100, or 179.08% of the national median, which was then $150,800, in California to a low of $99,100, or 63.73% of the national median, in Arkansas. In the later year, the median value of owner occupied housing units ranged from a high of $649,700, or 285.19% of the national median, which was then $227,800, in California to a low of $112,500, or 49.37% of the national median, in Mississippi. Between the two years, housing values grew the most, by $379,600, in California and at the fastest rate, by 215.82%, in Massachusetts — meanwhile, values actually fell in three states, by $19,200, $9,000, and $8,000, in North Dakota, Wyoming, and West Virginia, respectively, and they grew at the slowest rate, by just 0.89%, in Louisiana. Clearly, these differences correspond to geographic patterns of opportunity and, hence, household income, but they just as clearly reflect preferential responses to quality-of-life differentials — namely, the plane of living.

Perhaps the best-known research on how households respond to the plane of living originates from the hedonic price methodology formalized by Rosen (1974).[6] Within this so-called "compensating differentials" framework, equilibrating processes — population, employment, and wage growth (Carruthers and Mulligan 2008) — ensure that households are indifferent among locations, a situation that implies that: the value of wages plus the value of quality-of-life minus the cost of housing is more-or-less constant nationwide (see Glaeser 2007). Rosen (1979) first used hedonic price analysis to estimate the value of quality-of-life differentials by regressing wages (the transacted price of labor) on job and personal attributes, plus a set of location-specific natural amenities. Roback (1982, 1988) then extended the approach to the housing market by separating out the local real estate and labor markets, revealing that housing values also capitalize quality-of-life differentials.[7] In these studies, desirable (undesirable) living

[6] See Bartik and Smith (1987), Gyourko et al (1999), and/or Mulligan et al (2004) for in-depth reviews and Freeman (2003) for an overview of research methodology.

[7] Ideally, this kind of analysis is conducted with micro, or household-level, data, but that kind of data can be difficult, if not impossible, to obtain for locations across the entire country — especially at multiple points in time. For this reason, research of national scope commonly ends up using median housing value (and corresponding housing attribute) data reported by the Census Bureau (see, for example, Chay and Greenstone 2005; Welch et al 2007; Greenstone and

conditions negatively (positively) influence wages because, everything else being equal, people living in attractive (unattractive) places demand less (more) pay for their work; conversely, desirable (undesirable) living conditions positively (negatively) influence housing values because people living in attractive (unattractive) places are willing to pay more (less) for their homes.[8] In terms of migration, the more appealing a place is, the greater the number of households that desire to live there — so there is increased competition in the both labor and housing markets, driving wages down and housing values up. (See DiPasquale and Wheaton 1998 for a "macro" perspective on labor and housing markets).

These outcomes result from the fact that the contemporary regional development process is driven by a combination of opportunity and preference: more-and-more, households nationwide exhibit an attraction to places offering both jobs and quality-of-life — and, especially, a balance between the two (Glaeser et al 2001; Glaeser and Shapiro 2003). The behavioral mechanisms involved are well understood, but, less understood, are two broader, more systematic issues: (*i*) how the outcome plays out across the national migration system; and (*ii*) the relative importance of the plane of living in the temporal and spatial evolution of housing values.

2.2. Stylized Facts

The continental United States is made up of 3,103 county equivalents, including all counties and independent cities — of these: 1,082, containing about 83% of the population, belong to metropolitan areas; 687, containing about 10% of the population, belong to micropolitan areas; and 1,244, containing about 7% of the population, are not part of a core-based statistical area (CBSA). To set the scene for the upcoming econometric analysis, the spatial distribution of the population within individual counties is shown in Figure 2, a map of CBSA (blue and red) and non-CBSA (white) counties with population-weighted center-points marking each county's center of gravity.[9] These points were used to generate all remaining maps in this paper, via an inverse-distance-weighting (IDW) procedure, the simplest method of interpolating a surface from point data. Specifically, IDW estimates values between points *i* and *j* as a weighted average, where the

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Gallagher 2008). The drawback of this approach lies in the risk of generating what is variously called "aggregation bias," an "ecological fallacy," or a "modifiable areal unit problem" (Wong 2009) — all of which are ways of describing what happens when spatially aggregated data is used to draw conclusions about household-level behavior (Voss 2007). That being noted, aggregated data do represent a viable alternative to micro data — just as long as care is taken when making inferences from it.

[8] Other important extensions of this approach include papers by Berger et al (1987), Hoehn et al (1987), and Blomquist et al (1988), who developed quality-of-life rankings by simultaneously analyzing the effects of location-specific amenities both across and within metropolitan areas, and Gyourko and Tracy (1989, 1991) who demonstrated that local fiscal conditions also account for interregional variation in wages and rents.

[9] The population-weighted center-points were calculated in *ArcGIS* via the "mean center" (see, for example, Barber 1988) tool using census tract level data from 1990.

weight given to each point is determined by a standard distance-decay function (Fotheringham et al 2000; Longley et al 2001):

$$f(d_{ij}) = 1/d_{ij}^2 . \tag{1}$$

To generate the following maps, relevant data, all of which is available from the Census Bureau, was attached (using *ArcGIS*) to the population weighted center points and the surfaces were interpolated from there: Figure 3 displays trend surfaces of population change across the continental United States for (3a) 1970 – 1980, (3b) 1980 – 1990, and (3c) 1990 – 2000; Figure 4 displays trend surfaces of median housing value (in 2010 dollars) in (4a) 1980, (4b) 1990, and (4c) 2000; Figure 5 displays trend surfaces of median household income (again in 2010 dollars) in (5a) 1979, (5b) 1989, and (5c) 1999; and Figure 6 displays trend surfaces of the median mortgage payment — that is, the median monthly cost of owner occupied housing — as a percentage of median monthly household income in (6a) 1980, (6b) 1990, and (6c) 2000. The two measures of income (annual income and the median mortgage payment as a percentage of the monthly income) are considered in order to evaluate, first, income itself and, second, income relative to housing-related debt. Each group of maps shares a common scale, so the figures are internally consistent — that is to say, (-a), (-b), and (-c) are directly comparable — and, for all, the darker the shading, the greater the value. Descriptive statistics and the specific source of these and all other variables involved in this paper are listed in Table 2.

To begin, Figure 3 shows a systematic pattern of population deconcentration: from 1980 to 1990 to 2000, the maps reveal an intensifying pattern of spatial focusing (see Plane and Mulligan 1997) in the nation's migration system — a crystallization of growth and decline around what Frey (2002) has labeled the "Three Americas:" (*i*) the low-density, suburban "Sunbelt;" (*ii*) the high-density, urban "Melting-pot;" and (*iii*) the declining rural "Heartland." Next, Figure 4 shows that, in 1980, housing values were relatively uniform beyond major metropolitan areas but, by 1990, they began to exhibit more polarization along the metropolitan ⇔ nonmetropolitan continuum, a pattern that persisted in 2000, but with a key geographic twist — namely, that values rose significantly nationwide.[10] Across the United States, and, above all, in the rapid growth areas visible in Figure 3, housing values had already reached unprecedented levels by 2000, the year the country had essentially locked in on a course toward the housing bubble and

[10] Although the median housing values reported by the Census Bureau are obviously not the same as sales prices — they are derived from homeowner-provided estimates — they have been found to be a remarkably good indicator of actual market value (see Kiel and Zabel 1999).

subsequent financial collapse.[11] Then, Figure 5 shows that, from 1979 to 1999, median household incomes likewise hardened around major metropolitan areas but, at the same time, extended out into formerly remote areas — recall that the interstate highways system was not completed until the 1970s, and deregulation of the airline industry began lowering the cost of air travel in the 1980s[12] — especially in the Atlantic Southeast and Rocky Mountain West. (Maps based on wages would look rather different, but unearned components of income, including retiree pensions, dividend payments, and more, are integral to the matter at hand.) Finally, housing-related debt is shown in Figure 6, which reveals a nationwide climb over the course of the three decades: a greater proportion of monthly household income being channeled into mortgage payments, especially in major metropolitan and/or rapid growth areas. As a set, these maps illustrate the great wealth and debt that was amassed in the housing market, plus the spatial deconcentration of population, and, with it, household income, that has been realized in recent decades (Frey 1993, 2004; Fuguitt and Beale 1996). Together, they point to fundamental changes in the very nature of housing consumption — structural changes directly attributable to the evolving importance of the plane of living.

As for the plane of living itself, both natural and human amenities matter so, to close out this section, each is addressed in turn. About ten years ago, McGranahan (1999) constructed a natural amenities index covering all counties in the continental United States.[13] The index is based on six separate sub-indices: (*i*) January temperature; (*ii*) hours of sunshine in January; (*iii*) the January / July temperature gap; (*iv*) July humidity; (*v*) topographic variation; and (*vi*) relative water area, including access to coasts. Values of the sub-indices were transformed into *z*-scores and then aggregated (by adding them up) into a single composite index. As shown in Figure 7, counties registering the highest (lowest) scores are located in the most (least) environmentally appealing parts of the country — some specific counties are identified in the leftmost column of Table 3, which lists the top and bottom 10 in their ordinal ranking. All of the top counties are situated in the warm, sunny environs of coastal California, and all of the bottom counties are in the cold-in-the-winter / hot-and-humid-in-the-summer environs of the flat, landlocked Great Plains and Midwest. This index has been used in a wide variety of empirical research and is a good predictor of both migration and development, including land use change (see, for example, Carruthers and Vias 2005).

[11] Beginning in 2000, the conventional 30-year mortgage rate fell consistently through 2005, when it started slowly rising again. See the Federal Reserve Bank of St. Louis' FRED (Federal Reserve Economic Data) database: *http://research.stlouisfed.org/fred2/series/MORTG*.
[12] See various analyses from the Government Accountability Office: *http://www.gao.gov/new.items/d06630.pdf*.
[13] The natural amenities scale and underlying data are available online from the USDA's Economic Research Service, here: *http://www.ers.usda.gov/Data/NaturalAmenities/*.

While the natural amenities index distinguishes areas of the country according to their environmental appeal, a corresponding human amenities index is needed to identify the socioeconomic dimensions of the plane of living. The index — which was constructed by the authors for the purposes of this analysis — is composed of four sub-indices: (*i*) the percent of the population 18 years and older having a college degree, from the Census; (*ii*) per capita local government expenditure, from the Census of Governments; (*iii*) the per capita number of entertainment establishments, from the Economic Census; and (*iv*) territorial density, or the county's population divided by its land area, from the Census. The data from the Census corresponds to decennial census years but, since the Census of Governments and the Economic Census are conducted on off-census years, that data corresponds to 1977, 1987, and 1997. The index itself was constructed in the same way as the natural amenities index: by calculating z-scores for each of the sub-indices and adding them up. Figure 8 displays the resulting values in (8a) 1980, (8b) 1990, and (8c) 2000 and the remaining columns of Table 3 list the top and bottom 10 counties in their ordinal ranking for each year. As intended, the highest rated areas of the country are cosmopolitan places and resort destinations known for their abundant cultural, recreational, and other human amenities and the lowest rated areas are more rural places that do not have that same type of draw. Table 4, which contains a set of three correlation matrices (one for each year) of the sub-indices making up the human amenity index, shows that they are independent of one another. The index is, however, highly correlated — and, therefore, a stable measure — across years: the correspondence between 1980 and 1990 = 0.87; 1980 and 2000 = 0.83; and 1990 and 2000 = 0.87. The following paragraph briefly explains the rationale for each of the four sub-indices; for further information on socioeconomic factors that enhance quality-of-life see in-depth reviews by Bartik and Smith (1987), Gyourko et al (1999), and/or Mulligan et al (2004).

First, analysts have long recognized the benefits of education, a measure of human capital, for income (Glaeser and Maré, 2001) and human wellbeing more broadly (Putnam 2001). These benefits are particularly great in major metropolitan areas, which are commonly sought out by, to name a few groups, Costa and Kahn's (2000) college-educated "power couples" faced with a collocation problem, households and firms in Drennan's (2002) "information economy," and members of Florida's (2002a, 2002b) "creative class." Second, the benefits of local government expenditure have important effects on housing values because of the kind of Tiebout (1956) sorting it engenders (see Ladd 1998, Fischel 2001, and Oates 2002 for useful summaries). An aggregate measure of public spending, total direct expenditure, is used because its value as a composite amenity is what is of interest here — but Welch and Waldorf (2006) and Welch et al

(2007) explore how different kinds of spending influence both housing values and rents. Third, entertainment establishments are a strong draw in both urban (Glaeser et al 2001) and rural (Deller et al 2001; McGranahan et al 2001) areas of the country. Certain households are particularly drawn, for various reasons — see Black et al 2002 for a good example (gay couples) that readily generalizes to many other demographic and social groups — to areas abundant in adult, as opposed to child, related entertainment amenities. Last, density is increasingly recognized as a main factor influencing the comparative advantages of regions (Jacobs 1961; Glaeser and Gottlieb 2006). For example, the "new economic geography" framework (Fujita et al 1999; Baldwin et al 2003; Brackman et al 2009) suggests that the kind of variety (above-and-beyond entertainment opportunities) found in dense urban agglomerations has advantages for production and consumption alike.[14] For present purposes, the idea is the same: counties that are denser in population are more productive and provide their residents with a wider aray of high-quality goods and services.

The trend surfaces shown in Figures 7 and 8 are analogues of the contemporary plane of living: they jointly depict the spatial distribution of quality-of-life differentials across the United States. Compared to Goodrich et al's (1935, 1936) original conceptualization, reproduced in Figure 1, today's setting is more nuanced, particularly with its orientation toward natural amenities, but it nonetheless bears a certain resemblance. The Northeast Corridor and the Pacific Coast conurbations dominate the older and newer maps alike and, likewise, the Atlantic Southeast and remote parts of the Southwest remain what Hoover (1948, page 204) called "problem areas" even today. Then again, there are some big differences. Mainly, the great manufacturing regions of the Midwest — now often pejoratively referred to as the "Rustbelt" — and select agricultural areas as far west as the Great Plains stood out dramatically in the 1930s, but no more. Another large, more positive difference between the two eras is the wider Four Corners section of the Southwest, which rated poorly in the 1930s, but now rates higher for its natural and human amenities (see Mulligan and White 2002). Although the two indices are kept separate for the sake of exposition and the analytics in the next section, the combination of them is what makes up the plane of living — it is the surface that modern American households negotiate as they decide where to live, and at what cost.

[14] Recent theoretical evidence suggests that natural amenities may also contribute in a similar way (Wang and Wu 2010)

3. Econometric Analysis

3.1 A Parallel Plane of Living

The point of departure for the econometric analysis is a simple income capitalization model of housing values suggested by Tolley and Diamond (1982), Glaeser et al (2001), and Carruthers and Mulligan (2006):

$$mhv_i^* = \alpha_1 + \alpha_2 \cdot mhi_i^* + \varepsilon_i . \tag{2}$$

In this equation, mhv_i^* is the natural log of median housing value in county *i*; mhi_i^* is the natural log of median household income; α_1 and α_2 are estimable parameters; and ε_i represents the stochastic error term. (Ideally, the analysis would use value per square foot of living space, along with — or perhaps instead of — median housing value, but no census variable exists that would facilitate this metric.) Note that, because the equation is in log-linear form, the parameter α_2 is an elasticity, meaning that it registers the percent change in median housing value induced by a percent change in the relevant explanatory variable — or, more specifically, the rate at which the household income capitalizes into housing value. Note, too, that, while many studies have focused on estimating the income elasticity of demand for housing, a rule of thumb is that the "correct" income elasticity is somewhere around 1.0 (Muth 1969; Mills 1972; Mayo 1981). Although the parameter on household income should not be confused with an actual, household-level income elasticity of demand because it is based on aggregated data — and, more to the point, equation (2) is not, in any way, a demand function — logically, it should still be in the vicinity of 1.0 if it representatively describes the cross-national relationship between household income and housing value.

An alternative, more exploratory way of examining how household income capitalizes into housing values is to use the second measure of income identified in the background discussion, the median mortgage payment as a percentage of the monthly income — a measure that accounts for income relative to housing-related debt:

$$mhv_i^* = \beta_1 + \beta_2 \cdot mmp_i^* + \upsilon_i . \tag{3}$$

The notation is essentially the same as in equation (2), except that mmp_i^* is the natural log of the monthly mortgage payment and; the βs replace the αs; and υ_i represents the error term. Unlike α_2, it is not clear upfront what magnitude of value to expect out of β_2, the parameter that measures the rate at which the mortgage payment as a percentage of monthly income capitalizes into housing value. While not as cut-and-dry as equation (2) this alternative specification is worth pursuing, if only for exploratory purposes, because it offers another type of insight into the relationship between income and housing values — in particular, assuming that the size of mortgage payments relative to income captures the degree of debt and equity associated with homeownership, it gives some (admittedly exploratory) evidence related wealth.

Ordinary least squares (OLS) estimates of these two simple baseline models are listed, respectively, in the left- and right-hand panels of Table 5.[15] The fitted regression lines themselves, along with their corresponding data points, are shown in Figure 9 and Figure 11, scatter plots of the two income variables (on the *x*-axis) versus housing value (on the *y*-axis) in (9a and 11a) 1980, (9b and 11b) 1990, and (9c and 11c) 2000. As expected, the income elasticities estimated via equation (2) fall around (though upward of) 1.0; the elasticities estimated via equation (3) start out negative 1980 and become increasingly large in 1990 and 2000. The table also shows that median household income does a far better job of explaining housing value than the monthly mortgage payment as a percentage of income: the adjusted R^2s average ~0.58 for the former, compared to just ~0.04 for the later.

A useful feature of these models — and, indeed, the whole point of estimating them in bivariate form the first place — is that their error terms represent amenity indices because they expose the extent to which the income variables over- or under-predict housing value. In particular, the error term (the observed value minus the predicted value in the scatter plots) is positive (negative) when the model underestimates (overestimates) a county's median housing value, based on household income and mortgage payments. As explained in the background discussion, the compensating differentials framework indicates that those living in attractive (unattractive) places pay more (less) for their homes as a result of competition in the real estate market. So, the extent to which housing is over (under) valued relative to the national baseline may be interpreted as a measure of the premium (discount) that households pay for a given county's relative endowment of amenities — and, because of this, equations (2) and (3) can be used to construct analogues of the quality-of-life differentials mapped in Figures 6 and 7: a parallel plane of living.

To illustrate, trend surfaces of the residuals associated with the OLS regression lines shown in the two sets of plots are mapped, again using IDW, in Figure 10 and Figure 12. Both sets of maps square nicely with the maps of the natural and human amenity indices — and with each other, though not perfectly: the correspondence between the two types of errors is 0.70 in

[15] These and all subsequent models are estimated year-by-year because the parameters are expected to vary through time. In order to insure that the differences are statistically significant, Chow tests based on estimates of equations (2) and (3) were performed. In the Chow tests, the sum of squared residuals totaled across three years of estimation is compared to the sum of squared residuals from a model containing all three years pooled together. The resulting F-statistics for the income and mortgage payment models are 299.78 and 223.93, respectively – far greater than the critical value of 2.71 needed to reject the null hypothesis that the parameters are the same across all three years.

1980; 0.46 in 1990; and 0.48 in 2000. Note how the trend surfaces shift through time. In Figure 10, the Pacific West and Rocky Mountain West stand out as having high amenity values (deep purple) in all three panels, but, in the middle panel, the effect appears to settle somewhat — perhaps as a result of the brief reversal of migration trends that occurred in the 1980s (Frey 1993; Fuguitt and Beal 1996) — before picking up again in the final panel.[16] On the other side of the country, in the Northeast Corridor, the opposite happened: the amenity value, clearly visible in all three panels, swells in the middle panel before returning to more-or-less previous levels in the final panel. Meanwhile, the Great Plains and Midwest consistently register large disamenity values (deep green) but, in central Texas, the effect dissipates in the middle panel before returning again in the final panel. In the Atlantic Southeast, a region that experienced a great deal of growth between 1980 and 2000, the disamenity effect steadily declines (becoming more yellow) over the three panels, producing corresponding amenity values that take shape year-by-year. Very similar patterns are visible in Figure 12, with one key exception: the Northeast Corridor and major metropolitan centers of the Midwest and elsewhere consistently stand out (in deep red) as places where the housing-related debt as a percentage of monthly income debt greatly underestimates median housing value.

The ten counties at the top and bottom ends of the two estimated amenity scales are listed for each year in Table 6. The table shows some correspondence between the residuals from equations (2) and (3) — but more between the top and bottom ends of the natural and human amenity indices listed in Table 3. There are, however, two noteworthy differences, which help to illustrate just how well the estimated indices interface with the observed indices: (*i*) the top 10 counties include a blend of places along the Atlantic and Pacific seaboards rich in natural amenities, human amenities, and/or both; and (*ii*) the bottom 10 counties are dominated by remote, declining, and/or impoverished places in the Great Plains and Southwest. Compared to Figures 6 and 7, which illustrate the amenity-related quality-of-life differentials of the plane of living, Figures 10 and 12 represent its value-related differentials — that is, the former are analogues of the amenities themselves and the latter are analogues of their economic value. The two sets of maps are not so much alternative representations of the same thing as different, parallel dimensions of the modern socioeconomic landscape. As such, the surfaces they display are tightly interwoven: the amenity- and disamenity-related values shown in Figures 10 and 12 are direct outcomes of preferential actions taken by households in response to the quality-of-life differentials pictured in Figures 6 and 7. Given this relationship, the logical next step is to connect

[16] There is also evidence of households migrating out of California to comparatively less expensive locations throughout the West (Henrie and Plane 2007) so an interesting issue for further research is the extent to which western real estate values and amenity consumption have been driven by a wealth effect from that state.

the representations in a way that sheds light on how housing values evolved to their pre-crisis levels, through time and across space.

3.1Economic Opportunity Versus Personal Preference

The relative importance of economic opportunity (income) versus personal preference (the plane of living) in the recent evolution of housing values is weighed by expanding equations (2) and (3) to include a spatially lagged dependent variable (Anselin 1988; Arbia 2006) that addresses spatial autocorrelation in the median housing values of proximate counties, state-level fixed effects (Wooldridge 2000, 2002), a set of relevant explanatory variables — including the natural amenity and human amenity indices:

$$mhv_i^* = \rho \cdot W_{ij} \cdot mhv_j^* + \Phi_s + X_i^* \cdot \Gamma + \omega_i . \qquad (4)$$

Here, mhv_i^* again represents the natural log of median housing value in county *i*; $W_{ij} \cdot mhv_j^*$ represents the endogenous spatial lag of the dependent variable; X_i^* represents a vector of exogenous explanatory variables, all in natural log form; ρ represents a spatial autoregressive parameter that registers how median housing value in county *i* is influenced by median housing value in proximate counties *j*; Φ_s represents a vector of state fixed effects, including one for Washington, DC; Γ represents a vector of parameters on the exogenous explanatory variables; and ω_i represents the stochastic error term. By convention, W_{ij} is used to denote a 3,103 × 3,103 ($n \times n$) row-standardized spatial weights matrix that describes the connectivity of the dataset. The weights matrix was created using the population-weighted center of each county's population — the points in Figure 2 — to identify neighbors. In the scheme, each county *i* is related to all counties *j* having population centers located within 50 miles of its own population center or, in the 65 cases where the distance to the nearest neighbor is greater than 50 miles, to a single neighbor. Finally, the individual variables making up the vector X_i^* are as follows: (*i*) either (in separate estimations) median household income or the monthly mortgage payment as a percentage of monthly income; (*ii*) total population, a demand-side control; (*iii*) the median age of the population, another demand side control that addresses the tenure of homeowners; (*iv*) a construction cost index, a supply side control measured the average wage in the construction industry divided by the average wage across all industries; (*v*) the natural and human amenity indices, together representing the plane of living; and (*vi*) metropolitan and micropolitan area indicator variables.

Before moving on, observe that equation (4) indicates that proximate housing values influence one another — because, for example, nearby counties have common labor markets and, therefore, have real estate markets that are shaped by the same economic forces. In practice, the connection means that median housing value in county *i* depends on median housing values in counties *j* and the other way around so the spatial lag, $W_{ij} \cdot mhv^*_j$, is endogenous to mhv^*_i and the model cannot be properly estimated using OLS. A straightforward alternative is a spatial two-stage least squares (S2SLS) strategy developed by Kelejian and Prucha (1998).[17] In the first stage of the S2SLS algorithm, the spatially lagged dependent variable, $W_{ij} \cdot mhv^*_j$, is regressed on X_i and $W_{ij} \cdot X_i$ — the spatial lag of X_i — to produce predicted values. Then, in the second stage of the algorithm, the predicted values, say "$W_{ij} \cdot mhv^*_j$-hat," are used in place of the actual values in equation (4). This approach yields efficient, unbiased parameter estimates, whether or not spatial error dependence is also present (Das et al 2003). In order to carry the procedure out, the spatial variables, $W_{ij} \cdot mhv^*_j$ and $W_{ij} \cdot X_i$, were calculated in *GeoDa*, a program for spatial computation (Anselin 2003; Anselin et al 2006), then imported into *EViews*, an econometrics program, with the rest of the data, where the two-stage least squares (2SLS) regressions were run using panel settings to identify the states as cross-sections for fixed effects and as clusters for White-adjusted standard errors.

Table 7 lists the S2SLS estimation results for equation (4), with the median housing value version of the model shown in the left-hand panel and the monthly mortgage payment version of the model shown in the right-hand panel. Nearly all of the parameters are statistically significant with sensible signs and the adjusted R^2 values indicate that each of the equations does a good job of explaining variation in the dependent variable.[18] The results are as follows. First, each of the spatial lags is positive and they generally show a steadily increasing level of connectivity among proximate housing markets over the 30-year timeframe — that is, a substantive tightening of spatial interdependence. Second, the parameters on median household income remain close to the expected value of one, and grow closer to that value through time. The median mortgage payment is not statistically significant in 1980, which is not surprising because that was an era of exceptionally high interest rates — in the 1970s, the 30-year conventional mortgage rate began a precipitous climb that peaked at 18.45% in October, 1982[19] — when many homeowners' mortgage payments were skewed heavily toward interest rather than principle; the variable becomes significant in 1990 and doubles in size between 1990 and 2000. Third, the parameters on total population are positive, highly significant, and stable across the entire series of models.

[17] See Anselin 2009 for a plainspoken overview of the procedure and its alternatives.

[18] As a reminder: all parameters associated with continuous variables are elasticities, which are unit free metrics, so they enable reasonably direct comparisons to be made among the different variables.

[19] See: *http://research.stlouisfed.org/fred2/series/MORTG?cid=114*.

Fourth, the median age of the population is negative — signaling that tenure matters in the sense that older households live in lower valued housing — and significant in all instances except one: the 2000 monthly mortgage payment model. Fifth, the construction cost index is positive and statistically significant in both sets of models in 1980 and 1990, but not in 2000, perhaps due to a nationwide retrenchment in, and evening out of, the cost of homebuilding due to gains in the efficiency of production.[20] Sixth, the parameter on the natural amenity index is significant and positive across all models, and, in the income models, it nearly doubles in size between 1980 and 1990. Seventh, the parameter on the human amenity index is also consistently significant and positive, but it diminishes in size — probably due to an evening out of access to them through time. Last, the metropolitan and micropolitan area indicator variables register a fluctuating influence both across years and between the two model specifications.

As a final step, in order to examine further spatial relationships in the model, the estimating equation is expanded again[21] — this time, by adding spatial lags of the two amenity indices into the mix:

$$mhv_i^* = \rho \cdot W_{ij} \cdot mhv_j^* + \Phi_s + X_i^* \cdot \Gamma + W_{ij} \cdot Z_i^* \cdot \Lambda + \psi_i . \qquad (5)$$

All notation is exactly the same as in equation (4) except for: the vector $Z_i^* \in X_i^*$ — where Z_i^* is the natural amenity index and the human amenity index — so $W_{ij} \cdot Z_i^*$ represents the spatial lag of those two variables; Λ, a vector of parameters on the spatially lagged amenity variables; and ψ_i, the error term, in place of ω_i. This "spatial expansion" (Cassetti 1972) model is estimated the exact same way as before except that, because it contains spatially lagged explanatory variables, second order spatial lags, or spatial lags of the spatial lags, are used as additional instrumental variables in the first stage of the S2SLS algorithm.[22]

Table 8 lists the estimation results, which remain much the same for most of the explanatory variables, so the focus is on resulting differences. Across both panels of models, adding the spatially lagged amenity variable reduces the parameters on the spatially lagged dependent variables in 1980 and 1990 — but increases them slightly in 2000. In the first variant of the models, the parameter on the natural amenity index is reduced by the inclusion of its spatial

[20] The coefficient of variation (mean / standard deviation) of the Census Bureau's constant quality construction cost index across the Northeast, Midwest, South, and West regions fell from 0.19 in 1980 to 0.12 in 1990 to 0.11 in 2000. See: *http://www.census.gov/const/price_sold.pdf*.

[21] Adding independent variables to the models — especially in the form of spatial lags of extant independent variables — increases the possibility of their being hampered by multicollinearity. Multicollinearity arises when one or more of the independent variables included are closely correlated and can result in inefficient estimates if the estimated parameters have a large variance. In the present case, the large sample size helps minimize the issue — and what's really of interest is the extent to which the influence of the various amenities extends across geographic space *while* controlling local conditions. See Wooldridge (2000) for a discussion of multicollinearity and its implcations.

[22] Special thanks to Ingmar Prucha for his guidance on this.

lag, which carries a parameter that is larger or, in 2000, as large, as its non-lagged counterpart; in the second variant of the models, adding the spatial lag of the natural amenity index has little effect and, in fact, the spatial lag only comes in significant (and negative) in the 2000 model. Meanwhile, the parameters on the human amenity index are unchanged by the inclusion of its spatial lag, which exhibits a variable pattern of significance and influence, positive or negative, across the series of models. In net, proximate human amenities don't have much of an influence on housing values. The finding is sensible given that, over time, human amenities have become less spatially concentrated and, therefore, less influential on nearby areas than they have been in the past.

All together, the evidence reported in Tables 7 and 8 shows that the plane of living has played a main role in the recent evolution of housing values — and that this role is not static: it continues to evolve both through time and across geographic space. Setting aside the more exploratory mortgage payment models, the relative importance of natural and human amenities is straightforward to evaluate via the elasticities reported in the left-hand panel of Table 8. Specifically, the elasticities are applied to percent changes associated with "transforming" a county at the first quartile of the various amenity indices such that it was at the third quartile — that is, hypothetically, moving from the 25th percentile to the 75th. Such (cross-sectional) change in terms of the natural amenity index and its spatial lag implies shifts of 29.31% and 22.18%; such change in terms of the human amenity index and its spatial lag implies shifts of 60.10%, 56.26%, and 55.89% and 41.94%, 36.83%, and 37.69% in 1980, 1990, and 2000, respectively. Applying the various elasticities to these numbers yields impacts of 3.37%, 6.11%, and 7.34% and 4.34%, 5.20%, and 5.51% for the natural amenity index and its spatial lag, respectively, across the three years; do the same for the human amenity index yields impacts of 8.81%, 8.47%, and 5.90% and 4.35%, 0.00%, and –4.37%. These numbers are substantive enough to pay attention to: they suggest that public policy aimed at enhancing the plane of living may also bolster housing values and, in turn, household wealth.

4. Some Forward-looking Observations

Having explored the plane of living and evaluated its influence on housing values, the remainder of the discussion focuses on identifying some forward-looking observations in light of the financial crisis. To recap the main findings of the econometric analysis: (*i*) the quality-of-life differentials of the plane of living are oriented around environmentally appealing, cosmopolitan places; (*ii*) these amenity-related differentials give rise to corresponding value-related differentials that exhibit a parallel topography; (*iii*) over time, housing values have become increasingly connected across space and have also come under greater influence of natural amenities, but somewhat lesser influence of human amenities; and (*iv*) the influence of natural amenities has an extensive reach that has grown more powerful with time, while just the opposite appears to be the case for human amenities. As a whole, the evidence suggests that the plane of living played a big part in the ratcheting up of housing values evidenced in Figure 3 — an interpretation consistent with other evidence that quality-of-life has increased substantially in value over the past several decades (Costa and Kahn 2003; Kahn 2006). Several general observations follow from findings.

Foremost, an unhappy, and all-too-obvious, observation is that the implosion of the housing bubble has left many Americans holding homes valued less than they paid for them — and owe on them.[23] But, as the experience leading up to the crisis illustrates, a lot of these homes are embedded in markets with abundant natural and human amenities and excellent intermediate- to long-run prospects: California, to name just one state, is all-too-well acquainted boom and bust cycles, and has a demonstrated record of recovering from wild upheaval in its real estate markets. That is, in net, places having an enduring appeal for their high quality-of-life may come out of the slowly-easing crisis comparatively well. On the other hand, places that do not have the same kind of prospects — whether because of dissipating labor markets, low natural and/or human amenities, or, worse still, a combination of the two — are sliding down a steep and very slippery slope. Indeed, the kind of place-based policy frameworks that some analysts (like Partridge and Rickman 2006) have advocated as an approach to endemic poverty may eventually be needed to shore up housing markets with particularly grim outlooks. Power (1996) and Power and Barrett (2001) have suggested a plausible way forward for formerly resource-dependent areas of the Rocky Mountain West — but the same kind of path is just not open to manufacturing-dependent areas forsaken for their deteriorating economies and the character of their environments. As unjust as it is, regions that fail to grow, along with those that remain stranded in perpetual economic decline, may end up being permanent casualties of the financial crisis if, going forward, great innovation and effort is not taken in the formation of place-based housing and development policy.

[23] A question that may gain increased traction in the wake of the crisis is: how have housing-related income tax benefits contributed to the inflation of the housing bubble? And, by extension, to what extent have they subsidized the consumption of amenities? Voith and Gyourko (2002) show that, with tax benefit capitalization, high-income households consume greater quantities of land — and Gyourko and Saini (2003) find that the spatial distribution of income tax benefits for homeowners is highly skewed, with high-amenity states registering large positive net transfers and low-amenity states registering large negative net transfers. For these reasons (among others) Glaeser and Gyourko recommend lowering the cap for the tax write off from $1 million to $300,000 — a move estimated to impact fewer than one in 20 homeowners.

Glaeser (2007) argues for people-based — as opposed to place-based — policies for combating decline but, for its merits, the trouble with this perspective is that it literally assumes geography away: for many reasons, geographic space is "sticky" meaning that households and firms are not perfectly mobile and often cannot relocate very far, if at all. Consider, for instance, that people have entrenched family and social networks; aesthetic and psychological attachments to place; different perspectives on, and practical alternatives in, the reach and scale of labor markets; varying capacities, financial and otherwise, for relocation; and more. In short, a household's spatial behavior is influenced, in a very fundamental way, by its view of geography itself (see Abler et al 1971). While some households may be ready, willing, and able to relocate across the country, or even the world, for the sake of opportunity and/or preference, others find even the idea of doing so an anathema. Indeed, if this were not the case, places, as the collectives they are, would have no incentive to find ways of reinventing themselves — as Glaeser (2005) documents that Boston has a several times over the course of its history. Moreover, households that owe more on their mortgages than their homes are worth are generally unable to move at all (see, for example, Chan 2001 and Ferreira et al 2010) meaning that, for worse or for better, they are quite literally stuck in place.

To that point, a general suggestion is that, to every extent possible, public policy should focus on both preserving natural amenities and generating human amenities — and most especially human capital. Natural amenities were consistently observed to play a greater-and-greater role in the two sets of income capitalization models from 1980 – 2000 and, not only that, their influence has appreciable (and growing) geographic reach: households pay a premium to live in environmentally appealing places — and, also, to live near them. The continuing importance of natural amenities to both migration and job growth attests to this (Clark et al 2003; McGranahan 2008; Whisler et al 2008; McGranahan et al 2010). Although the influence of human amenities has declined through the decades, they, unlike natural amenities, may readily be generated by public policy. For example, Markusen (2004, 2006), McGranahan and Wojan (2006), Rupasingha et al (2006), Rupasingha and Goetz (2006), Wojan et al (2007), Florida et al 2008, and Florida and Mellander (2010) all illustrate various ways in which economic development strategies designed around human capital and/or a "creative" mix contribute to increased economic growth and stability. And, importantly, Storper and Scott (2009) and Scott (2009) argue that the role of footloose migration and, by extension, the natural amenities that have historically driven it, may, in fact, be overrated and, therefore, prescribe greater investments in human capital. At a time of widespread divestment among state governments in the system of public higher education, the United States seems to be heading in the wrong direction — even if that divestment has been forced, in part, by the financial crises and its impact on tax rolls. All of this is to say that the present findings add more depth to the pool of evidence in favor of using place-based policy frameworks to improve household economic security by enhancing the plane of living.

5. Summary and Conclusion

This paper began by setting out three specific objectives: (*i*) to illustrate how housing values vary from place-to-place and explain why quality-of-life differentials cause them to vary so dramatically; (*ii*) to estimate a series of income capitalization models aimed at weighing the relative importance of household income and mortgage debt versus the plane of living in the - recent evolution of housing values; and (*iii*) to identify some forward-looking observations, with a particular eye toward the dissolution of the ongoing crisis. Having met those objectives, the closing comments briefly refocus on the challenge the United States continues to face.

As noted at the onset, in 2008 alone, American homes lost an estimated $2 trillion in value. Between October 2007 and October 2008, the year over which the crisis exploded, the 20 Case-Shiller[24] housing price indices fell by a nationwide average of 16.41% — an aggregate figure that, while bad, masks even worse region-specific news: greater than 30% single-year declines in Phoenix, Las Vegas, and San Francisco; and greater than 20% single-year declines in Miami, Los Angeles, San Diego, and Detroit. For most regions, the overall setback, while nonetheless dramatic, is really a matter of a few years, with the price indices back at their ~2004 – ~2005 levels. For others, however, the setback appears to be far more insurmountable, at least in the foreseeable future: Cleveland, and Detroit, for example, experienced almost none of the boom between 2000 and 2007, and ended up back at more-or-less their 2002, and pre-2000 levels, respectively, raising the specter of a "lost decade" in the appreciation of a main form of American wealth. In Miami, San Diego, Phoenix, and other high natural amenity regions, it is reasonable to expect that preference-driven migration will eventually drive housing values back up. Likewise, in Chicago, New York, the District of Columbia, and other high human amenity (not to mention opportunity) regions, it is equally reasonable to expect that growth will eventually drive housing values back up. But what about regions like Cleveland, Detroit, and many others that have suffered from years of economic decline and even outright neglect? Although the human tragedy of the financial crisis extends nationwide, with a comprehensive recovery still only beginning to emerge, if at all, these parts of the country appear particularly vulnerable. They rest on the

[24] Available from Standard and Poor's on line, here:
http://www2.standardandpoors.com/portal/site/sp/en/us/page.topic/indices_csmahp/0,0,0,0,0,0,0,0,0,1,1,0,0,0,0,0.html.

downside of the plane of living and will almost certainly present special challenges — even once the long-gathering storm finally lets up.

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Table 1. Median Value of Owner–occupied Homes ($2010) by State in 1980 and 2005

	1980		2005		Difference			1980		2005		Difference	
	Median value	Percent of US median	Median value	Percent of US median	Value	Percent		Median value	Percent of US median	Median value	Percent of US median	Value	Percent
US	$150,824	100.00%	$227,800	100.00%	$76,976	51.04%	MT	$147,968	98.11%	$178,976	78.57%	$31,008	20.96%
AL	$108,120	71.69%	$132,600	58.21%	$24,480	22.64%	NE	$121,176	80.34%	$153,952	67.58%	$32,776	27.05%
AZ	$180,472	119.66%	$252,144	110.69%	$71,672	39.71%	NV	$220,728	146.35%	$385,424	169.19%	$164,696	74.61%
AR	$99,144	65.73%	$118,864	52.18%	$19,720	19.89%	NH	$153,136	101.53%	$326,536	143.34%	$173,400	113.23%
CA	$270,096	179.08%	$649,672	285.19%	$379,576	140.53%	NJ	$195,840	129.85%	$454,104	199.34%	$258,264	131.88%
CO	$206,040	136.61%	$303,688	133.31%	$97,648	47.39%	NM	$144,840	96.03%	$170,680	74.93%	$25,840	17.84%
CT	$215,016	142.56%	$369,240	162.09%	$154,224	71.73%	NY	$146,336	97.02%	$352,104	154.57%	$205,768	140.61%
DE	$142,256	94.32%	$277,168	121.67%	$134,912	94.84%	NC	$114,784	76.10%	$173,536	76.18%	$58,752	51.18%
DC	$225,488	149.50%	$522,784	229.49%	$297,296	131.85%	ND	$139,672	92.61%	$120,496	52.90%	–$19,176	-13.73%
FL	$144,432	95.76%	$257,720	113.13%	$113,288	78.44%	OH	$143,888	95.40%	$176,256	77.37%	$32,368	22.50%
GA	$117,640	78.00%	$200,600	88.06%	$82,960	70.52%	OK	$113,560	75.29%	$121,176	53.19%	$7,616	6.71%
ID	$146,336	97.02%	$183,464	80.54%	$37,128	25.37%	OR	$188,224	124.80%	$273,632	120.12%	$85,408	45.38%
IL	$171,904	113.98%	$250,104	109.79%	$78,200	45.49%	PA	$124,712	82.69%	$179,384	78.75%	$54,672	43.84%
IN	$118,592	78.63%	$155,584	68.30%	$36,992	31.19%	RI	$149,872	99.37%	$382,568	167.94%	$232,696	155.26%
IA	$129,472	85.84%	$144,976	63.64%	$15,504	11.97%	SC	$111,928	74.21%	$153,816	67.52%	$41,888	37.42%
KS	$120,496	79.89%	$146,608	64.36%	$26,112	21.67%	SD	$116,688	77.37%	$138,312	60.72%	$21,624	18.53%
KY	$109,072	72.32%	$141,304	62.03%	$32,232	29.55%	TN	$113,560	75.29%	$155,040	68.06%	$41,480	36.53%
LA	$137,088	90.89%	$138,312	60.72%	$1,224	0.89%	TX	$124,712	82.69%	$144,160	63.28%	$19,448	15.59%
ME	$120,904	80.16%	$211,208	92.72%	$90,304	74.69%	UT	$191,352	126.87%	$227,392	99.82%	$36,040	18.83%
MD	$188,768	125.16%	$381,072	167.28%	$192,304	101.87%	VT	$134,912	89.45%	$235,824	103.52%	$100,912	74.80%
MA	$154,632	102.52%	$491,640	215.82%	$337,008	217.94%	VA	$153,408	101.71%	$288,728	126.75%	$135,320	88.21%
MI	$124,440	82.51%	$203,048	89.13%	$78,608	63.17%	WA	$193,528	128.31%	$309,672	135.94%	$116,144	60.01%
MN	$173,128	114.79%	$270,368	118.69%	$97,240	56.17%	WV	$122,808	81.42%	$114,784	50.39%	–$8,024	-6.53%
MS	$100,096	66.37%	$112,472	49.37%	$12,376	12.36%	WI	$155,040	102.80%	$207,536	91.10%	$52,496	33.86%
MO	$117,096	77.64%	$167,416	73.49%	$50,320	42.97%	WY	$192,576	127.68%	$183,600	80.60%	–$8,976	-4.66%

Source: United States Census Bureau.

Table 2. Descriptive Statistics

	Min.	Med.	Max.	Mean	St. Dev.	Source
	1980					
Construction Cost Index	0.40	1.40	5.17	1.42	0.33	REIS
% College Degree	1.60	10.00	47.80	11.43	5.46	CBP
Entertainment Est. / Capita	0.00	0.01	0.14	0.01	0.01	Calculated
Human Amenity Index	1.48	5.68	40.51	6.00	2.52	Census
Median Age of Population	19.20	30.70	57.10	31.05	3.91	Census
Median Household Income	17,609.20	36,915.48	79,829.26	37,900.48	8,817.53	Census
Median Housing Value	26,597.34	86,184.00	532,002.66	93,185.55	37,596.36	Census
% Monthly Mortgage Payment	0.12	0.26	0.65	0.26	0.04	Census
Plane of Living — (2)	-1.47	-0.01	1.32	0.00	0.23	Estimated
Plane of Living — (3)	-1.21	-0.02	1.90	0.00	0.35	Estimated
Total Population	91.00	21,714.00	7,477,239.00	72,563.45	293,466.44	Census
Territorial Density	0.15	36.18	24,094.72	174.54	934.20	Census
Total Direct Spending / Capita	134.61	1,872.60	10,764.06	2,012.63	809.16	COG
	1990					
	Min.	Med.	Max.	Mean	St. Dev.	Source
Construction Cost Index	0.25	1.24	3.31	1.26	0.30	REIS
% College Degree	3.70	11.70	53.40	13.47	6.60	CBP
Entertainment Est. / Capita	0.00	0.01	0.20	0.01	0.01	Calculated
Human Amenity Index	0.88	5.61	40.30	6.00	2.51	Census
Median Age of Population	20.00	34.30	55.40	34.41	3.64	Census
Median Household Income	14,439.60	38,095.68	99,597.12	40,067.52	10,896.78	Census
Median Housing Value	25,198.32	75,936.00	818,664.00	90,020.33	56,664.09	Census
% Monthly Mortgage Payment	0.12	0.27	0.74	0.28	0.04	Census
Plane of Living — (2)	-1.35	-0.002	1.87	0.00	0.28	Estimated
Plane of Living — (3)	-1.31	-0.04	1.87	0.00	0.43	Estimated
Total Population	107.00	22,242.00	8,863,164.00	79,614.74	328,980.12	Census
Territorial Density	0.14	38.11	24,232.59	182.93	931.38	Census
Total Direct Spending / Capita	205.33	2,161.40	16,899.27	2,364.96	1,040.45	COG
	2000					
	Min.	Med.	Max.	Mean	St. Dev.	Source
Construction Cost Index	0.15	1.12	3.91	1.15	0.33	REIS
% College Degree	0.00	9.92	40.02	10.95	4.95	CBP
Entertainment Est. / Capita	0.00	0.02	0.31	0.02	0.01	Calculated
Human Amenity Index	0.48	5.66	41.21	6.00	2.54	Census
Median Age of Population	20.60	37.40	54.30	37.38	3.99	Census
Median Household Income	16,118.84	42,764.71	105,319.83	44,785.58	11,280.09	Census
Median Housing Value	17,526.00	96,012.00	1,270,001.27	106,679.94	63,513.66	Census
% Monthly Mortgage Payment	0.18	0.30	1.02	0.31	0.05	Census
Plane of Living — (2)	-1.76	0.003	2.13	0.00	0.28	Estimated
Plane of Living — (3)	-1.76	0.004	2.02	0.00	0.42	Estimated
Total Population	67.00	24,747.00	9,519,338.00	90,101.01	361,545.66	Census
Territorial Density	0.16	41.48	24,366.01	192.71	918.70	Census
Total Direct Spending / Capita	24.93	2,861.62	22,041.87	3,135.66	1,389.86	COG
	Same Across All Years					
Metro	0.00	0.00	1.00	0.35	0.48	Census
Micro	0.00	0.00	1.00	0.22	0.42	Census
Natural Amenity Index	3.60	9.86	21.17	10.05	2.29	ERS

Notes: all dollar values are in 2010 dollars; calculated means calculated by the authors; CBP is County Business Patterns; Census is the decennial census; COG is the Census of Governments; ERS is the Economic Research Service report, McGranahan (1999); estimated means estimated via equation (2) or equation (3); REIS is the Bureau of Economic Analysis' Regional Economic Information System.

Table 3. Natural Amenity Index and Human Amenity Index – Top 10 and Bottom 10 Counties

	Top 10 Counties							
			Human Amenity Index					
	Natural Amenity Index		1980		1990		2000	
1.	Ventura County	CA	New York City	NY	New York City	NY	New York City	NY
2.	Humboldt County	CA	San Francisco County	CA	San Francisco County	CA	Gilpin County	CO
3.	Santa Barbara County	CA	District of Columbia	DC	District of Columbia	DC	San Francisco County	CA
4.	Mendocino County	CA	Suffolk County	MA	Storey County	NV	District of Columbia	DC
5.	Del Norte County	CA	Philadelphia County	PA	Alpine County	CA	Suffolk County	MA
6.	San Francisco County	CA	Storey County	NV	Suffolk County	MA	Arlington County	VA
7.	Los Angeles County	CA	Alexandria County	VA	Philadelphia County	PA	Hudson County	NJ
8.	San Diego County	CA	Baltimore	MD	Hudson County	NJ	Philadelphia County	PA
9.	Monterey County	CA	Hudson County	NJ	Hinsdale County	CO	Alpine County	CA
10.	Orange County	CA	Menard County	TX	Alexandria County	VA	Kenedy County	TX
.	Bottom 10 Counties							
.			Human Amenity Index					
.	Natural Amenity Index		1980		1990		2000	
3094.	Pennington County	MN	Carlisle County	KY	Lawrence County	KY	Bledsoe County	TN
3095.	Grand Forks County	ND	Spencer County	KY	Taliaferro County	GA	Crawford County	GA
3096.	Dodge County	MN	Morgan County	TN	Magoffin County	KY	Glascock County	GA
3097.	Trail County	ND	Coosa County	AL	Livingston County	KY	Shannon County	SD
3098.	Mower County	MN	Bollinger County	MO	Gallatin County	KY	Menifee County	KY
3099.	Pembina County	ND	Edmonson County	KY	Van Buren County	TN	Taliaferro County	GA
3100.	Norman County	MN	Bland County	VA	Jackson County	KY	Owsley County	KY
3101.	Tipton County	IN	Jackson County	KY	Edmonson County	KY	Long County	GA
3102.	Wilkin County	MN	Menifee County	KY	Menifee County	KY	Leslie County	KY
3103.	Red Lake County	MN	Buffalo County	SD	Buffalo County	SD	Buffalo County	SD

Table 4. Correlation Matrix of Sub-indices Making up the Human Amenity Index

	% Population w/ College Degree	Total Direct Spending Per Capita	Entertainment Est. Per Capita	Territorial Density
1980				
% Population w/ College Degree	1.00	-	-	-
Total Direct Spending Per Capita	0.28	1.00	-	-
Entertainment Est. Per Capita	0.28	0.38	1.00	-
Territorial Density	0.23	0.19	0.03	1.00
1990				
% Population w/ College Degree	1.00	-	-	-
Total Direct Spending Per Capita	0.24	1.00	-	-
Entertainment Est. Per Capita	0.33	0.40	1.00	-
Territorial Density	0.29	0.13	0.05	1.00
2000				
% Population w/ College Degree	1.00	-	-	-
Total Direct Spending Per Capita	0.25	1.00	-	-
Entertainment Est. Per Capita	0.42	0.36	1.00	-
Territorial Density	0.25	0.15	0.06	1.00

Table 5. OLS Estimates of Baseline Income Capitalization Models

	ln Median Household Income						ln Monthly Mortgage Payment					
	1980		1990		2000		1980		1990		2000	
	Est. parameter	t-value	Est. parameter	t-value	Est. parameter	t-value	Est. parameter	t-value	Est. parameter	t-value	Est. parameter	t-value
Constant	–0.8988 ***	–4.21	–2.9199 n/s	–10.56	–3.5844 ***	–14.66	11.1288 ***	146.01	12.2729 ***	142.93	12.4515 ***	139.67
ln Median Household Income	1.1674 ***	57.05	1.3455 ***	50.79	1.4100 ***	61.16	-	-	-	-	-	-
ln Mortgage Payment as % Monthly Income	-	-	-	-	-	-	–0.1843 ***	–3.34	0.7538 ***	12.04	0.8165 ***	11.35
n		3,103		3,103		3,103		3,103		3,103		3,103
Adjusted R^2		0.57		0.60		0.58		0.01		0.06		0.07

Notes: all models were estimated using White-adjusted standard errors clustered by state; OLS is ordinary least squares; all hypothesis tests are two-tailed; *** denotes significant at $p < 0.01$; ** denotes significant at $p < 0.05$; n/s denotes not significant.

Table 6. Error Terms from Baseline Income Capitalization Models — Top and Bottom 10 Counties

	Top 10 Counties											
	Median Household Income						Monthly Mortgage Payment					
	1980		1990		2000		1980		1990		2000	
1.	Pitkin County	CO	New York County	NY	New York County	NY	Pitkin County	CO	Pitkin County	CO	Pitkin County	CO
2.	New York County	NY	Pitkin County	CO	Pitkin County	CO	Marin County	CA	Marin County	CA	Nantucket County	MA
3.	San Francisco County	CA	San Francisco County	CA	Nantucket County	MA	San Mateo County	CA	San Mateo County	CA	Marin County	CA
4.	Mono County	CA	San Luis Obispo County	CA	San Miguel County	CO	Mono County	CA	Santa Clara County	CA	New York County	NY
5.	Marin County	CA	Nantucket County	MA	Taos County	NM	New York County	NY	Nantucket County	MA	Santa Clara County	CA
6.	Santa Barbara County	CA	Santa Barbara County	CA	San Juan County	WA	Orange County	CA	New York County	NY	San Mateo County	CA
7.	Inyo County	CA	Santa Cruz County	CA	Dukes County	MA	Santa Clara County	CA	Falls Church County	VA	Los Alamos County	NM
8.	Lake County	CA	San Mateo County	CA	San Francisco County	CA	San Francisco County	CA	Westchester County	NY	Santa Cruz County	CA
9.	Santa Cruz County	CA	Marin County	CA	Santa Cruz County	CA	Eagle County	CO	San Francisco County	CA	Teton County	WY
10.	Alpine County	CA	Los Angeles County	CA	Williamsburg County	VA	Summit County	CO	Fairfax County	VA	Eagle County	CO
.												
.	Bottom 10 Counties											
.	Median Household Income						Monthly Mortgage Payment					
.	1980		1990		2000		1980		1990		2000	
3094.	Upton County	TX	Harding County	NM	Roberts County	TX	La Salle County	TX	Keweenaw County	MI	Dickens County	TX
3095.	Slope County	ND	Pawnee County	NE	Boyd County	NE	Ziebach County	SD	Mellette County	SD	Hall County	TX
3096.	Kenedy County	TX	Slope County	ND	Miner County	SD	Mora County	NM	Aurora County	SD	McPherson County	SD
3097.	Shannon County	SD	Petroleum County	MT	Steele County	ND	Kiowa County	CO	Shannon County	SD	McDowell County	WV
3098.	McMullen County	TX	Jewell County	KS	Sanborn County	SD	Harding County	NM	Worth County	MO	Blaine County	NE
3099.	Esmeralda County	NV	Wheeler County	NE	Kent County	TX	Kenedy County	TX	Todd County	SD	La Salle County	TX
3100.	Harding County	NM	Sanborn County	SD	Jewell County	KS	Blaine County	NE	McPherson County	SD	Zavala County	TX
3101.	Borden County	TX	Borden County	TX	Grant County	NE	Todd County	SD	McDowell County	WV	Shannon County	SD
3102.	Kiowa County	CO	King County	TX	Loving County	TX	Loving County	TX	Loving County	TX	Loving County	TX
3103.	Loving County	TX	Loving County	TX	King County	TX	Shannon County	SD	Apache County	AZ	King County	TX

Table 7. S2SLS Estimates of Amenity Models

	ln Median Household Income						ln Monthly Mortgage Payment					
	1980		1990		2000		1980		1990		2000	
	Est. parameter	t-value	Est. parameter	t-value	Est. parameter	t-value	Est. parameter	t-value	Est. parameter	t-value	Est. parameter	t-value
Constant	1.0778 ***	3.16	–0.1699 n/s	–0.54	–1.5059 ***	–4.74	5.4759 ***	15.43	4.4111 ***	11.73	4.0053 ***	12.08
ln Spatial Lag	0.1349 ***	6.07	0.2036 ***	9.49	0.1738 ***	6.94	0.4682 ***	15.54	0.5419 ***	18.51	0.5599 ***	20.33
ln Median Household Income	0.7466 ***	26.74	0.8044 ***	26.58	0.9664 ***	25.78	-	-	-	-	-	-
ln Mortgage Payment as % Monthly Income	-	-	-	-	-	-	0.0177 n/s	0.56	0.0934 ***	2.58	0.2772 ***	6.48
ln Population	0.0473 ***	8.98	0.0509 ***	9.33	0.0490 ***	8.83	0.0633 ***	12.19	0.0627 ***	11.60	0.0568 ***	9.10
ln Median Age of Population	–0.0967 **	–2.31	–0.2384 ***	–5.19	–0.2331 ***	–5.45	–0.2336 ***	–5.58	–0.1870 ***	–3.80	–0.0115 n/s	–0.24
ln Construction Cost	0.0949 ***	5.63	0.0662 ***	4.56	–0.0112 n/s	–1.07	0.0625 ***	3.56	0.0821 ***	4.92	–0.0051 n/s	–0.38
ln Natural Amenity Index	0.1994 ***	8.22	0.3123 ***	11.89	0.3669 ***	12.95	0.1263 ***	4.60	0.1611 ***	5.17	0.1437 ***	4.32
ln Human Amenity Index	0.1523 ***	8.89	0.1511 ***	7.97	0.0965 ***	4.54	0.2232 ***	11.37	0.2626 ***	13.06	0.2482 ***	13.15
Metropolitan Area Indicator	0.0231 ***	2.51	–0.0052 n/s	–0.56	–0.0176 n/s	–1.73	0.1120 ***	12.19	0.1198 ***	12.27	0.1345 ***	12.49
Micropolitan Area Indicator	0.0294 ***	3.33	0.0100 n/s	1.19	0.0189 ***	2.36	0.0743 ***	7.71	0.0678 ***	7.31	0.0807 ***	7.88
n		3,103		3,103		3,103		3,103		3,103		3,103
Adjusted R^2		0.81		0.88		0.86		0.74		0.83		0.80

Notes: all state fixed effects have been suppressed in order to conserve space; all models were estimated using White-adjusted standard errors clustered by state; S2SLS is Kelejian and Prucha's (1998) spatial two-stage least squares estimator; all hypothesis tests are two-tailed; ⋆⋆⋆ denotes significant at $p < 0.01$; ⋆⋆ denotes significant at $p < 0.05$; n/s denotes not significant.

Table 8. S2SLS Estimates of Spatial Expansion Amenity Models

	ln Median Household Income						ln Monthly Mortgage Payment					
	1980		1990		2000		1980		1990		2000	
	Est. parameter	t-value	Est. parameter	t-value	Est. parameter	t-value	Est. parameter	t-value	Est. parameter	t-value	Est. parameter	t-value
Constant	1.4399 ***	3.66	–0.2097 n/s	–0.64	–2.2376 ***	–6.77	6.0035 ***	13.67	4.5674 ***	11.07	4.0818 ***	8.78
ln Spatial Lag	0.0560 **	2.01	0.1622 ***	6.50	0.2007 ***	7.22	0.3998 ***	9.20	0.5233 ***	12.96	0.5628 ***	11.97
ln Median Household Income	0.7523 ***	26.50	0.8154 ***	26.52	1.0011 ***	27.29	-	-	-	-	-	-
ln Mortgage Payment as % Monthly Income	-	-	-	-	-	-	0.0319 n/s	0.99	0.1054 ***	2.94	0.2890 ***	6.42
ln Population	0.0505 ***	9.17	0.0523 ***	9.36	0.0457 ***	8.03	0.0667 ***	12.05	0.0634 ***	11.11	0.0567 ***	8.63
ln Median Age of Population	–0.0911 **	–2.13	–0.2376 ***	–5.13	–0.2409 ***	–5.65	–0.2284 ***	–5.42	–0.1848 ***	–3.75	–0.0095 n/s	–0.21
ln Construction Cost	0.0958 ***	5.61	0.0668 ***	4.63	–0.0070 n/s	–0.68	0.0603 ***	3.44	0.0831 ***	4.98	–0.0066 n/s	–0.51
ln Natural Amenity Index	0.1148 ***	3.43	0.2086 ***	6.18	0.2503 ***	7.44	0.1388 ***	3.61	0.1871 ***	4.55	0.2041 ***	4.79
ln Spatial Lag of Natural Amenity Index	0.1959 ***	4.03	0.2346 ***	4.87	0.2484 ***	4.79	–0.0182 n/s	–0.33	–0.0608 n/s	–1.08	–0.1381 **	–2.29
ln Human Amenity Index	0.1466 ***	8.42	0.1505 ***	7.85	0.1056 ***	4.85	0.2104 ***	10.74	0.2543 ***	12.60	0.2394 ***	12.79
ln Spatial Lag of Human Amenity Index	0.1036 ***	3.17	0.0439 n/s	1.37	–0.1160 ***	–3.66	0.1462 ***	3.53	0.0851 n/s	1.83	0.0530 n/s	1.08
Metropolitan Area Indicator	0.0225 ***	2.38	–0.0063 n/s	–0.65	–0.0189 n/s	–1.89	0.1096 ***	12.04	0.1167 ***	11.91	0.1312 ***	12.29
Micropolitan Area Indicator	0.0291 ***	3.25	0.0097 n/s	1.15	0.0186 ***	2.36	0.0731 ***	7.61	0.0673 ***	7.27	0.0802 ***	7.79
n		3,103		3,103		3,103		3,103		3,103		3,103
Adjusted R^2		0.80		0.87		0.86		0.74		0.83		0.80

Notes: all state fixed effects have been suppressed in order to conserve space; all models were estimated using White-adjusted standard errors clustered by state; S2SLS is Kelejian and Prucha's (1998) spatial two-stage least squares estimator; all hypothesis tests are two-tailed; *** denotes significant at $p < 0.01$; ** denotes significant at $p < 0.05$; n/s denotes not significant.

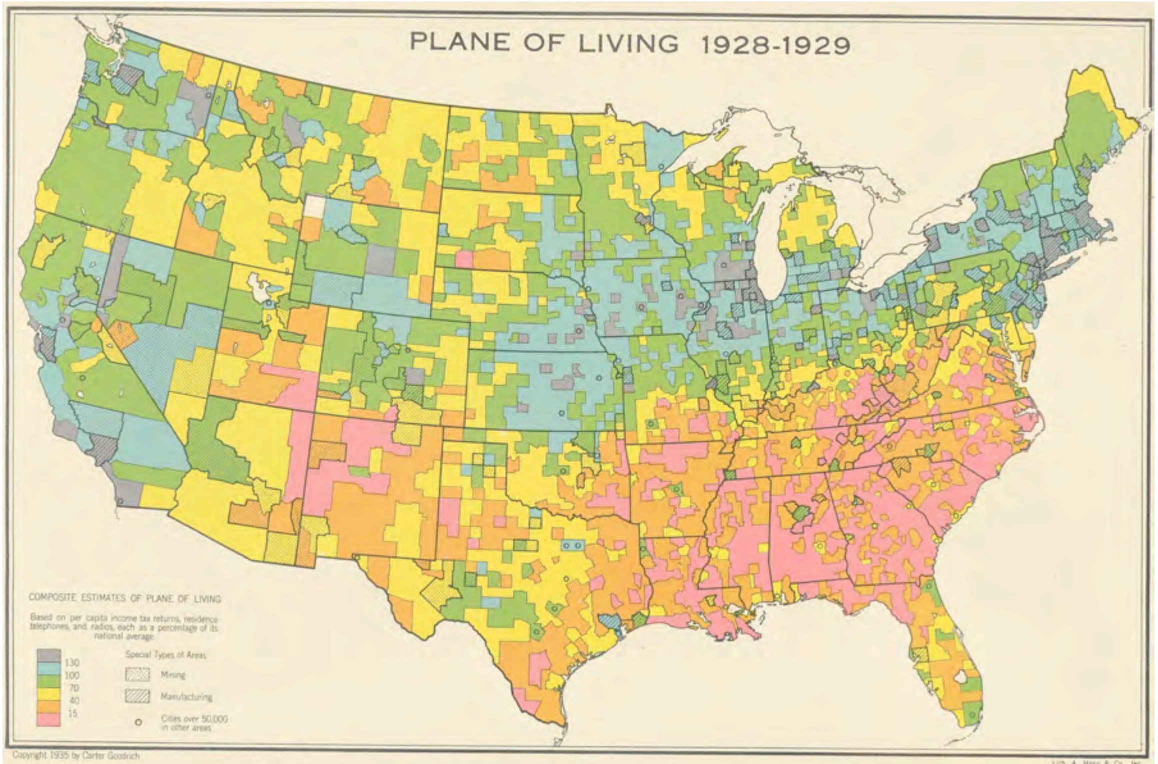


Figure 1. The Plane of Living (Goodrich et al 1936)

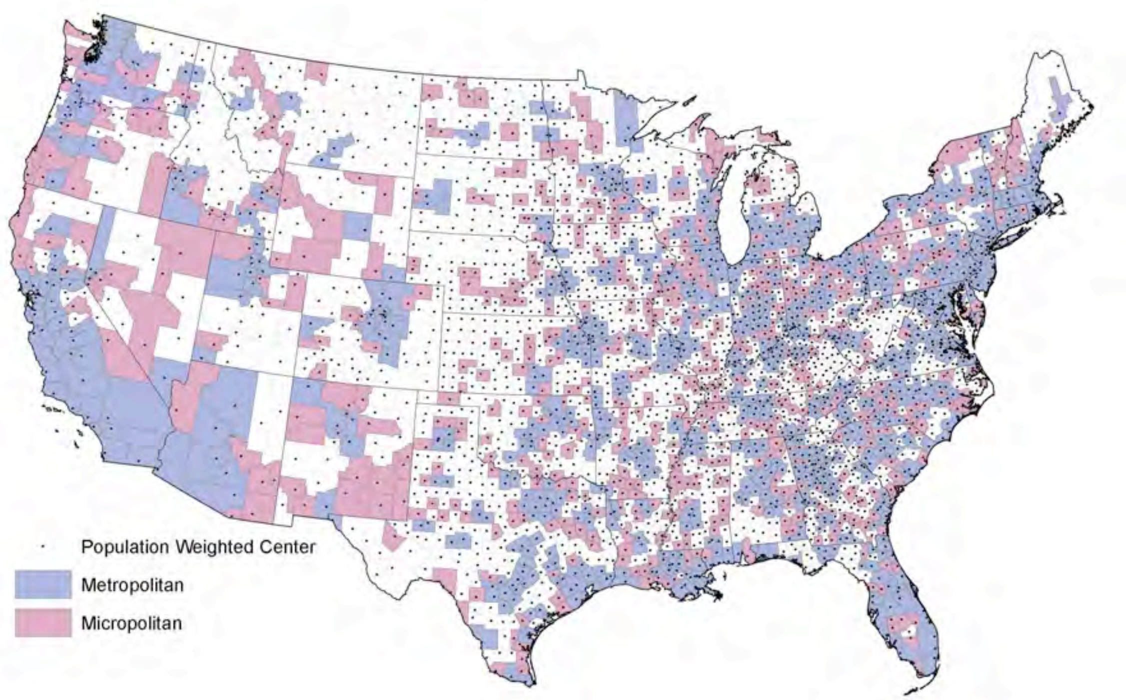
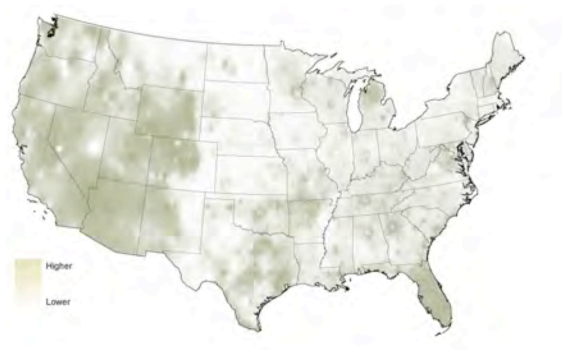
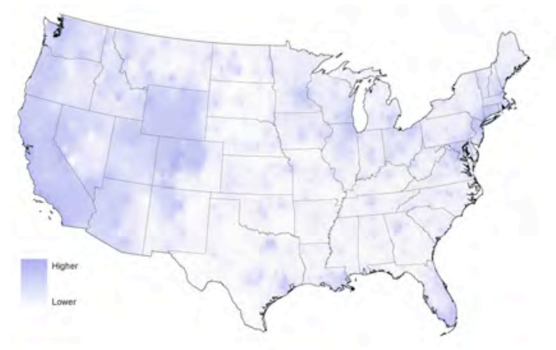


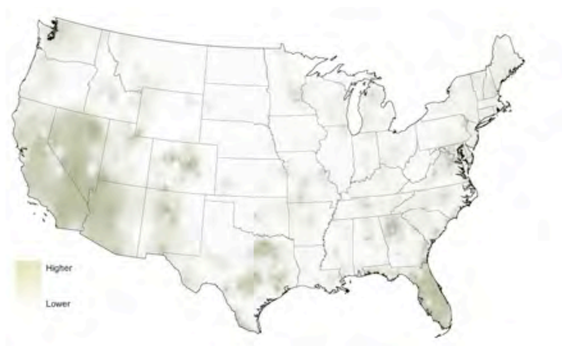
Figure 2. The American Constellation of Population Centers and Core Based Statistical Areas (CBSAs)



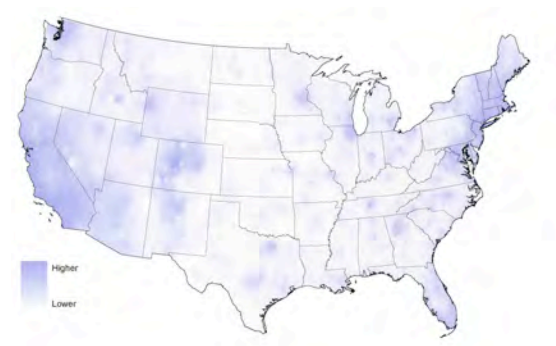
(3a)



(4a)



(3b)



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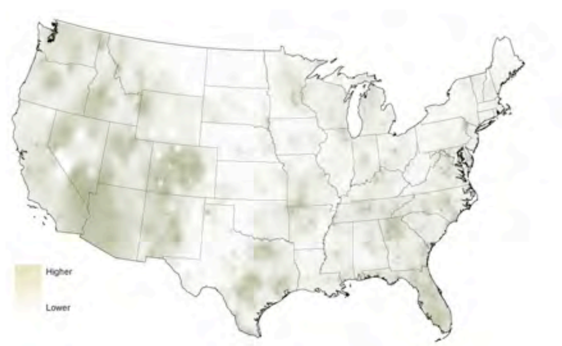

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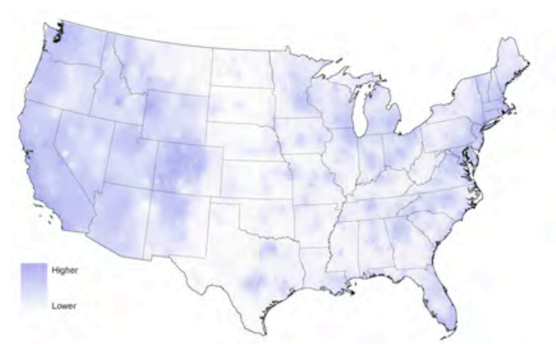
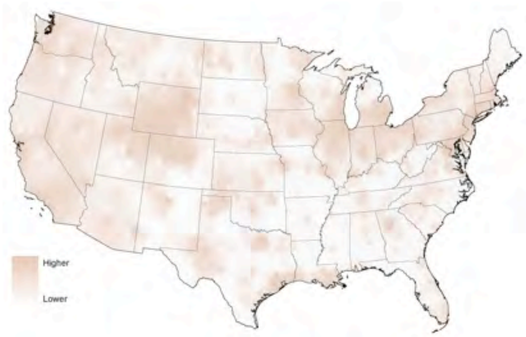


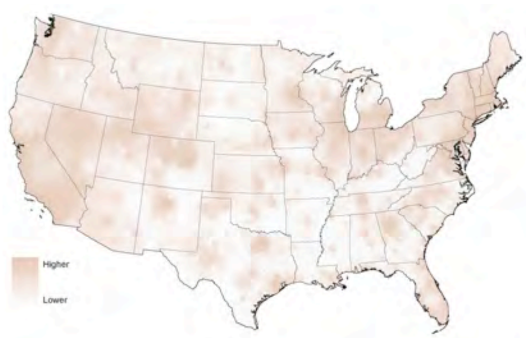
(4c)

Figure 3. Rate of Population Change in (3a) 1980, (3b) 1990, and (3c) 2000

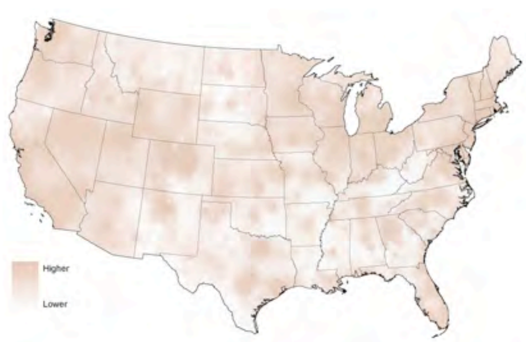
Figure 4. Median Housing Value ($ 2010) in (4a) 1980, (4b) 1990, and (4c) 2000



(5a)

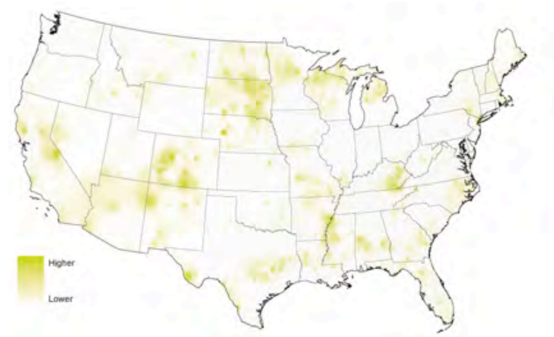


(5b)

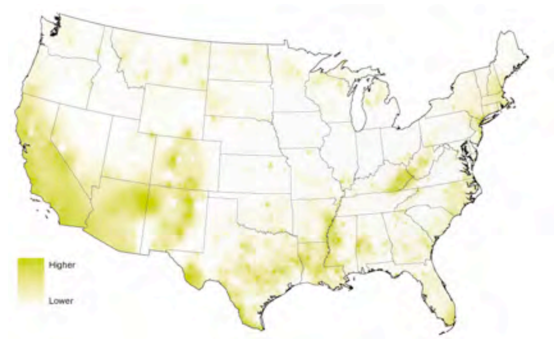


(5c)

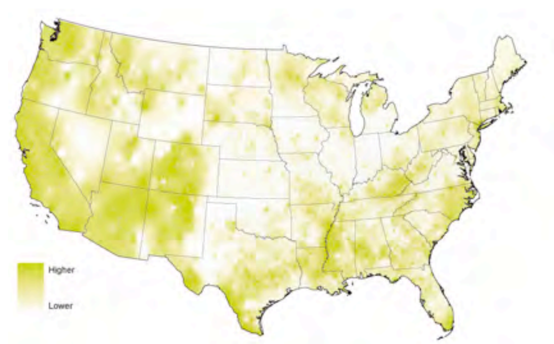
Figure 5. Median Household Income ($ 2010) in (5a) 1980, (5b) 1990, and (5c) 2000



(6a)



(6b)



(6c)

Figure 6. Mortgage Payment as a Percentage of Monthly Income in (6a) 1980, (6b) 1990, and (6c) 2000

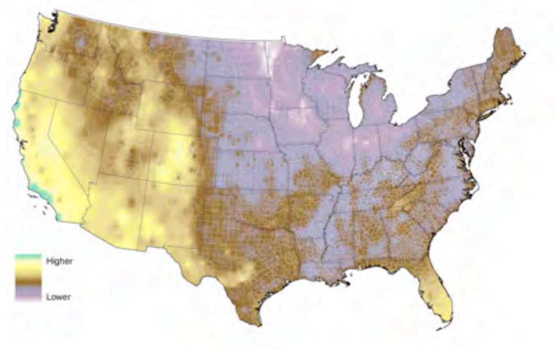
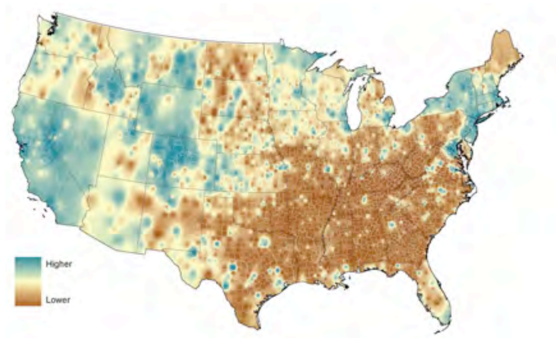
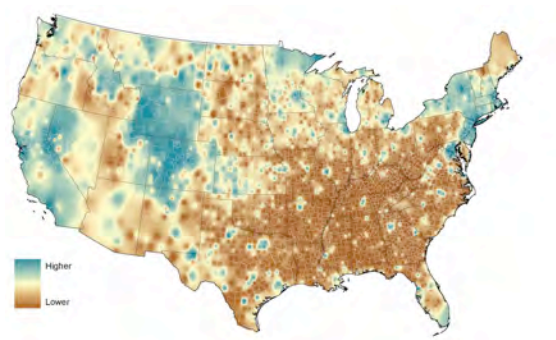


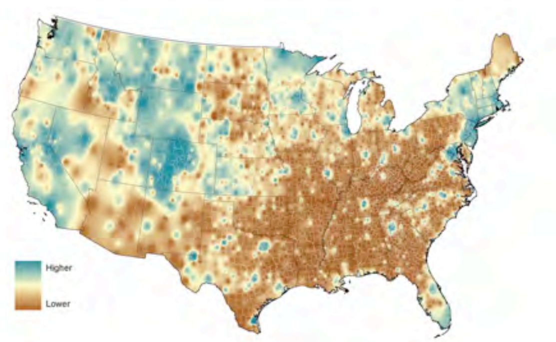
Figure 7. Value of Natural Amenity Index



(8a)

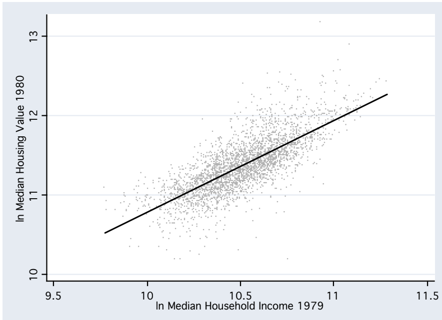


(8b)

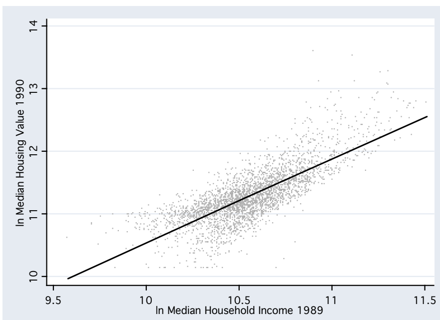


(8c)

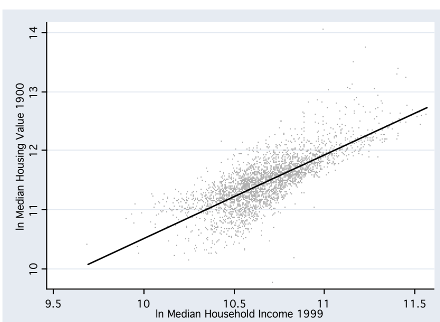
Figure 8. Value of Human Amenity Index in (8a) 1980, (8b) 1990, and (8c) 2000



(9a)

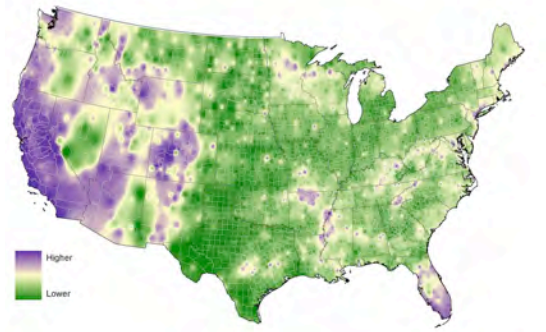


(9b)

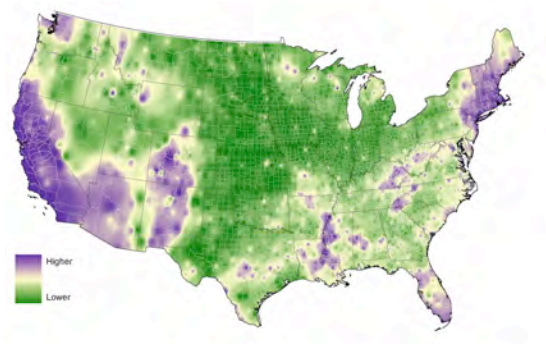


(9c)

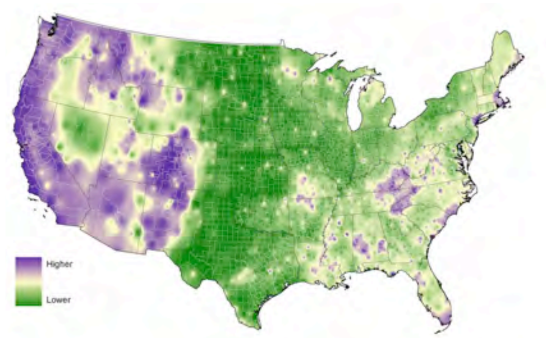
Figure 9. Natural Log of Median Household Income Versus Natural Log of Median Housing Value in (9a) 1980, (9b) 1990, and (9c) 2000



(10a)

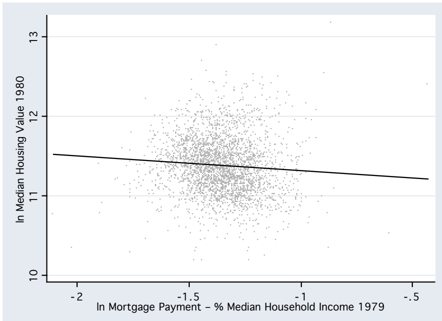


(10b)

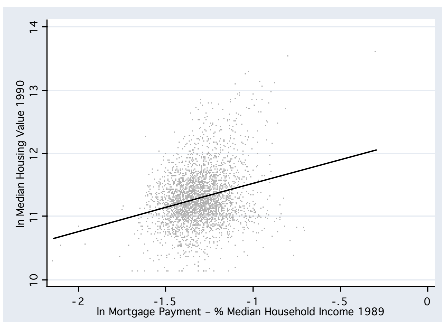


(10c)

Figure 10. Plane of Living Estimated from Median Household Income (10a) 1980, (10b) 1990, and (10c) 2000



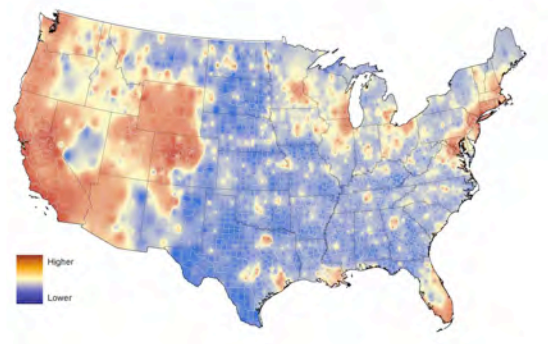
(11a)



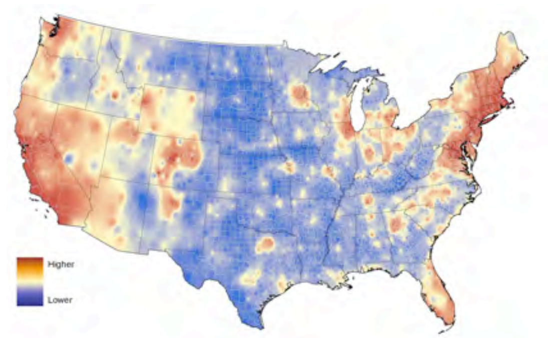
(11b)

(11c)

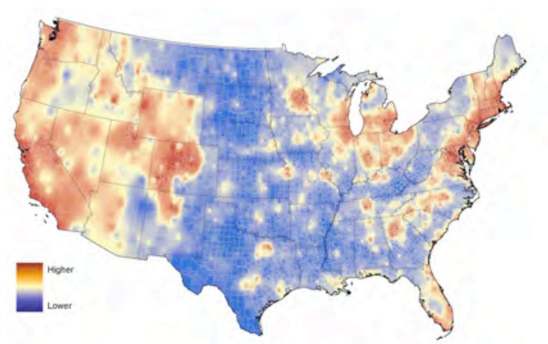
Figure 11. Natural Log of Monthly Mortgage Payment as a Percentage of Household Income Versus Natural Log of Median Housing Value in (11a) 1980, (11b) 1990, and (11c) 2000



(12a)



(12b)



(12c)

Figure 12. Plane of Living Estimated from Monthly Mortgage Payment (12a) 1980, (12b) 1990, and (12c) 2000