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The plane of living and the precrisis evolution of housing values in the USA

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Abstract

This article explores the relationship between quality-of-life differentials and housing values in the decades leading up to the recent financial crisis in the USA. 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. Some general observations for public policy follow from these findings.

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JEL classifications: C21, Q51, Q56, R21, R23
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'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 USA. At the time, the nation was in the grip of the Great Depression and policymakers had a pressing need to understand how the distribution of the population had evolved to that point—and, going forward, how to influence migration flows in a way that enhanced economic opportunity and personal well-being (Goodrich and School, 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

All figures are reproduced in color online.

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.

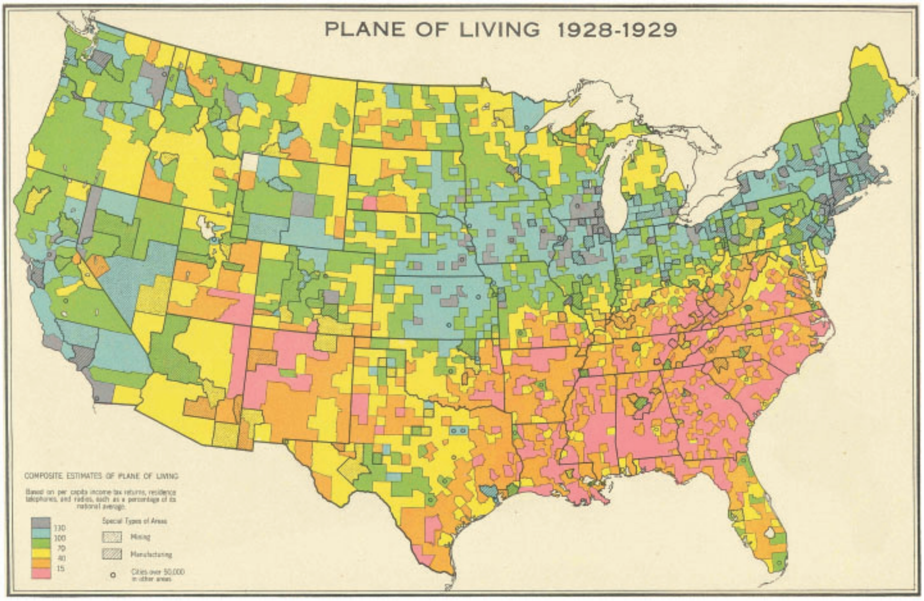

Figure 1. The plane of living (Goodrich and School, 1936).

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 socio-economic processes and outcomes.

Today, the USA continues to endure 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 extended nationwide but was unevenly inflated (see also: Gyourko and Sinai, 2003; Glaeser and Gyourko, 2008; Glaeser et al., 2008; Martin, 2011) due, in large part, to 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 national topography of

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

housing values mirrors that of the plane of living. Although this relationship is widely known, the broader, systematic patterns that emerge from it have not been fully characterized.

This article does so by examining the nation's contemporary plane of living and using it to explore how housing values evolved to their precrisis levels through time and across geographic 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 simple 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 a set of general, forward-looking observations. The analysis, which covers the entire continental USA, provides a panoramic look at the housing value landscape in 1980, 1990 and 2000. Like Goodrich et al. (1935, 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, on a conceptual level, with suggesting ways of interpreting that information in a forward-looking way. But, '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, that acceleration has come to pass: 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 reason to expect that the resulting topography of housing values has shifted as well. Moreover, any nationwide recovery 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 seems important to know more about how those differences came to be.

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

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.

Table 1. Median value of owner-occupied homes ($2010) by state in 1980 and 2005

	1980		2005		Difference			1980		2005		Difference	
	Median value (in US$)	Percent of US median (%)	Median value (in US$)	Percent of US median (%)	Value (in US$)	Percent (%)		Median value (in US$)	Percent of US median (%)	Median value (in US$)	Percent of US median (%)	Value (in US$)	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	7616	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	1224	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	−8976	−4.66

Source: US Census Bureau.

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 2 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, $9000 and $8000 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 also 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 comes from the hedonic price methodology originated 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, 2011). 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 simultaneously capitalize quality-of-life differentials.[7] In these studies, desirable (undesirable) living 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 both the labor and housing

6 See Bartik and Smith (1987), Gyourko et al. (1999) and/or Mulligan et al. (2004) for an in-depth review 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, e.g. Chay and Greenstone, 2005; Welch et al., 2007; Greenstone and 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.

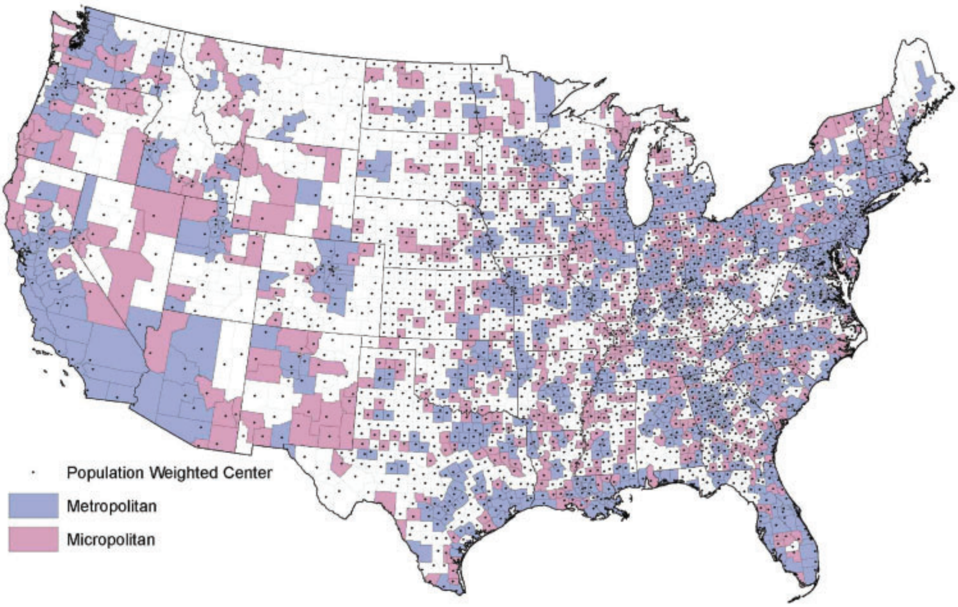

Figure 2. The American Constellation of Population Centers and Core-Based Statistical Areas (CBSAs).

markets, driving wages down and housing values up (see DiPasquale and Wheaton, 1996 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 both 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 the broader, systematic patterns that emerge.

2.2. Stylized facts

The continental USA is made up of 3103 county equivalents, including all counties and independent cities—of these: 1082 containing ~83% of the population, belong to metropolitan areas; 687 containing ~10% of the population, belong to micropolitan areas and 1244 containing ~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 nonCBSA (white) counties with population-weighted center-points marking each county's center of gravity.[9] These points were used to generate all of the remaining maps in this article, 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

9 The population-weighted center-points were calculated in *ArcGIS* via the 'mean center' (see, e.g. Barber, 1988) tool using census tract level data from 1990.

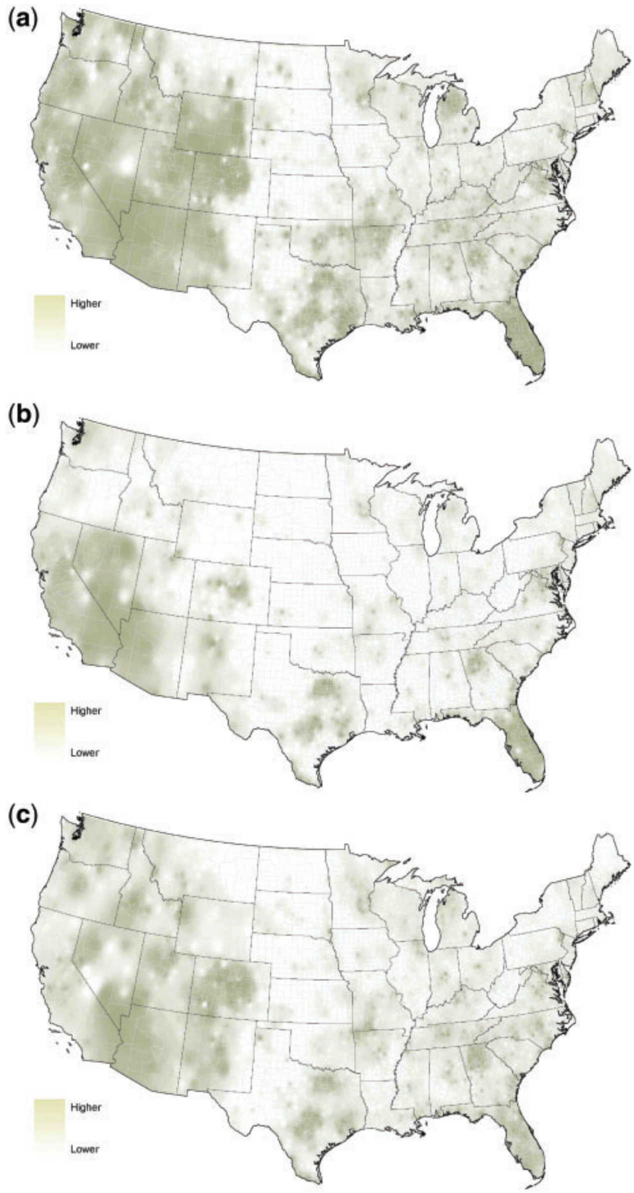

Figure 3. Rate of population change in (a) 1980, (b) 1990 and (c) 2000.

the 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

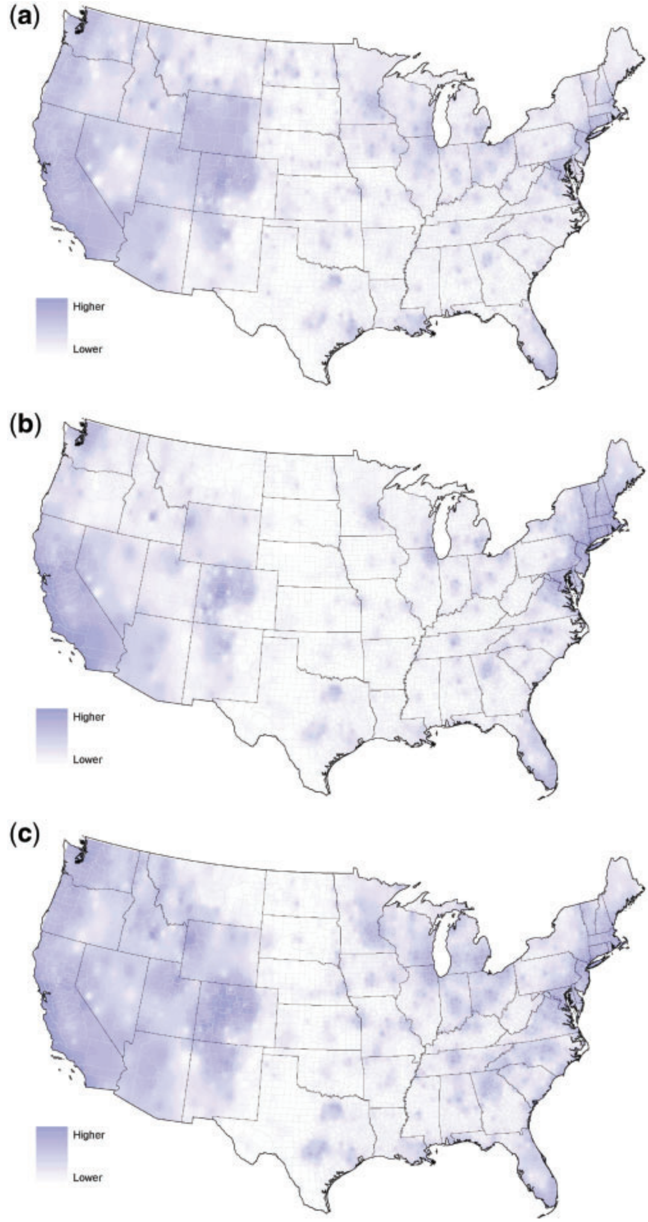

Figure 4. Median housing value ($ 2010) in (a) 1980, (b) 1990 and (c) 2000.

population change across the continental USA for (Figure 3a) 1970–1980, (Figure 3b) 1980–1990 and (Figure 3c) 1990–2000; Figure 4 displays trend surfaces of median housing value (in 2010 dollars) in (Figure 4a) 1980, (Figure 4b) 1990 and (Figure 4c) 2000; Figure 5 displays trend surfaces of median household income (again in 2010 dollars) in (Figure 5a) 1979, (Figure 5b) 1989 and (Figure 5c) 1999; and Figure 6

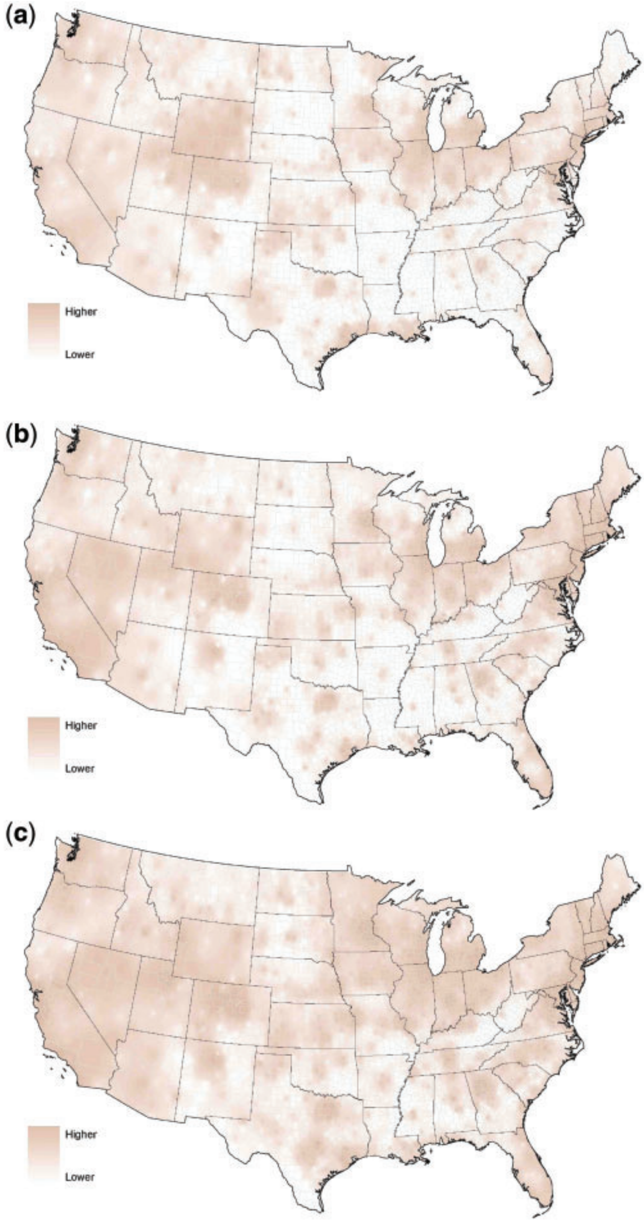

Figure 5. Median household income ($ 2010) in (a) 1980, (b) 1990 and (c) 2000.

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 (Figure 6a) 1980, (Figure 6b) 1990 and (Figure 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

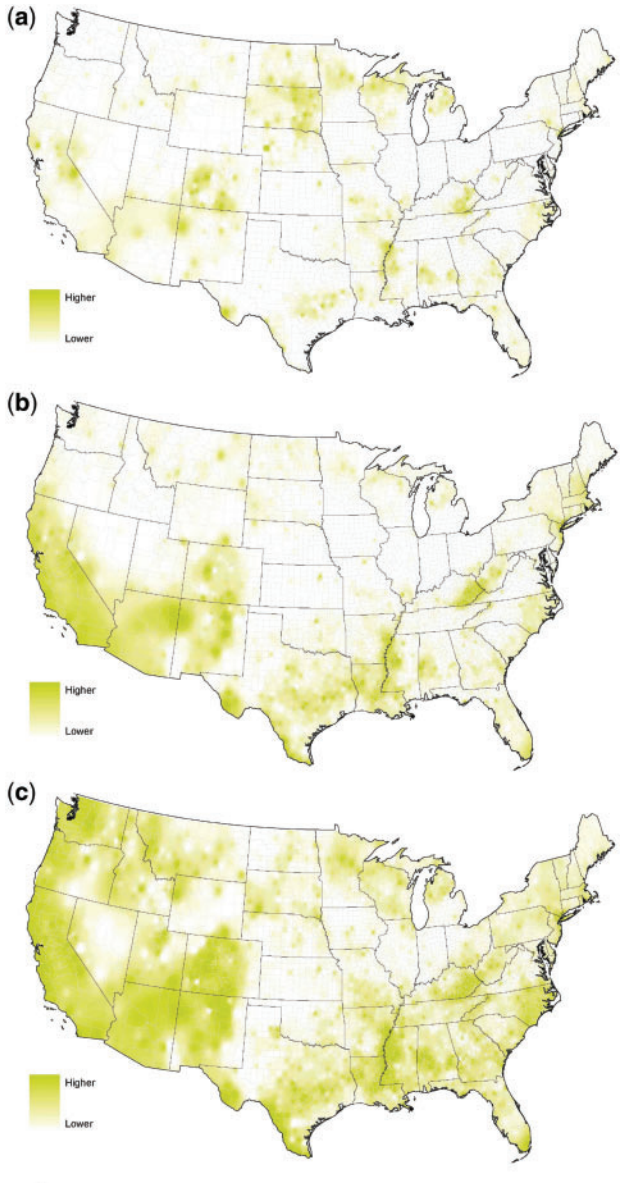

Figure 6. Mortgage payment as a percentage of monthly income in (a) 1980, (b) 1990 and (c) 2000.

relative to housing-related debt.[10] 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 article are listed in Table 2.

10 Thanks to an anonymous referee for recommending that housing related debt be explored as a part of this analysis.

Table 2. Descriptive statistics

	Minimum	Median	Maximum	Mean	St. Dev.	Source
1980						
Construction cost index	0.40	1.40	5.17	1.42	0.33	REIS
Percentage college degree	1.60	10.00	47.80	11.43	5.46	CBP
Entertainment establishments per 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	8817.53	Census
Median housing value	26,597.34	86,184.00	532,002.66	93,185.55	37,596.36	Census
Percentage 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 per capita	134.61	1872.60	10,764.06	2012.63	809.16	COG
1990						
Construction cost index	0.25	1.24	3.31	1.26	0.30	REIS
Percentage college degree	3.70	11.70	53.40	13.47	6.60	CBP
Entertainment establishments per 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
Percentage 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 per capita	205.33	2161.40	16,899.27	2364.96	1040.45	COG
2000						
Construction cost index	0.15	1.12	3.91	1.15	0.33	REIS
Percentage college degree	0.00	9.92	40.02	10.95	4.95	CBP
Entertainment establishments per 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
Percentage 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 per capita	24.93	2861.62	22,041.87	3135.66	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

Note: all dollar values are in 2010 dollars; calculated means calculated by the authors; estimated means estimated via Equation (2) or Equation (3).

CBP, County Business Patterns; Census, the decennial census; COG, Census of Governments; ERS, Economic Research Service report, McGranahan (1999); REIS, Bureau of Economic Analysis' Regional Economic Information System.

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—that is, 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: values rose significantly nationwide.[11] Across the USA 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 essentially locked in on a course toward the bubble and subsequent financial collapse.[12] 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, for example, 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[13]—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 national housing market.) 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 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 10 years ago, McGranahan (1999) constructed a natural amenities index covering all counties in the continental USA.[14] The index is based on six separate subindices: (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 subindices 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 left-most column of Table 3, which

11 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).

12 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.

13 See various analyses from the Government Accountability Office: http://www.gao.gov/new.items/d06630.pdf.

14 The natural amenities scale and underlying data are available online from the USDA's Economic Research Service at: http://www.ers.usda.gov/Data/NaturalAmenities/.

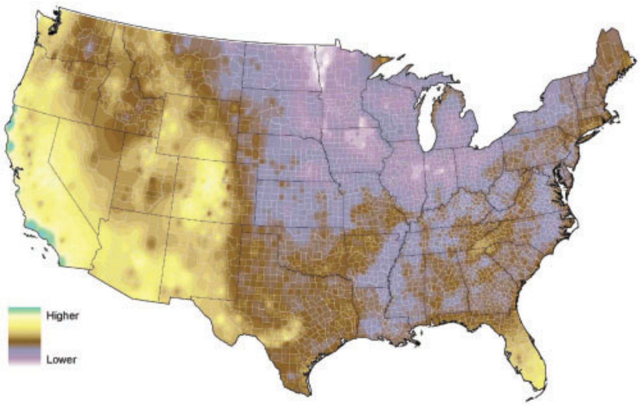

Figure 7. Value of natural amenity index.

Table 3. Natural amenity index and human amenity index–top 10 and bottom 10 counties

	Natural amenity index	Human amenity index		
		1980	1990	2000
Top 10 counties				
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				
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

lists the top 10 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, e.g. Carruthers and Vias, 2005).

Whereas the natural amenities index distinguishes areas of the country according to their environmental appeal, a corresponding human amenities index is needed to identify the socio-economic dimensions of the plane of living. The index—which was constructed by the authors for the purposes of this analysis—is composed of four subindices: (i) the percent of the population aged ≥18 years 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 subindices and adding them up. Figure 8 displays the resulting values in (Figure 8a) 1980, (Figure 8b) 1990 and (Figure 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-created 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 subindices 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 subindices; for further information on socio-economic 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 well-being more broadly (Putnam, 2000). 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 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., 2011) 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; Brakman et al., 2009) suggests that the kind of variety (above-and-beyond entertainment opportunities) found in dense urban agglomerations

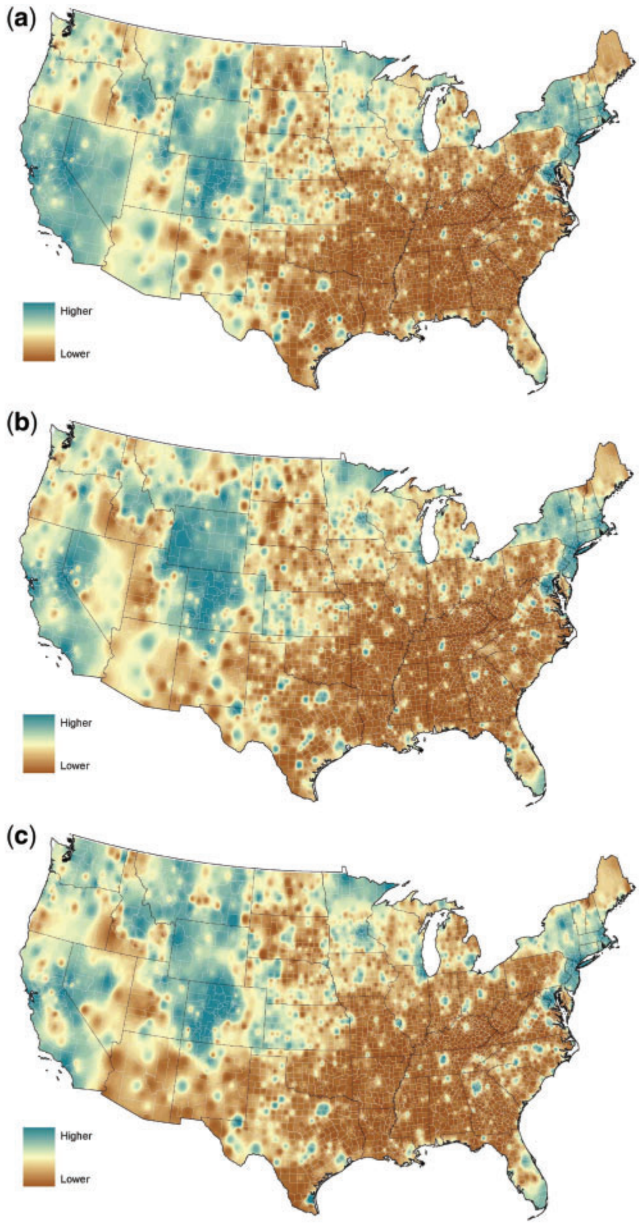

Figure 8. Value of human amenity index in (a) 1980, (b) 1990 and (c) 2000.

has advantages for production and consumption alike.[15] For present purposes, the idea is the same: counties that are denser in population are more productive and provide their residents with a wider array of high-quality goods and services.

15 Recent theoretical evidence suggests that natural amenities may also contribute in a similar way (Wang and Wu, 2011).

Table 4. Correlation matrix of subindices making up the human amenity index

	Percentage population w/ college degree	Total direct spending per capita	Entertainment establishments per capita	Territorial density
1980				
Percentage Population w/ College Degree	1.00	—	—	—
Total direct spending per capita	0.28	1.00	—	—
entertainment establishments per capita	0.28	0.38	1.00	—
territorial density	0.23	0.19	0.03	1.00
1990				
Percentage Population w/ college degree	1.00	—	—	—
Total direct spending per capita	0.24	1.00	—	—
Entertainment establishments per capita	0.33	0.40	1.00	—
Territorial density	0.29	0.13	0.05	1.00
2000				
Percentage population w/ college degree	1.00	—	—	—
Total direct spending per capita	0.25	1.00	—	—
Entertainment establishments per capita	0.42	0.36	1.00	—
Territorial density	0.25	0.15	0.06	1.00

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 USA. Compared with Goodrich and School (1936) and Goodrich et al.'s (1935) 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, 204) called 'problem areas' even today. Then again, there are some key 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.

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):

$$\mathrm{mhv}_i^* = \alpha_1 + \alpha_2\,\mathrm{mhi}_i^* + \varepsilon_i. \tag{2}$$

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 percentage change in median housing value induced by a percentage 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:

$$\mathrm{mhv}_i^* = \beta_1 + \beta_2\,\mathrm{mmp}_i^* + \upsilon_i. \tag{3}$$

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 as; and v_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 (OLSs) estimates of these two simple baseline models are listed, respectively, in the left- and right-hand panels of Table 5.[16] The fitted regression lines themselves, along with their corresponding data points, are shown in Figure 9 and Figure 10, scatter plots of the two income variables (on the x-axis) versus housing value (on the y-axis) in (Figures 9a and 10a) 1980, (Figures 9b and 10b) 1990 and

16 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 3 years of estimation is compared with the sum of squared residuals from a model containing all 3 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 3 years.

Table 5. OLS estimates of baseline income capitalization models

	ln median household income						ln monthly mortgage payment					
	1980		1990		2000		1980		1990		2000	
	Estimated parameter	*t*-value	Estimated parameter	*t*-value	Estimated parameter	*t*-value	Estimated parameter	*t*-value	Estimated parameter	*t*-value	Estimated 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 percentage monthly income	—	—	—	—	—	—	−0.1843***	−3.34	0.7538***	12.04	0.8165***	11.35
n		3103		3103		3103		3103		3103		3103
Adjusted R^2		0.57		0.60		0.58		0.01		0.06		0.07

$^{***}P<0.01$; $^{**}P<0.05$; n/s, not significant.
Note: All models were estimated using White-adjusted standard errors clustered by state; all hypothesis tests are two-tailed.

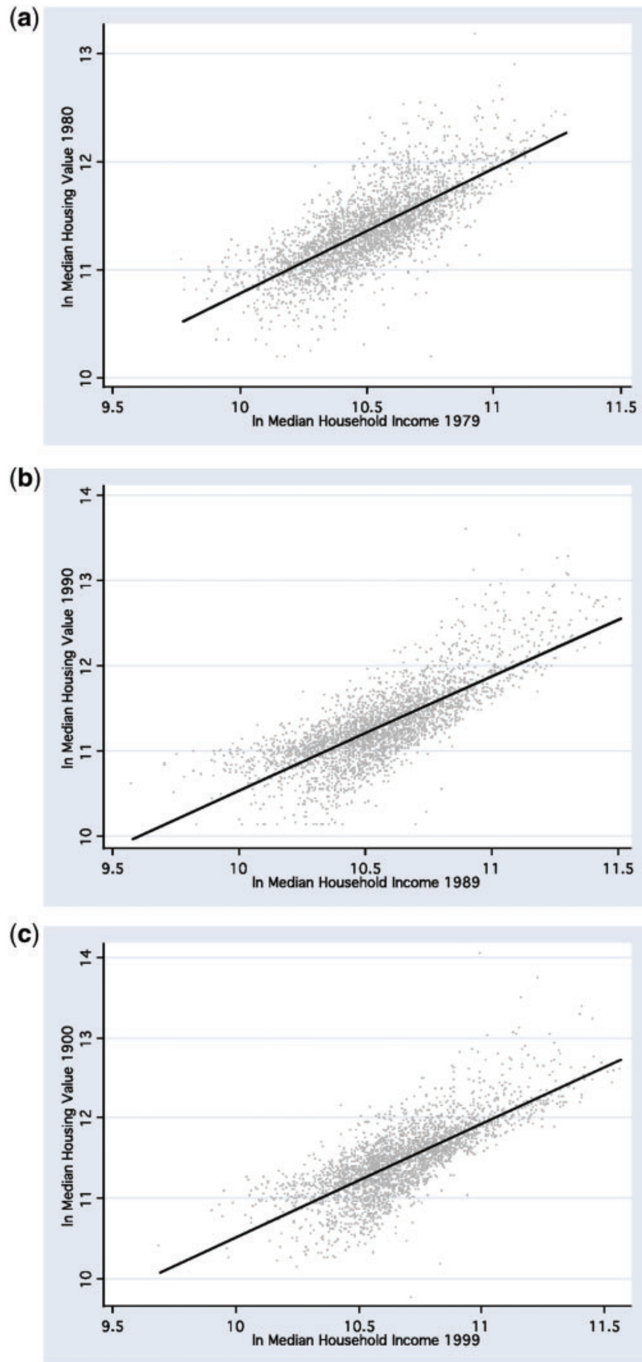

Figure 9. Natural log of median household income versus natural log of median housing value in (a) 1980, (b) 1990 and (c) 2000.

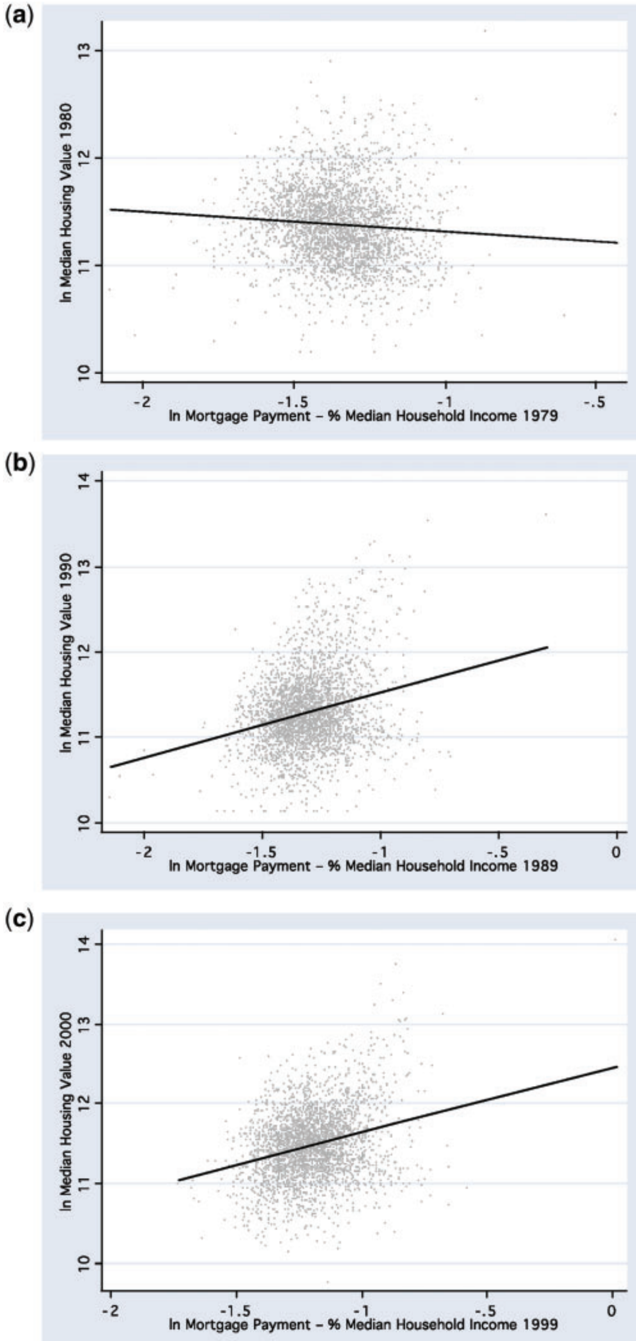

Figure 10. Natural log of monthly mortgage payment as a percentage of household income versus natural log of median housing value in (a) 1980, (b) 1990 and (c) 2000.

(Figures 9c and 10c) 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^2's average $\sim$0.58 for the former, compared with $\sim$0.04 for the latter.

A useful feature of these models—and, indeed, the whole point of estimating them in bivariate form in 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 Figures 11 and 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 1980, 0.46 in 1990 and 0.48 in 2000. Note how the trend surfaces shift through time. In Figure 11, 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 Beale, 1996)—before picking up again in the final panel.[17] 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.

17 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.

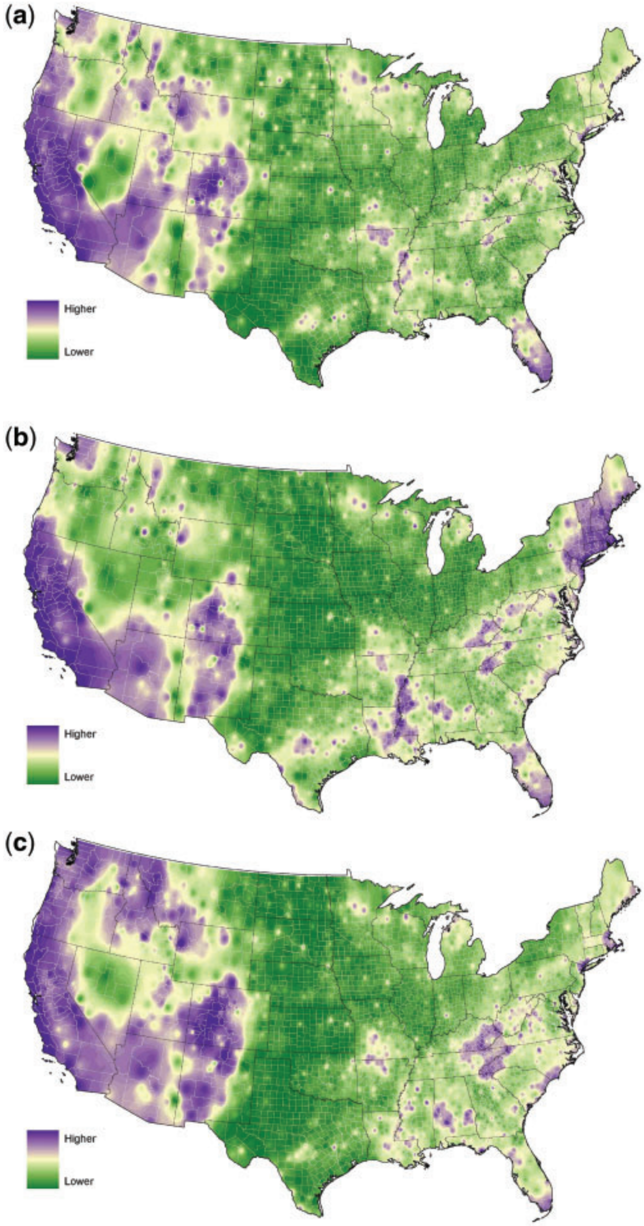

Figure 11. Plane of living estimated from median household income in (a) 1980, (b) 1990 and (c) 2000.

The 10 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

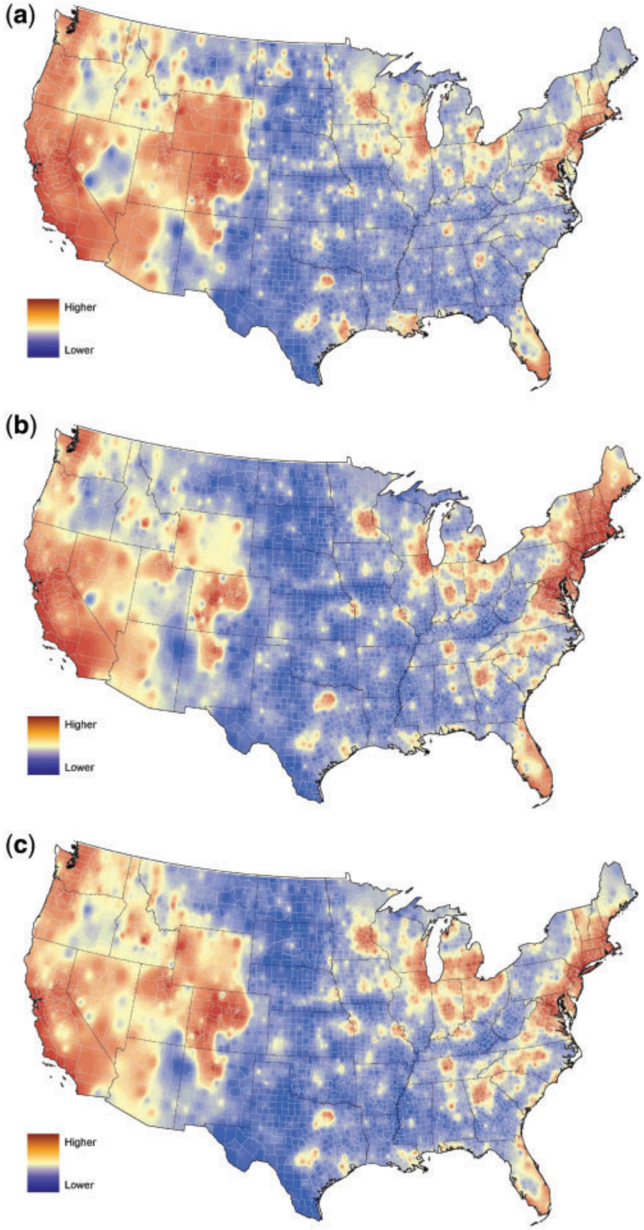

Figure 12. Plane of living estimated from monthly mortgage payment in (a) 1980, (b) 1990 and (c) 2000.

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 with Figures 6 and 7, which illustrate the amenity-related quality-of-life differentials of the plane of living, Figures 11 and 12 represent its value-related differentials—that is, the former are

Table 6. Error terms from baseline income capitalization models—top 10 and bottom 10 counties

	Median household income			Monthly mortgage payment		
	1980	1990	2000	1980	1990	2000
Top 10 counties						
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						
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

analogs of the amenities themselves and the latter are analogs 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 socio-economic landscape. As such, the surfaces they display are tightly interwoven: the amenity- and disamenity-related values shown in Figures 11 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 the representations in a way that sheds light on how housing values evolved to their precrisis levels, through time and across space.

3.2. Economic 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:

$$\mathrm{mhv}_i^* = \rho \cdot W_{ij}\,\mathrm{mhv}_j^* + \Phi_s + X_i^* \cdot \Gamma + \omega_i. \tag{4}$$

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 3103×3103 ($n \times n$) row-standardized spatial weights matrix that describes the connectivity of the data set. The weights matrix were 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).[18] In the first stage of the S2SLS algorithm, the spatially lagged dependent variable, $W_{ij} \cdot mhv_j^*$, is regressed on X_i and $W_{ij}\ X_i$—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 $W_{ij}\ X_i$, 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.[19] 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 1, 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[20]—when many homeowners' mortgage payments were skewed heavily toward interest rather than principal; 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. 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.[21] 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

18 See Anselin, 2009 for a plainspoken overview of the procedure and its alternatives.

19 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.

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

21 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*.

Table 7. S2SLS estimates of amenity models

	ln median household income						ln monthly mortgage payment					
	1980		1990		2000		1980		1990		2000	
	Estimated parameter	*t*-value	Estimated parameter	*t*-value	Estimated parameter	*t*-value	Estimated parameter	*t*-value	Estimated parameter	*t*-value	Estimated 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 percentage 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	3103		3103		3103		3103		3103		3103	
Adjusted R^2	0.81		0.88		0.86		0.74		0.83		0.80	

***$P<0.01$; **$P<0.05$; n/s, not significant.

Note: 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.

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[22]—this time, by adding spatial lags of the two amenity indices into the mix:

$$\mathrm{mhv}_i^* = \rho \cdot W_{ij} \cdot \mathrm{mhv}_j^* + \Phi_s + X_i^* \cdot \Gamma + W_{ij} \cdot Z_i^* \cdot \Lambda + \psi_i. \tag{5}$$

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 $W_ijZ_i^*$ 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 in exactly the 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.[23]

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 lag, which carries a parameter that is larger or, in 2000, as large, as its nonlagged 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

22 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 implications.

23 Special thanks to Ingmar Prucha for his guidance on this.

Table 8. S2SLS Estimates of Spatial Expansion Amenity Models

	ln median household income						ln monthly mortgage payment					
	1980 Estimated parameter	*t*-value	1990 Estimated parameter	*t*-value	2000 Estimated parameter	*t*-value	1980 Estimated parameter	*t*-value	1990 Estimated parameter	*t*-value	2000 Estimated 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 percentage 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		3103		3,103		3103		3103		3103		3103
Adjusted R^2		0.80		0.87		0.86		0.74		0.83		0.80

***$P<0.01$; **$P<0.05$; n/s, not significant.

Note: 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.

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: as outlined below, they suggest that public policy aimed at enhancing the plane of living may also bolster housing values and, in turn, household wealth.

4. Summary and conclusion

This article set out to characterize the broad, systematic patterns that have emerged from the relationship between quality-of-life differentials and housing values in the decades leading up to the recent financial crisis. As a whole, the evidence suggests that the plane of living played an important part in the ratcheting up of housing values evidenced in Figure 3—an interpretation consistent with other evidence that quality-of-life increased substantially in value during the latter half of the 20th century (Costa and Kahn, 2003; Kahn, 2006). Having met the overarching objective, the closing comments outline some general conclusions and refocus on the challenge that the USA continues to face.

A general suggestion is that, to every extent possible, public policy should focus on both preserving natural amenities and generating human amenities—especially human capital (Partridge and Rickman, 2006; Glaeser, 2011). Natural amenities were consistently observed to play a greater-and-greater role in the two sets of income capitalization models from 1980 to 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 (Power, 1996; Power and Barrett, 2001; Clark et al., 2003; McGranahan, 2008; Whisler et al., 2008; McGranahan et al., 2011). 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), Glaeser (2005) McGranahan and Wojan (2007), Rupasingha et al. (2006), Rupasingha and Goetz (2007), 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 nation seems to be heading in the wrong direction—even if that austerity has been forced, in part, by the financial crises and its impact on tax rolls.

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: >30% single-year declines in Phoenix, Las Vegas and San Francisco; and >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. [25] 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 downside of the plane of living and will present special challenges—even once the long-gathering storm finally lets up.

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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*.

25 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 they are quite literally stuck in place.

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