A Great House? Realtors and Hedonic Analysis

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Introduction

It is time we consolidate the differences between professional understanding and academic understanding of real estate value. Increasing precision in the methods utilized to measure willingness-to-pay for non-market amenities or externalities, specifically the hedonic pricing method in the case of this paper, present the opportunity to understand the value of and capitalize on amenities in a holistic manner. Although it is commonly understood by real estate professionals and consumers alike that a beautiful neighborhood commands a premium on property values, with a regression analysis we may quantify many of the characteristics that make up these premiums (or unfavorable characteristics that undermine value) and estimate the impact of qualitative changes to them. Since Rosen's (1974) conceptual framework for hedonic regression analysis, studies have used and improved the model in order to measure select characteristics of interest. From the wealth of research using this method, we have arrived at a point where it is possible to not only estimate changes in welfare caused by alterations of individual characteristics or amenities, but gain a greater understanding of the market through a more complete profile of the determinants of value.

The implications of hedonic analysis are especially relevant to decision-makers interested in amenity-based development. Beyond the structural characteristics of a property, such as number of bathrooms and condition of roofing, this paper will illuminate the leverage amenities have over value. Communities rich in natural amenities, such as scenic views and proximity to outdoor recreation, will experience economic prosperity through immigration of educated entrepreneurs and increased tourism (Lorah, Southwick, 2010; McGranahan, 1999). On a more manageable scale, high-quality open spaces or greenways can significantly elevate the value of nearby properties (Crompton et al., 2004). Further, Crompton (2001) found that even narrow greenways, with little recreation value, can benefit a community and raise property values.

This paper compares value of neighborhood amenities from the accumulated academic understanding using hedonic regression analysis to the colloquial and professional understanding shared by realtors. A sample of 287 property sales in Ashland, Oregon, over the last several years is used to create the hedonic pricing analysis. The results of this analysis are compared with the expectations of realtors who were involved in the sale of the same properties. Results from the realtor survey suggest that there is little consensus between realtors about what constitutes desirable amenities. Although realtors overwhelmingly agree that quality of a property's nearby neighborhood and amenities are "very important" factors in a property's price, ratings of individual amenities aggregate to noise. The most influential amenities, according to our regression, include proximity to parks and quality of a property's outward appearance. These results suggest that many other characteristics and amenities have a negligible effect on sale price.

Literature Review

Rosen's original model for product differentiation based on characteristics, and a few early applications thereof, did not consider neighborhood amenities in its price function. Although his initial hypothesis seems to be correct, the functional form suggested had to evolve in order to become accurate. This task was taken up by Li and Brown (1980), who were the first to consider the effects of neighborhood amenities on hedonic housing prices. The definition of neighborhood amenities according to Li and Brown included "aesthetic attributes, pollution levels and proximity [to conveniences]" (pp. 125). The study found that excluding

neighborhood amenities from an analysis resulted in misleading coefficients and significance levels of many characteristics. Later studies would confirm this and continue to expand the scope of characteristics included in regressions.

Boyle and Kiel (2001) provide an insightful review of the previous 27 years of hedonic research. They note that few studies have considered more than one variable of interest as of yet. Their review includes the popular subjects of hedonic analysis: air quality, noise and disamenities, water quality, and neighborhood variables. Further, hedonic studies consistently indicate that, despite increasing complexity, including more characteristics in the model will reduce omitted variable bias. The review also concludes that multiple environmental, structural, and neighborhood characteristics are necessary to produce accurate estimates of relevant coefficients.

Despite overwhelming support for the inclusion of neighborhood variables, their effect on the coefficients of structural characteristics was uncertain. Boyle and Taylor (2001) conducted a hedonic analysis to understand the integrity of structural characteristics from multiple data sources and when possibly inaccurate environmental data is considered in the model. Similar concerns are raised by Shultz and King (2001). Most studies, as Boyle and Taylor explain, assume the structural variables and their estimated coefficients to be accurate and test only for consistency and validity of environmental or neighborhood variables. Their conclusion looked favorably upon tax assessor's data, the primary source of information in the case of this paper, as a reliable source for structural characteristics (especially compared to the Census). It also found that including environmental variables are not inherently a threat to the estimated coefficients of structural characteristics.

The most comprehensive and au courant review of hedonic methods was published recently by Kuminoff, Parmeter, and Pope (2010). This invaluable resource reviews progress of hedonic research, including concerns about the inaccuracy of results and misspecification of variables. Unlike the research discussed previously, it is not a literature review. The study utilizes a Monte Carlo evaluation to identify the most reliable methods for hedonic pricing analyses. Because it is nearly impossible to control for all characteristics affecting the dependent variable, research on omitted variable management is necessary. Results indicated that a flexible Box-Cox linear form is most efficient at reducing bias from omitted variables. Their results also support the current understanding that adding spatial variables similarly reduces bias, and temporal variables is necessary for most studies to avoid misspecification. Without accounting for the influences of time and location, hedonic regression analyses misappropriate their impact upon other variables in the study.

In summary, there is sufficient research to begin considering a standardized model for policy and professional applications. Studies have been homogeneous enough to take away a few expectations about the determinants of value for real estate properties. High quality open spaces and greenways, as mentioned before, tend to have a positive impact on property values that diminishes with distance (Nicholls and Crompton, 2005). To elaborate, the value of proximity to reprieve from the urban sprawl is reflected in property prices. However, it may be better explained that we value diversity in our surrounds, as rural residential properties carry no premium from the amenities' abundant forests, yet significant premiums are found for proximity to lakes (White and Leefers, 2007). Disamenities like nearness to airports and exposure to noise have almost universally been found to undermine value (Navrud, 2003); Li and Brown estimated a $460 decrease in value for every 10 decibel increase in noise.

However, hedonic analyses rarely consider how characteristics vary in quality; instead simply measuring variance in quantity. For instance, the effect of a home's view has been considered since Rosen's original model, yet very few have considered a scale of quality for this variable, relying on view-sheds or dummy variables to represent general states of a view. Scenic views are of particular interest in this paper and are included in the regression for comparison with the expectations of real estate professionals. Bourassa, Hoesli and Sun (2003) review the progress of understanding aesthetic values via the hedonic method, concluding their impact is very significant, albeit fickle and multidimensional. This paper expands on the impact of varying quality on value.

Finally, there is some precedence for comparing the results of hedonic analyses (and other valuation methods) to professional opinion. Willis and Garrod (1993) asked real estate professionals to estimate the value of identical houses at different locations. Interestingly, professionals within the same town shared greatly varying opinions. Results suggest that the professionals may have overestimated amenity premiums, although this is unfortunately subject to suspicion because of methodological deficiencies. As the researchers noted, the study's locational variables lacked precision (p. 211). Rodriguez and Sirmans (1994) compared their hedonic analysis of the value of residential views to professional opinion as well. Their regression was similarly troubled by lacking spatial variables, although these were not understood as necessary at the time. This study found that some real estate professionals did not believe any premium was derived from a view; others overestimated the value of a view by up to 15%. However, these studies are unified by their illustration of uncertainty in the understanding of amenity value.

Methodology

From our understanding of the hedonic pricing method's development, we specified an empirical model for the regression. To minimize omitted variable bias and best ensure the accuracy of amenity and environmental coefficients, the model includes an array of variables for structural, spatial, and temporal characteristics. An additional array was included for various quality assessments prepared by the Jackson County Assessor's office and from realtor survey responses. Our model contained 287 observations for properties sold over the past two years, the result of carefully omitting sales between family and other non-market sales. From survey responses, we gained additional information for 100 properties in our sample.

Separate surveys were crafted for each selling agent in the Ashland area who had sold a property in the sample. These personal surveys asked a series of short questions about each property they sold. The agent was asked to rate from "Not desirable" to "Very desirable" on a 5-point Likert scale the property's outside condition, inside condition, convenience of location, neighborhood quality, and view from property. They were provided a picture of the property (when available), details about the sale, and the option to skip properties they were unwilling (or unable) to provide details about.

Non-survey data was gathered from both the Assessor's office and Southern Oregon Multiple Listing Service for the hedonic pricing analysis. Matching the data on properties from these two sources produced a wide array of observations for each property. The Assessor's office provided an assessment of landscape and view quality for each property. These assessments, which were standardized with the assistance of an internal handbook, presented a unique counter-perspective to the opinion of real estate agents.

Linear, Box-Cox, and logarithmic transformations were performed on continuous variables in an attempt to reduce skewness in the model. Although many continuous variables are positively skewed, testing revealed that log transformations reduce t scores and R-squares and introduce other noise into the regression results. It was concluded that this cross-sectional analysis did not require transformation.

Thus, the linear price equation became:

Sale Price = a + b(Acres) + c(Bathrooms) + d(Bedrooms) + e(Square Feet) + f(Age>10) + g(Age>25) + h(Age>50) + i(Age>75) + j(Age>100) + k(Sold 24 to 16 Months Ago) + l(Sold 16 to 8 Months Ago) + m(Deck) + n(Garage) + o(Patio) + p(Paved Drive) + q(Trail Adj) + r(Trail Near) + s(Park Adj) + t(Park Near) + u(On a Hillside) + v(On a Knoll) + w(On Rolling Terrain)

and either the following for Assessor's quality ratings:
+ x(Landscape Quality) + y(View Quality)

or the following for realtor quality opinions:
+ x(Outside Condition) + y(Inside Condition) + z(Convenience of Location) + A(Neighborhood Quality) + B(View Quality).

Assessor's quality ratings and realtor quality rating are separated intentionally, although there was no indication of multicollinearity. A correlation matrix reveals that the Assessor's view quality and realtor's view quality observations have a less than 1% correlation. The implication of this will be discussed in the next section.

Results

Two regressions were completed for comparison. The first regression (Table 1) utilized only structural, spatial, and temporal variables without realtor opinion. The most statistically significant variables appear to be the size of lot and property, number of bedrooms, the quality of the property's landscaping, whether or not it was made between 25 and 50 years ago, and if it has a paved driveway. The second regression (Table 2) included all the variables in the first regression but substituted the Assessor's assessments of landscape quality and view quality for the five realtor survey responses. Although none of the realtor opinions are statistically significant, this may be because of its relatively small sample size of 100. The results from this second regression are particularly revealing. Including these opinions lowers t-scores of most other variables, leaving lot acreage, property square feet, and proximity to parks statistically significant.

Table 1. Regression Results Without Realtor Opinion

Source	SS	df	MS		
Model	4.7561e+12	24	1.9817e+11	Number of obs =	287
Residual	1.9620e+12	262	7.4886e+09	F(24, 262) =	26.46
				Prob > F =	0.0000
				R-squared =	0.7080
				Adj R-squared =	0.6812
Total	6.7181e+12	286	2.3490e+10	Root MSE =	86537

saleprice	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
acres	208210.5	33393.38	6.24	0.000	142457	273964.1
bathrooms	-596.0245	11040.04	-0.05	0.957	-22334.52	21142.48
bedrooms	-23707.12	9398.19	-2.52	0.012	-42212.72	-5201.528
squarefeet	150.4536	14.82451	10.15	0.000	121.2632	179.6439
LandScapeQ~y	27035.05	6555.943	4.12	0.000	14126.01	39944.1
ViewQuality	1729.966	6568.718	0.26	0.792	-11204.23	14664.16
age10	-34800.37	17758.17	-1.96	0.051	-69767.27	166.5308
age25	-67045.56	19013.22	-3.53	0.000	-104483.7	-29607.39
age50	-38825.98	23217.86	-1.67	0.096	-84543.33	6891.365
age75	7592.288	32140.41	0.24	0.813	-55694.11	70878.68
age100	18330.23	24740.57	0.74	0.459	-30385.43	67045.89
Sold24to16	35911.2	12418.75	2.89	0.004	11457.93	60364.46
Sold16to8	27429.9	13528.18	2.03	0.044	792.0958	54067.69
deck	-15780.04	12558.72	-1.26	0.210	-40508.91	8948.825
garage	-1085.806	13177.83	-0.08	0.934	-27033.74	24862.13
patio	-16620.69	11982.48	-1.39	0.167	-40214.9	6973.517
paveddrive	30982.11	11457.2	2.70	0.007	8422.199	53542.02
trailadj	-3689.442	35625.55	-0.10	0.918	-73838.28	66459.39
trailnear	1491.884	20874.91	0.07	0.943	-39612.06	42595.83
parkadj	19016.93	32772.21	0.58	0.562	-45513.51	83547.37
parknear	39594.83	23169.51	1.71	0.089	-6027.327	85216.98
OnHillside	-2493.992	17733.52	-0.14	0.888	-37412.36	32424.37
OnKnoll	-35662.78	45524.79	-0.78	0.434	-125303.8	53978.25
OnRolling	4282.762	27556.48	0.16	0.877	-49977.6	58543.12
_cons	43893.12	34112.62	1.29	0.199	-23276.67	111062.9

Table 2. Regression Results With Realtor Opinion

Source	SS	df	MS		
Model	2.0736e+12	27	7.6800e+10	Number of obs =	100
Residual	3.8438e+11	72	5.3386e+09	F(27, 72) =	14.39
				Prob > F =	0.0000
				R-squared =	0.8436
				Adj R-squared =	0.7850
Total	2.4580e+12	99	2.4828e+10	Root MSE =	73066

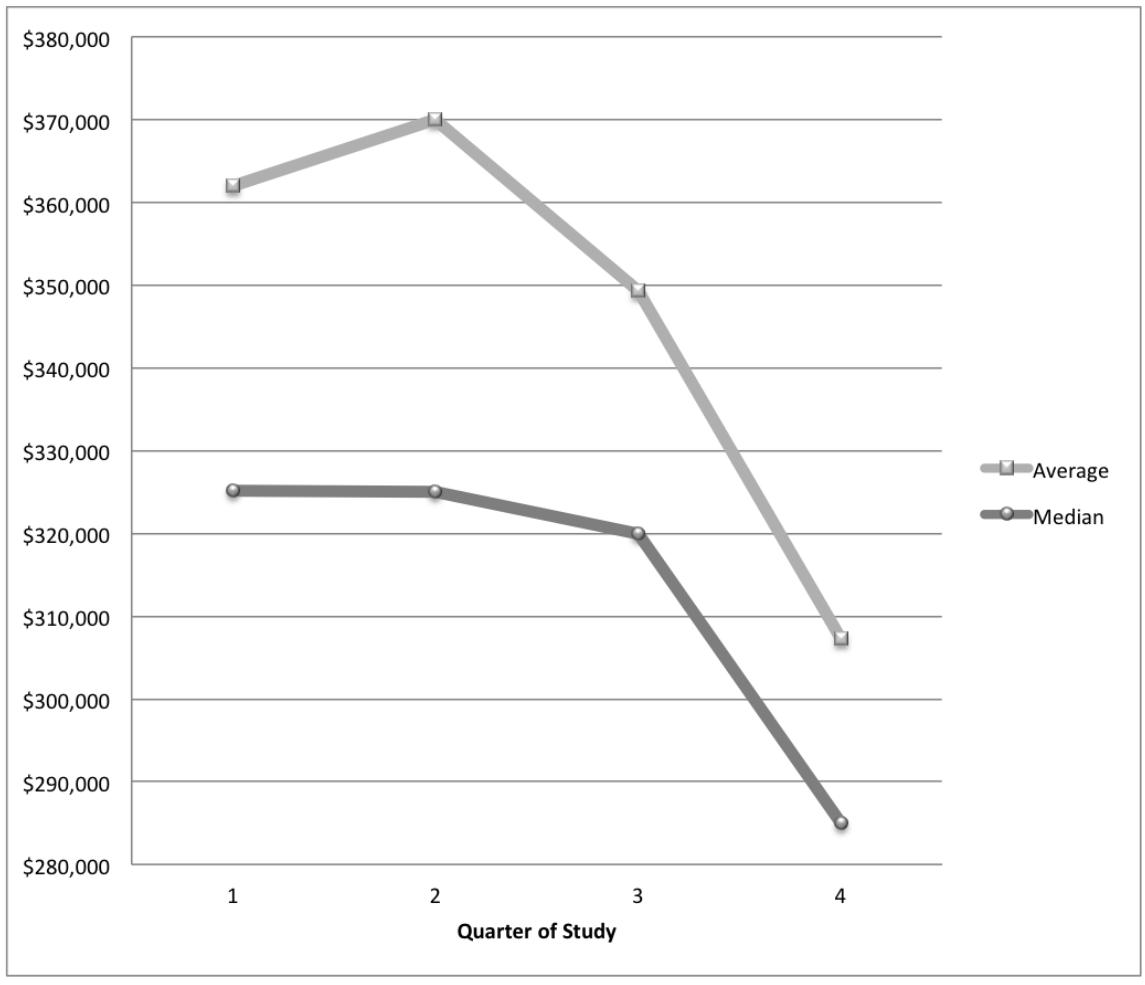
saleprice	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
acres	236717.4	64729.48	3.66	0.000	107681.5	365753.2
bathrooms	-17839	19354.53	-0.92	0.360	-56421.54	20743.54
bedrooms	-24517.63	13751.41	-1.78	0.079	-51930.56	2895.295
squarefeet	176.3954	24.88826	7.09	0.000	126.7815	226.0092
age10	-36649.12	25463.21	-1.44	0.154	-87409.11	14110.86
age25	-53050.01	32513.89	-1.63	0.107	-117865.3	11765.25
age50	-57756.68	39950.89	-1.45	0.153	-137397.3	21883.96
age75	36741.68	50112.01	0.73	0.466	-63154.79	136638.2
age100	16622.4	40337.34	0.41	0.682	-63788.62	97033.42
Sold24to16	26361.93	23653.84	1.11	0.269	-20791.13	73514.99
Sold16to8	11244.79	22001.68	0.51	0.611	-32614.75	55104.33
deck	7419.342	20822.74	0.36	0.723	-34090.04	48928.72
garage	31114.8	24306.01	1.28	0.205	-17338.34	79567.95
patio	-18176.84	18775.66	-0.97	0.336	-55605.44	19251.76
paveddrive	25995.79	18597.73	1.40	0.166	-11078.1	63069.68
trailadj	9581.847	56869.92	0.17	0.867	-103786.3	122950
trailnear	11810.68	47498.14	0.25	0.804	-82875.14	106496.5
parkadj	32190.42	58852.71	0.55	0.586	-85130.32	149511.2
parknear	149442.3	43699.6	3.42	0.001	62328.74	236555.9
OnHillside	-27901.18	27407.63	-1.02	0.312	-82537.29	26734.93
OnKnoll	9346.281	46948.06	0.20	0.843	-84242.96	102935.5
OnRolling	-27969.73	52955.12	-0.53	0.599	-133533.8	77594.36
SurveyOuts~y	25350.45	13626.06	1.86	0.067	-1812.6	52513.51
SurveyInsi~y	-1084.701	12660.71	-0.09	0.932	-26323.37	24153.97
SurveyConv~e	15709.47	12474.69	1.26	0.212	-9158.37	40577.31
SurveyNeig~d	112.1413	13713.1	0.01	0.993	-27224.42	27448.71
SurveyView	-1708.768	8811.914	-0.19	0.847	-19275	15857.46
_cons	-60065.88	72296.25	-0.83	0.409	-204185.8	84054.05

Interestingly, the bathroom and bedroom coefficients for both regressions are negative. This could be explained by the inclusion of square feet and lot acreage in the regression. Controlling for square feet, each additional bathroom and bedroom begins to crowd the property. This is consistent with some hedonic analyses including Blomquist (1981) Jim and Chen (2009), and it seems others avoid bedrooms and bathrooms in their regression entirely

(Benson, Hansen, Schwartz, et al., 1998; Osland, 2010). Yet, this is not the only abnormality in the results.

Another point of interest is the impact of sale date on sale price. After some experimentation, it became evident that the best way to capture changes in the Ashland market over time was to group our two-year sample into thirds. The two earliest of these thirds were included in the regression to capture temporal effects. Against conventional understanding of the real estate market, these two dummy variables indicating in what third a particular property was sold are both positive and significant. This is indicative that the Ashland market has experienced deflation in sale prices over the last two years. Against the expectation of a local realtor involved with the project, sales between 2009 and 2011 were still under the influence of the 2008 recession (Figure 1).

Figure 1. Changes in Real Estate Sales Prices by Quarter of Study



Conclusion

The hedonic pricing method has illuminated the value of various characteristics and amenities over the years, and the results of this application could be very informative to local realtors. These results are limited by the number and focus of variables. For instance, there was only one variable to control for the quality of a property's neighborhood (the realtor survey response) and it was statistically insignificant. Common spatial dividers are few and meaningless because Ashland is such a small city. However, this paper has been able to uncover useful information about the variables available.

Lack of consensus between realtors has translated into inconsistency in the regression results. Survey results for all amenities, save outside condition of the property, were inconclusive. Not only do a majority of the Likert scale responses from realtors fail to correlate with price in a significant way, the regression estimates some coefficients to be negative. This noise contrasts starkly with the standardized ratings of the Assessor's office. The Assessor's rating of landscape quality is both positive and significant indicating that something about a property's outward appearance may be an important factor in perceived value. This is mirrored by the only realtor survey response which approaches statistical significance: property's outside condition. A larger survey sample could prove more conclusive.

In regards to amenities, it appears that their impact is not as great as realtors expected. In survey responses, realtors overwhelming agreed that neighborhood amenities are a very important factor in a property's value. Yet, when asked to rate a property's surrounding neighborhood, this accord rapidly dissolved. Using dummy observations from both the Assessor's office and Multiple Listing Service offer a meaningful assessment of the study's 287 properties. Having a paved drive is important, suggests the regression, although other outward facing characteristics such as a garage, deck, or patio do not appear so. A property being within brief walking distance of a park has a positive impact that approaches statistical significance, as expected under the proximate principle (Crompton et al., 2004). Unfortunately, too few properties within the sample were either immediately adjacent to a park, or near to a trail, to further analyze their effect on price.

The lasting impact of the 2008 recessions was unanticipated, and may be the source of ambiguity in our data. Our personal experience in the Ashland market suggested that the quality of a property's view and proximity to recreation would have a significant impact on sale price. This is consistent with the importance realtors placed on a property's amenities in our survey. However, these and other predictions were not confirmed by our sample. Future attempts to bridge professional and academic understanding should take extra care in acquiring qualitative data. The participants of this study may have responded by drawing on wisdom they had gained of a market that no longer existed.

The strength of hedonic pricing analyses rests in the robustness of their modeling and reliability of their observations. This paper's original intention was to buttress the accuracy of an otherwise ordinary empirical model with expert opinion. We were to take a holistic look at the possible influences on sale prices, and contrast these with the estimates of real estate professionals. It is evident that confining respondents to a 5-point Likert scale may be too simplistic, our sample size may be skewing results, and structuring the model to rely on professional opinion for key variables is detrimental to its integrity. Further, the divide between colloquial assumptions and academic assessments of the determinants of value is greater than we initially thought.

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