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Influence of Natural Amenities on Residential Property Values in a Rural Setting

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Hedonic pricing has been used to identify values of nonmarket natural resource amenities. Most of these studies have been completed in suburban or urban communities rather than rural areas. The hedonic pricing study presented here includes developed residential parcel transactions occurring in a rural county in Michigan. We develop two hedonic pricing models using transaction data for two rural residential parcel types: developed parcels located in subdivisions, and developed parcels not located in subdivisions. Proximity to lakes and subdivision open areas positively affected the values of some parcel types, while proximity to forested land, publicly owned land, streams, and a National Scenic River did not have a positive influence. Results found in this study completed in a rural setting contrast with the results of other studies completed in suburban and urban settings.

Keywords hedonic pricing, natural amenities, property values, rural, subdivisions

Rural areas of the United States often contain natural resources that provide a variety of beneficial market and nonmarket goods and service flows. Quantifying the market values associated with these natural resources is relatively straightforward (e.g., the market value of agriculture or timber production); however, clearly defining the value of nonmarket service flows is more difficult. Hedonic pricing provides a method for quantifying nonmarket values that are capitalized, in part, via property values. It is particularly useful for estimating the nonmarket values of service flows from the natural amenities associated with rural areas (e.g., forests, lakes, rivers, publicly owned land, and open space).

Most hedonic pricing studies, however, have been completed in urban (e.g., Bolitzer and Netusil 2000; Tyrvainen and Miettinen 2000; Lutzenhiser and Netusil 2001) or suburban areas (e.g., Rinehart and Pompe 1996; Irwin 2002; Kim and Johnson 2002; Thorsnes 2002) rather than rural settings. Economic theory suggests that natural amenity values in developed areas, where natural amenities may be scarce, may differ from natural amenity values in rural areas, where natural amenities may be plentiful. Few hedonic pricing studies are done in rural areas. Bastian et al. (2002) focused on nonresidential, agricultural property in rural Wyoming, Similarly, Sengupta and Osgood (2003) studied the impact of "remoteness" and natural amenities on the market for ranchettes, or hobby agriculture land, in rural Arizona.

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The purpose of this research is to quantify the values that residential property purchasers in a rural settings place on natural resource amenities. Specifically, we employ hedonic pricing to determine how the value of residential properties in a rural county are influenced by proximity to forests, lakes, a National Scenic River, streams, and publicly owned lands.

Methods

Hedonic Pricing Framework

Hedonic pricing theory is described in depth by Rosen (1974) and Anderson and Bishop (1986). Hedonic pricing assumes that purchasers of a good are, in fact, purchasing a collection of characteristics of the good. In measuring land attributes, researchers typically treat land price as a function of several classes of attributes involving structures, the neighborhood, and the environment. Each of these classes of attributes may include many variables (e.g., number of bedrooms, garage size, and proximity to a river). In theory, we assume that prices represent the buyer's willingness to pay for the bundle of attributes embodied in a given property. The marginal value of the attribute, which accrues to the property owner/seller, can be estimated statistically. The hedonic framework has been used regularly to measure the influence that amenities and disamenities have on property values. Environmental amenities such as open green space (Bolitzer and Netusil 2000), neighborhood parks (Espey and Owusu-Edusei 2001), and urban wetlands (Mahan et al. 2000) have been found to positively affect property values through the use of hedonic modeling.

Study Area Description

The study area for this research is Wexford County, Michigan—located in the northern Lower Peninsula. The county has experienced a sharp increase in both population and number of households between 1990 and 2000 (U.S. Census Bureau 2006). During that period the county's population increased 15.6% to 30,484 people (a growth rate more than 2 times that of Michigan's rate of 6.7%). Despite these increases, the population density of the county remains fairly low at 53.9 people/square mile, well below the statewide population density of 175 people/square mile. Though much of the county is rural, there are several small incorporated towns and one larger urban area, the city of Cadillac, located in the county's southeastern quadrant.

Wexford County is well known for its expansive areas of undeveloped land, its multitude of recreation opportunities, and its water resources (Schindler et al. 2002). Of the 368,000 acres within the county, 73% are classified as forestland, 11% as rangeland, and 8% as agriculture land. Publicly owned lands comprise a significant portion of this land area; 41% of the acres in the county are managed either by the USDA Forest Service or the Michigan Department of Natural Resources. Lakes occur throughout the county, comprising approximately 7,700 surface acres of open water. Lake Mitchell is the largest (and premier) lake in the unincorporated portion of the county. In addition to lakes, numerous streams and a congressionally designated National Scenic River crisscross the county. The topography of the area includes rolling hills highlighted by a ridgeline traversing the center of the county from east to west. The variety of natural amenities available makes Wexford County a very suitable location to study the impact of natural resources on rural residential property values.

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Data Collection and Cleaning

Arm's-length transactions of residential developed properties occurring in the unincorporated areas of the county in the years 2000 and 2001 were identified through records obtained from the Wexford County Department of Equalization. Tax assessments completed in year 2001 for the identified parcels were obtained from the tax assessors contracted with each of the county's 16 township governments. After removing transacted parcels with missing assessment records and those parcels with tax assessments that were internally inconsistent, 268 developed residential parcels remained for analysis.

A spatial database of the transacted parcels was digitized in ArcView 3.2a (ESRI 2000) based upon each parcel's legal description and a spatial plat database purchased from Rockford Map Publishers, Inc. Spatial databases of land cover, amenity and disamenity features, and geopolitical boundaries were collected from the Wexford County Department of Planning. The proximity of each residential parcel to the features of interest (from parcel edge for parcels not located in subdivisions and from parcel centroid for parcels located in subdivisions) was calculated within ArcView 3.2a. Parcels located on the upper portion of the ridge traversing the county (above 1,350 feet) were identified using a digital elevation model (DEM) of the county. The ridge is a unique feature in this county and it was expected that individuals would be willing to pay a premium to live there.

Based on a preliminary review of the parcel assessments, we noted that parcels located in subdivisions appeared systematically different from parcels not located in subdivisions. Specifically, subdivision parcels more frequently had fireplaces, multiple bathrooms, multiple floors, multiple bedrooms, garages, and sewer services compared to developed parcels not located in subdivisions. A Chow test on a preliminary regression model indicated structural change between subdivision and nonsubdivision parcels. As such, subdivision and nonsubdivision parcels are treated in separate regression models. Of the 267 transacted parcels with sufficient assessment data, 149 were classified as nonsubdivision (NS), 107 as subdivision (S), and 11 were removed from further analysis. The 11 cases removed from analysis were subdivision parcels with mobile homes located on the subdivision parcel, rather than a permanent home.

In both of the developed parcel models, the dependent variable is the nominal parcel sale price. The independent variables selected for inclusion in the models are those consistent with the theoretical "bundle of goods" (including the natural resource amenities of interest) that influences the purchase price of residential property. Models with both untransformed and single-log dependent variables as well as double-log models were fitted. The models with untransformed dependent variables performed best, lend themselves to the most straightforward interpretation, and these two models are presented here.

NS Parcel Model:

$$\begin{aligned}\text{SALEPR} = {} & \beta_0 + \beta_1(\text{ACRE}) + \beta_2(\text{ACRE}^2) + \beta_3(\text{HAGE}) + \beta_4(\text{HAGE}^2) \\ & + \beta_5(\text{DISTRD}) + \beta_6(\text{DISTSCRIV}) + \beta_7(\text{DISTSTRM}) + \beta_8(\text{DISTFOR}) \\ & + \beta_9(\text{DISTPUB}) + \beta_9(\text{DISTLMITCH}) + \delta_1(\text{RIDGE}) + \delta_2(\text{TOWN}) \\ & + \delta_3(\text{SEAS}) + \delta_4(\text{HOUSE}) + \delta_5(\text{ADFLOOR}) + \delta_6(\text{BASEMENT}) \\ & + \delta_7(\text{GARAGE}) + \delta_8(\text{PORCH}) + \delta_9(\text{BRICK}) + \delta_{10}(\text{ADJLAKEO4}) + \text{e}\end{aligned}$$

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S Parcel Model:

$$\begin{aligned}\text{SALEPR} = {} & \beta_0 + \beta_1(\text{ACRE}) + \beta_2(\text{ACRE}^2) + \beta_3(\text{HAGE}) + \beta_4(\text{HAGE}^2) \\ & + \beta_5(\text{DISTRD}) + \beta_6(\text{DISTSCRIV}) + \beta_7(\text{DISTSTRM}) \\ & + \beta_8(\text{DISTFOR}) + \beta_9(\text{DISTPUB}) + \beta_{10}(\text{BATH}) \\ & + \beta_{11}(\text{SQFT}) + \delta_1(\text{RIDGE}) + \delta_2(\text{TOWN}) + \delta_3(\text{SEAS}) \\ & + \delta_4(\text{ADJLAKEO4}) + \delta_5(\text{ADJMITCH4}) + \delta_6(\text{SUBPARK}) + \text{e}\end{aligned}$$

where ACRE is the acreage of the parcel; ADFLOOR equals 1 if the residence has more than one floor; ADJLAKEO4 equals 1 if the parcel is located within 400 feet of a lake other than Lake Mitchell; ADJMITCH4 equals 1 if the parcel is located within 400 feet of Lake Mitchell; BASEMENT equals 1 if the residence has a basement; BATH is the number of bathrooms within the residence; BRICK equals 1 if the exterior of the residence is brick or block; DISTFOR is the distance to nearest public or private forested land; DISTLAKEM is the distance to Lake Mitchell; DISTPUB is the distance to the nearest publicly owned land; DISTSCRIV is the distance to the National Scenic River; DISTSTRM is the distance to the nearest stream; DISTRD is the distance to the nearest state highway; GARAGE equals 1 if a garage is present on the parcel; HAGE is the age of the house; RIDGE equals 1 if the parcel is located at above 1,350 feet, HOUSE equals 1 if the residence is a house rather than a mobile home; PORCH equals 1 if the residence has a porch; SALEPR is the nominal parcel sale price; SEAS equals 1 if the parcel was purchased from May through September; SQFT is the square footage of the residence; SUBPARK equals 1 if the parcel is located adjacent to an open space within a subdivision; and TOWN equals 1 if the parcel is located within 1 mile of a town.

Inconsistencies in the data available in the assessment records prohibited us from including in the NS model some variables commonly used in hedonic pricing studies (e.g., number of bathrooms, square footage). In the NS model we have included the variable "ADFLOOR" to identify those properties that may demand a higher selling price due to living space on multiple floors.

Results

Parcel Characteristics

NS parcels are, on average, moderate to large tracts of land (8.6 acres) located only 47 feet from forested land, approximately $\frac{1}{2}$ mile from both publicly owned land and from streams, and approximately 8 miles from both the National Scenic River and from Lake Mitchell. Eleven parcels are within 400 feet of a lake other than Lake Mitchell. The sales price of NS parcels ranges from $3,000 to over $300,000. S parcels are very small tracts of land, averaging just over $\frac{1}{2}$ acre in size. S parcels are located, on average, 322 feet from forested land, nearly $\frac{1}{2}$ mile from publicly owned land, $\frac{6}{10}$ of a mile from streams, and approximately 13 miles from the National Scenic River. Thirty-three parcels are located within 400 feet of Lake Mitchell and 13 are within 400 feet of a lake other than Lake Mitchell. S parcel sales price range from $14,000 to $475,000.

General Model Results

Collectively, the independent variables in the NS and S parcel models are statistically significant predictors of parcel selling price with model F-statistics of 7.62 and 9.89,

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respectively (Table 1). The NS parcel model has an adjusted R^2 of .45 while the S parcel model has an adjusted R^2 of .68. The standard errors of the independent variable coefficients in all models are corrected for heteroscedasticity using White's heteroscedasticity consistent covariance matrix (White 1980). The independent variable tolerance values and matrix condition were examined for indications of multicollinearity in the models.

NS Parcel Model

With the exception of BASEMENT and $HAGE^2$, the structural variables included in the model are significant predictors of selling price and have the expected relationships. As expected, the acreage of the parcel has a positive impact on parcel selling price—moderating as acreage increases. Parcels located on the ridge traversing the county have a higher selling price than similar parcels located elsewhere in the county, all else being equal. While this positive influence may be related to viewsheds, no attempt was made to quantify the viewsheds of individual parcels. Equivalent properties sold during the peak buying season resulted in a significantly higher selling price than those sold at other times of the year. Those NS parcels located within 1 mile of a town sell for significantly less than other parcels, all else being equal.

Of the natural features considered, only proximity to forested land was found to influence the sales price of NS parcels. Contrary to expectations, increasing distance from forested land had a positive impact on NS parcel sales price. For example, NS parcels located 500 feet from the nearest forested land sold for nearly $19,000 more than similar parcels with forested land on the property.

S Parcel Model

With the exception of SQFT, the relationships between the structural variables included in the model and S parcel sales price are consistent with expectations. Similar to NS parcels, transactions completed during the peak season resulted in higher parcel sales price while parcels located within one mile of towns sold for less, all else being equal. No significant impact on sales price resulted from being located along the ridge. Wexford County subdivisions frequently contain one or more platted subdivision park areas. S parcels located immediately adjacent to these platted park areas sell for significantly more than other parcels, all else being equal.

Of the natural amenity variables, only close proximity to Lake Mitchell influenced S parcel selling price. Lake Mitchell has a substantial impact on selling price, as those S parcels adjacent sold for nearly $108,000 more than those not adjacent, all else being equal. Proximity to the National Scenic River, streams, forested land, and publicly owned land had no statistically significant impact on sales price.

Discussion

Surface Water

Surface water is frequently found to have a positive impact on property sale price in hedonic pricing studies (e.g., Brown and Pollakowski 1977; Diamond 1980; Loomis et al. 2004). Of the surface water features included in this study, only close proximity to Lake Mitchell had a statistically significant influence on sales prices. Lake Mitchell is the premier lake in the county, and buyers appear willing to pay a premium for residential parcels located along this lake (offering lake access). Close proximity to

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Table 1. Hedonic pricing model of developed residential parcels purchased in rural Wexford County, Michigan

Non-subdivision parcel model (NS) (N = 149)				Subdivision parcel model (S) (N = 107)			
Dependent variable = nominal sale price				Dependent variable = nominal sale price			
Variable	Expected sign	Coefficient	Standard error	Variable	Expected sign	Coefficient	Standard error
Intercept		2,705.00	33,174.78*	Intercept		– 10,372.96	40,874.78
ACRE	+	2,657.71	779.73***	ACRE	+	85,283.01	29,337.13***
$ACRE^2$	–	– 37.40	14.15***	$ACRE^2$	–	– 15,565.97	5,994.13**
HAGE	–	– 1,631.10	581.21***	HAGE	–	– 2,558.81	1,084.49**
$HAGE^2$	+	11.10	6.91	$HAGE^2$	+	37.68	16.25**
DISTRD	+	– 0.06	0.60	DISTRD	–	1.63	2.05
DISTSCRIV	–	0.15	0.38	DISTSCRIV	–	– 0.34	0.33
DISTSTRM	–	– 2.48	1.59	DISTSTRM	–	– 4.58	2.79
DISTFOR	–	37.91	19.31*	DISTFOR	–	– 3.45	25.56
DISTPUB	+	– 0.34	1.32	DISTPUB	–	– 1.26	3.25
RIDGE	+	22,930.80	10,560.78**	RIDGE	+	– 3,430.32	17,336.66
TOWN	–	– 18,333.07	10,267.99*	TOWN	–	19.755.67	17,481.86
SEAS	+	11,744.98	6,651.87*	SEAS	+	22,676.91	11,428.16*
DISTLMITCH	+	0.27	0.36	ADJMITCH4	+	108,025.80	19,786.13***
ADJLAKEO4	–	5,300.30	8,478.38	ADJLAKEO4	–	5,809.76	19,258.69
ADFLOOR	+	31,032.68	12,918.79**	BATH	+	52,157.11	8,626.86***
BASEMENT	+	10,269.41	7,759.80	SQFT	+	25.65	16.79
GARAGE	+	25,320.08	6,991.14***	SUBPARK	+	45,599.07	25,782.57*
PORCH	+	14,587.20	7,099.10**				
BRICK	+	89,648.76	42,160.93**				
HOUSE	+	46,545.17	10,678.95***				
Adj $R^2 = 0.47$	F = 7.62	SE = 36,494***		Adj $R^2 = 0.65$	F = 9.89	SE = 53,077***	

*$p < 0.10$ **$p < 0.05$ ***$p < 0.01$.

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the many other lakes in the county, most of which are small compared to Lake Mitchell, did not yield a sales price premium. Likewise, there was no statistically significant impact resulting from proximity to the many streams in the county. Contrary to expectations, no premium existed for parcels located closer to the National Scenic River in the county.

Forested Land

We expected that proximity to forested land would result in greater parcel value for all parcel types. This expectation was based in part on the existing hedonic pricing literature completed in suburban communities. Thorsnes (2002) found that undeveloped subdivision lots immediately adjacent to forested land sold for between $5,800 and $8,400 more than lots not immediately adjacent to forested land. Likewise, Kim and Johnson (2001) and Irwin (2002) have found positive impacts on the value of suburban properties in proximity to forested land. In rural Wexford County, proximity to forested land does not increase the value of S parcels and, in fact, it negatively influences the value of NS parcels. The use of a binary forest adjacency variable (as used by Thorsnes' 2002) did not change the coefficient sign.

Comparisons of the results from our study with those of Thorsnes (2002) are particularly interesting given that Thorsnes study area (Kent County, Michigan) is just 100 miles south of Wexford County, Michigan. The disparity may result from differences in the supply of forested land within the two counties. Only 27% of the land area in Kent County is forested (USDA Forest Service, 2004) while 73% of the land area in Wexford County is forested (Schindler et al. 2002). Purchasers in Kent County may view forested land as a relatively scarce commodity, resulting in their willingness to pay a premium for parcels in proximity to forested land. Purchasers in Wexford County, in contrast, may not view forested land as a scarce commodity and as such do not pay premiums for parcels in proximity to forested land. In fact, purchasers of NS parcels in Wexford County may view parcels free of forested land as a scarce commodity and, as such, are willing to pay a premium for those few parcels that are located away from forested land.

While proximity to forested land is not a positive influence on the value of S parcels, adjacency to platted subdivision parks/open space has a significant positive influence. Platted subdivision parks in Wexford County can vary from developed recreational areas to lots simply left undeveloped because of soil conditions. S parcels immediately adjacent to platted subdivision parks/open space sold for approximately $46,000 more than those not adjacent to subdivision parks, all else remaining equal. It should be noted that Irwin (2002) found that preserved open space had a significantly greater positive impact on sale price than privately owned "developable" forest. Irwin (2002) defined preserved open space as privately owned lands protected from development and publicly owned land. It is possible that subdivision purchasers view platted subdivision parks as preserved land while nearby forested land (public or private) is seen as developable (or harvestable). The difference in the relationships between the two amenities and property values may result from this perception; however, we did not specifically test this.

Public Land

Public land proximity has been found to have a positive impact on property sale price (e.g., Bolitzer and Netusil 2000; Irwin 2002), and our expectation was that this

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relationship would hold in Wexford County. However, proximity to publicly owned land was found to have no significant impact on parcel sale price. The use of a binary measure of proximity did not change the results. This finding is quite surprising, given that public land in Wexford County provides many recreational and aesthetic service flows. Bolitzer and Netusil (2000) have pointed out that public land could be viewed as a nuisance if high recreation use creates negative externalities for nearby landowners. However, given the dispersed nature of the recreation activities on most public lands in Wexford County, the likelihood that public recreation would be viewed as a nuisance seems slight. As with forested land, the large supply of publicly owned land in the county may preclude any price premium for proximity.

Conclusions

In this study, we quantify how natural amenities influence the value of two residential parcel types in rural Wexford County, Michigan, through the development of two separate hedonic pricing models. Currently, the hedonic pricing literature offers few studies applicable to natural amenity valuation in rural communities. Additionally, few studies develop separate hedonic pricing models for different residential parcel types. The natural resource amenity values found in this study of a rural community differ from values found in studies completed in suburban communities. In addition, our results indicate that the impacts of natural amenities on parcel sale price vary depending upon the type of residential parcels considered.

Proximity to public land and forested land did not positively influence the sale price of residential parcels in Wexford County. This finding is contrary to the existing hedonic pricing literature. We propose that the large supplies of publicly owned land and forested land in the study area mitigated any price premiums for proximity to these amenities. For those natural amenities in Wexford County where there is scarcity (i.e., proximity to Lake Mitchell and proximity to subdivision parks), purchasers of some parcel types are willing to pay a premium for proximity. A cross-sectional study completed in communities with varying supplies of natural amenities would likely yield further insight into the relationship between natural amenity supply and capitalized natural amenity values. In the future, as development in Westford County continues, the supply of forested land may decrease and the number of parcels adjacent to public land may increase. Then, proximity to these amenities may begin to yield positive impacts on property values. This study provides a benchmark for future hedonic studies in the area.

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