Journal of Leisure Research
1996, Vol. 28, No. 1, pp. 18-26

Recreation Benefits of Neighboring Sites: An Application to Riparian Rights

Christos Siderelis and Gary Perrygo
Department of Parks,
Recreation and Tourism Management,
College of Forest Resources,
North Carolina State University

Travel cost methods cannot be utilized in deriving welfare benefits to households who reside adjacent to recreation sites, for they have direct access to site benefits at virtually zero cost. Hedonic theory is applied to a housing market that abuts Hyco Lake, NC. The linear feet of shoreline is the unique attribute that localizes the lakeshore housing market from others. Regressing the annual rental prices of lakeshore homes on lot and housing attributes, the shoreline coefficient is positive and significant. Since we are valuing the localized benefits of a lake, we interpret the shoreline coefficient as the marginal benefit of riparian rights per household and use this value in computing recreation benefits.

KEYWORDS: *Recreation resources, recreation economics, recreation modeling, hedonics*

Introduction

Determining the willingness-to-pay by households for recreation sites is important in guiding public policy and in designing land use policies (Freeman, 1979). However, there is no market through which public recreation sites can be valued by analysts. Lacking a price with which to value site benefits, the use of indirect techniques are required to estimate the recreation demands and compute welfare benefits (Mendelsohn, 1987). For example, travel cost methods involve computing a price of a site's services when both travel distance and the opportunity cost of travel time per trip are measurable. But what about the localized benefits from a recreation site where the travel costs of entry are virtually zero for adjoining property owners?

If the benefits are observable, hedonic property value techniques appear to be well-adapted for studying the welfare benefits to households (Brookshire, Thayer, Schulze, & d'Arge, 1982; Brown & Pollakowski, 1977; Mendelsohn, 1985). We estimate the benefits of riparian rights for households whose properties abut a privately owned apron of land around Hyco Lake in north central North Carolina. Lakeshore property owners are given riparian rights to the lake with the permitted construction of boat-houses, ramps, and piers, and other indirect benefits such as the clearing of trees

---

The authors are a Professor of Recreation Resources and Research Associate, respectively. Contact Siderelis at Dept. of PRTM, Box 8004, NCSU, Raleigh, 27695-8004. This study was funded from a lake research project in North Carolina sponsored by the Carolina Power and Light Company, Raleigh, NC.

and shrubs for direct scenic views, and weather moderating effects. The riparian rights are viewed as localized recreation benefits by lake developers, a concept supported by Clark and Downing (1985) who found that households placed a high value on water-oriented amenities and riparian rights, whether at lakes, streams, or marine locations. Although not the focus of this paper, property owners can also incur localized externalities (e.g., noise, ground litter) due to the kinds of activities and ensuing conflicts that occur when other visitors cannot be excluded from public area use.

In past lake studies, Knetsch (1964) compared property values to the presence or absence of a lake or reservoir. David (1968) compared shoreline property values to lake quality characteristics, and Burby (1971) studied factors affecting residential locations in reservoir recreation areas. Information on riparian benefits from this study can be used by power company officials as an input into their deliberations on a proposed change in current policy at a distant lake to allow for the transfer of riparian rights to lakeshore property owners.

Hedonic Theory

The expanded uses of hedonics began in 1961 with the first of many papers to examine the transportation-saving aspects associated with alternative residential locations (Mohring, 1961), and later the behavior of prices for durable consumer goods and quality changes over time (Rosen, 1974). More recently hedonic theory has been applied to the study of environmental degradation of recreation resources and residential property (Wilman, 1984). Studies completed on the potential changes to the quality of recreation sites included water (Bouwes & Schneider, 1979), hunting (Livengood, 1983), and fishing (Clark & Kahn, 1989). Examinations of the positive capitalized effects of various recreation amenities on property values have included parks (Weicker & Zerbst, 1973), greenways (Correll, Lillydahl & Singell, 1978), schools and park-schools (Hendon, 1973), water parks (Darling, 1973), and open space (Curtis, 1993).

Hedonic valuations assume that real estate properties differ on many attributes, including numerous structural and neighborhood characteristics, in lot features, availability of local public services, and accessibility to desired destinations, and that these neighborhood and housing attributes can be grouped together to describe each property. The resulting hedonic market represents housing prices in equilibrium from the interaction of households in the real estate market.

Traditionally, the analysis of hedonic markets follows a two-stage approach (Clark & Kahn, 1989; Freeman, 1979). First, the hedonic price schedule is estimated, which is an equilibrium relationship between housing prices and their attributes. Buyers maximize their utility by selecting a specific group of housing attributes. This implies that households equate their marginal bid for each attribute to the marginal implicit price of that attribute, the latter being the gradient of the hedonic price function. Since the implicit

price reflects the services that the household receives from an attribute, it is interpreted as the equilibrium price for an additional unit of an attribute that a buyer faces in the market. However, the implicit price does not reveal demand information about household behavior. For this reason, the estimation of demand functions for housing attributes are derived in the second-stage by regressing the marginal price of each attribute against the quantity demanded for the attribute as well as other socio-economic characteristics of the household. The equilibrium condition imposed is that the marginal implicit price of a housing attribute is equal to the buyer's willingness-to-pay for that attribute. (When we refer to demand functions, they are technically inverse demand or marginal bid functions.)

Explicitly, let the price, p_H, for a house be a function of the vector Z attributes that describe the house (e.g., square feet of interior space, lot size). The hedonic function can be written as:

$$p_H = f(z_1, z_2, \ldots, z_j; \gamma),$$

where γ is a parameter vector. The marginal implicit price of an attribute for the household, let us say z_i, can then be found by differentiating the rental price function, where the marginal implicit price of z_i is $\partial p_H / \partial z_i$.[1]

In the second stage of the hedonic, the household maximizes utility $U(z_1, z_2, \ldots, z_j, x; S)$ subject to the budget constraint $Y = P_H + x$, where Y is a household's income and x is the consumption of all other goods. S is a vector of socioeconomic characteristics describing the household. In the framework of consumer choice, households take the hedonic price function as know and given, where households select housing attributes and prices, but cannot influence the parameters that characterize the hedonic price function. The first-order conditions for a maximum imply that the household equates it marginal rate of substitution between x goods and each housing attribute to the marginal implicit price of that attribute, so that,

$$\partial P_H(Z; \gamma) / \partial z_i = w_i(Z, Y\text{-}P_H, S; \alpha^i) \text{ and } i = 1, 2, \ldots, J.$$

The expression on the right-hand side of the equality sign is the rate at which the household is willing to substitute x for z_i, and is denoted by w_i or the household's willingness-to-pay for z_i. In general, w_i is a function of Z, $Y - P_H$, and S, with α^i being the associated parameter vector. Palmquist (1991) addresses the theoretical and econometric difficulties (e.g., identification of parameters in estimation, restrictions in the functional forms of demand equations, and simultaneous equation bias) that make the data requirements more difficult to fulfill in the application of the second-stage.

In the context of the Hyco Lake problem, only lakeshore lot owners have a quantity of *shoreline*, the linear feet of land abutting the lake apron,

[1]The partial derivative of housing price with respect to the variable z_i follows the notation: $\partial P_H / \partial z_i$ where P_H is housing price, and z_i is an attribute. We solve for the marginal value of z_i by dropping all terms from the regression equation that do not contain z_i, and take the first derivative of the remaining equation.

which grant them riparian rights to Hyco Lake. We perceive shoreline as the surrogate measure of the localized benefits to households from riparian rights that can only be experienced by lakeshore households at home; while non-lakeshore properties are not affected by the shoreline attribute. Under this condition, the equilibrium price schedule is unchanged by shoreline since only the prices of lakeshore properties change. Furthermore, with lakeshore prices in equilibrium we assume that the localized benefits of riparian rights to Hyco Lake households do not affect the prices of lakeshore properties at other lakes in the region.

If the estimation of the localized benefits of a measured attribute are for a homogeneous neighborhood, Palmquist (1992) argues that the estimation of the second-stage hedonic is eliminated since the data for a single hedonic market are insufficient in identifying how the same property owner would respond to different prices and incomes. In valuing the localized benefits of riparian rights, the implicit price per linear foot of shoreline is interpreted as the marginal benefit measure for each household. Our definition of riparian rights is, necessarily, broad enough to include direct benefits, like the extension of piers from the shoreline, and the indirect, difficult to measure, psychological benefits from living next to water. While piers and boat houses are closely associated with riparian rights, they were viewed as non-essential attributes in estimating such rights. Although unlikely, a negative sign on the implicit price for the linear feet of shoreline would mean that the lake management authority is imposing a social cost upon lakeshore households.

Specifying the hedonic equation for a homogenous area is not the same as arguing for market segmentation (Palmquist, 1992). In focusing on lakeshore homes, we are not making the traditional market segmentation argument where the differences in housing prices are indications of market segments, and housing prices may act as price barriers between lakeshore and scenic view housing segments (Freeman, 1979). We are simply indicating that shoreline is a localized phenomenon and eliminating the second-stage is simply an advantage since we avoid the statistical problems associated with a second-stage estimation. This is not to deny earlier comments about our study approach that it is also appropriate to collect data on scenic view properties that do not have riparian rights even though an estimation of riparian benefits is the object of study. By including scenic view properties, we would obtain information on housing characteristics other than shoreline, which we agree may, in fact, strengthen the specification of the hedonic and shoreline coefficient estimates.

Methodology

The Hyco Lake Reservoir was built in 1965 to provide cooling water for electric power generation. The reservoir impounds 3,750 surface acres of water with 120 miles of shoreline and 879 lakeshore homes. Households along the lakeshore pay an annual lease fee of $.02 per linear foot of shoreline to the lake managing authority.

In 1994, a random sample of 283 owners of lakeshore lots were mailed questionnaires, following a modified Dillman approach, requesting their opinions about Hyco Lake boating conditions. Of the 222 responses from property owners, we excluded 16 incomplete property records and one 156 acre property that was listed as a farm. Approximately 79% of the sample indicated that they were second home owners and the remaining 21% were primary residents. Of the sample, the median gross annual income was $70,000 per annum. The attributes of sampled houses and lakeshore lots were collected from the computerized records kept in the Person and Caswell assessors' offices (Table 1).

Lakeshore real estate at Hyco Lake is rarely sold, in part due to the small size of the housing market and housing starts, which began 20 years ago. Without sales data from comparable Hyco lakeshore properties, quasi-market prices were computed from appraisal values (Brigham, 1965; David, 1968; Darling, 1973; Sumka, 1977; Smith, 1978; and Witte, Sumka, and Erickson, 1979). An often mentioned advantage of using property appraisals was to avoid the bias that might occur during normal market activity (e.g., forced sales due to bankruptcy, distressed sales due to death or relocation, less than knowledgeable seller). Real estate appraisals, made by county assessors' offices, involved the examination of site plans, and relied on a replacement-cost appraisal approach with standardized cost and depreciation

TABLE 1
Definitions of Housing and Lot Characteristics

Variable	Definition
Rent	Estimate of annual rent as computed with present value formula
Floorspace	Square feet of house on main floors
Basement	Square feet of finished basement
Unfinished	Square feet of unfinished basement
Utility	Square feet of attached utility room
Porch	Square feet of enclosed porch
Stoop	Square feet of entry stoop
Acreage	Size of lot in acres
Pier	Square feet of pier(s) on lake
Boathouse	Square feet of boathouse(s) on lake
Age	Age of main house (new = 0)
Shoreline	Linear feet of property adjoining waterfront apron
Deck	Square feet of wooden decks and porches
Garage	Square feet of attached or detached garages
Street	Dummy variable for paved street (1,0)
Utilities	Dummy variable for presence of well, septic, electric (1,0)
Trailer	Dummy variable for home type as trailer-home (1,0)

Notes. Of the 24 independent variables initially identified for regression analysis, only 17 variables, listed above, were retained for analysis.

allowance tables. Standardized costs were adjusted by appraisers from on-site inspections of the physical aspects of each property. In turn, we adjusted the appraisals of sampled lakeshore properties to comparable market conditions with the assessment-to-sales ratios computed by the North Carolina Department of Taxation from 1994 housing transactions. The assessment-to-sales ratio equaled .9372 for Person County which reassessed in 1993 and .8152 for Caswell which reassessed in 1992.

Freeman (1979) suggests that inferences about the streams of housing benefits to households be drawn by converting observed present housing values into annual rents. By assuming that a household was indifferent to either renting or buying a home, we converted each housing price to an annualized rental stream, expressed as a net present value after discounting.[2] Estimates of annual rental prices were derived from $r_H = (i + t)(1 - g)p'$, where g equaled the marginal income tax bracket from household incomes, i a real interest rate, t local property tax rates, and p' the quasi-market housing prices. Without detailed household information, we assumed that the marginal tax brackets were for 1994 joint returns. The real interest rate, i, was adjusted for inflation such that, $i \approx R - g$ where R was the municipal bond rate of 7.85%, and g was an inflation rate of 2.8% for 1994. The property tax rates were .0063 for Person and .00745 for Caswell counties. Ignoring property taxes would lead to an under-estimation of annual rental prices.

Results

Since the property tax rates differed among Person and Caswell counties, we tested the equality of annual rental price means between the two counties resulting in an insignificant t-test value ($t = .82$, $df = 63$, $p > .01$). The mean sample annual rent was \$4,116 (±2,167) per year, the mean lot size was 1.08 (±.50) acres, and the mean amount of shoreline was 248 (±242) linear feet.

Box-Cox techniques indicated linear regression to be superior over the semi-log or other common forms of hedonic regressions. In addition, the independent variables of housing size, pier, boat house, shoreline, lot size, shoreline were entered into regression analysis in various forms (raised to powers, series of dummy variables, or natural logs), but the untransformed variables performed best. The results of the hedonic regression are displayed

[2]In addition to assuming that housing is a consumptive good, other assumptions that are important to hedonic theory might include (1) that the household locates so as to maximize consumer benefits and if the rental value exceeds its willingness to pay, the household will not locate there; (2) the housing market is efficient in that there exists a sufficient number of housing units on the real estate market so that choices among housing units are continuous; (3) the housing market is sufficiently flexible to prevent persistent excess demand of housing units (Barr, 1987). An alternative interpretation of rent includes the periodic cost of housing and represents the sum of the present and future streams of benefits and costs that can be derived from a home.

in Table 2. Overall, the shoreline hedonic model explained 85% of the variation in annual rental prices.

The majority of the structural and site variables were statistically significant and of the expected signs. Increasing rental prices were positively associated with increases in square feet of floor space (t = 13.693) and negatively associated with the age of house (t = −63.91), which apparently captured the lack of maintenance and obsolescence. We eliminated independent variables that contributed nothing to the explanatory power of the model (e.g., all homes had septic tanks), or were collinear with other independent variables. We estimated the tolerances ($1 - R_k^2$) by regressing each attribute on other attributes, and examined the matrix of correlations between the estimated coefficients, where attributes like concrete decks and carports with high ($> \pm .7$) collinearity were dropped from hedonic analysis.

Regression coefficients reflected the proportional change in the annual rental price associated with unit changes in housing attributes. The annual rental price was $293.96 for an acre of land, shoreline was $.64 per linear foot, and the measure of their collinearity was r = −.41. The age of the home, the presence of a trailer-home, and paved streets have statistical significance (Prob $> |t| \leq .05$) and negative influences on increases in annual rents. The presence of trailer-homes and increasing age of homes were ob-

TABLE 2
Hedonic Regression Results (N = 205)

Variable	Coefficient	Std. Error	*t*-ratio	Mean
Floorspace	1.53	.1116	13.693	1109.92
Basement	.81	.1502	5.389	234.63
Unfinished	.36	.1522	2.369	232.79
Utility	4.37	2.2130	1.977	6.23
Porch	.76	.3052	2.483	169.12
Stoop	4.86	2.5786	1.884	6.18
Acreage	293.96	153.4036	1.916	1.07
Pier	.54	.2274	2.385	290.83
Boathouse	.58	.2304	2.501	343.37
Age	−63.91	9.1296	−7.000	11.39
Shoreline	.64	.3066	2.096	243.64
Deck	.67	.2091	3.192	291.90
Garage	.87	.4955	1.762	38.38
Street	−347.64	148.7979	−2.336	.20
Utilities	963.55	241.0703	3.997	.82
Trailer	−1040.80	267.9052	−3.885	.06
Constant	973.19	216.9272	4.486	

Notes. All the coefficients with the exceptions of the square feet of stoop areas and garages were significant at .05 level. The coefficient of shoreline is interpreted as the amount of annual rent, $.64, per linear foot.

viously perceived by households as less desirable attributes, and reduced rental values in the Hyco lakeshore housing market. From the significance of trailer-homes on lakeshore property, we can only infer that if it was economically sensible to use land for trailers, then the land value must be less than for permanent homes. We expected paved streets to contribute positively to annual rental prices of lakeshore lots, but it reduced rental prices. We can only conclude that paved streets must incorporate idiosyncratic features that we were unable to capture and adequately control in the hedonic regression.

Summary and Conclusions

Since no other techniques were available to indirectly value riparian rights to neighboring households, the hedonic property value method was adapted for this purpose. The specification of the hedonic equation was for a homogenous neighborhood of lakeshore homes at Hyco Lake. Since we estimated a localized price function, only the hedonic results were necessary to generate benefit measures (Palmquist, 1992). We derived an implicit price for shoreline, and interpreted it as the marginal benefit of riparian rights per household. Taking the partial derivative of annual rental prices with respect to the linear foot of shoreline, the marginal benefit was $.64 per annum per household. Subtracting the lease rate of $.02 per shoreline foot per annum charged by the lake authority, the resulting marginal benefit was $.62 per linear foot for the Hyco lakeshore market. The mean sample quantity of shoreline was 248 linear feet per lot, resulting in an annual benefit of $153.76 per household. With 879 lakeshore lots, the aggregate benefits of riparian rights was approximately $135,155 per annum for Hyco lakeshore residents.

Our results are not necessarily transferable to other lakes, nor may the hedonic estimates be valid in a future time period, if conditions change in at the Hyco lakeshore housing market. There are a number of recreation resources, such as rail-trails, greenways, and parks, that can benefit from the application of this localized welfare valuation technique. Further research may study the effect of household characteristics on the willingness-to-pay for localized benefits from recreation resources by comparing hedonic results in differing neighborhoods, as has been done with localized externalities.

References

Bouwes, N. W., Sr., & Schneider, R. (1979). Procedures in estimating benefits of water quality change. *American Journal of Agricultural Economics, 61*, 535-539.

Brigham, E. F. (1965). The determinants of residential land values. *Land Economics, 41*(Nov.), 325-334.

Brookshire, D. S., Thayer, M. A., Schulze, W. D., & d'Arge, R. C. (1982). Valuing public goods: a comparison of survey and hedonic approaches. *The American Economic Review, 72*(1), 165-177.

Brown, G. M., Jr., & Pollakowski, H. O. (1977). Economic valuation of shoreline. *Review of Economics and Statistics, 59*(Feb.), 272-278.

Burby, R. J. III (1971). A quantitative analysis of factors influencing residential location in reservoir recreation areas. *Journal of Leisure Research, 3*(2), 69-80.

Clark, R. N., & Downing, K. B. (1985). Why here and not there: the conditional nature of recreation choice. In *Proceedings-Symposium on Recreation Choice Behavior, Missoula, Montana, March 22-23, 1984.* (General Technical Report INT-184), USDA, Forest Service, Ogden, UT: Intermountain Research Station.

Clark, D. E., & Kahn, J. R. (1989). The two-stage hedonic wage approach: A methodology for the valuation of environmental amenities. *Journal of Environmental Economics and Management, 16,* 106-120.

Correll, M. R., Lillydahl, J. H., & Singell, L. D. (1978). The effects of greenbelts on residential property values: some findings on the political economy of open space. *Land Economics, 54*(2), 207-217.

Curtis, R. E. (1993). *Valuing open space in Maryland: an hedonic analysis.* Unpublished master's thesis, University of Maryland, College Park, Maryland.

Darling, A. H. (1973). Measuring benefits generated by urban water parks. *Land Economics, 49*(Feb.), 22-34.

David, E. L. (1968). Lakeshore property values: a guide to public investment in recreation. *Water Resources Research, 4*(4), 697-707.

Freeman, A. M. III (1979). *The Benefits of Environmental Improvement Theory and Practice.* Baltimore: Johns Hopkins University Press.

Hendon, W. S. (1973). Property values, schools, and park-school combinations. *Land Economics, 49*(May), 216-218.

Knetsch, J. L. (1964). The influences of reservoir projects land values. *Journal of Farm Economics, 46*(Feb.), 231-243.

Livengood, K. R. (1983). Value of big game from markets for hunting leases: the hedonic approach. *Land Economics, 59*(3), 287-291.

Mendelsohn, R. (1985). Estimating the structural equations of implicit markets and household production functions. *Review of Economics and Statistics, 66,* 673-677.

Mendelsohn, R. (1987). Modeling the demand for outdoor recreation. *Water Resources Research, 23*(5), 961-967.

Mohring, H. (1961). Land values and the measurement of highway benefits. *Journal of Political Economy* (June), 236-249.

Nelson, J. (1978), Residential choice, hedonic prices, and the demand for urban air quality. *Journal of Urban Economics, 5*(July), 357-369.

Palmquist, R. B. (1992). Valuing localized externalities. *Journal of Urban Economics, 31*(Jan.), 59-68.

Rosen, S. (1974). Hedonic prices and implicit markets: product differentiation in pure competition. *Journal of Political Economy, 82*(1), 34-55.

Smith, B. A. (1978). Measuring the value of urban amenities. *Journal of Urban Economics, 5*(July), 370-387.

Sumka, H. J. (1977). Measuring the quality of housing: an econometric analysis of tax appraisal records. *Land Economics, 53*(Aug.), 298-309.

Weicker, J. C., & Zerbst, R. H. (1973). The externalities of neighborhood parks: an empirical investigation. *Land Economics, 49*(Feb.), 99-105.

Wilman, E. A. (1984). *External costs of coastal beach pollution: an hedonic approach.* Washington D.C.: Resources for the Future.

Witte, A., Sumka, H., & Erickson, H. (1979). An estimate of a structural Hedonic price model of the housing market: an application of Rosen's theory of implicit markets. *Econometrica, 47*(Sept), 1151-1173.