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A HEDONIC ANALYSIS OF PRIVATE HUNTING LAND ATTRIBUTES USING AN ALTERNATIVE FUNCTIONAL FORM

Mark L. Messonier and E. Jane Luzar

Abstract

A hedonic framework is used to analyze selected attributes of Louisiana deer hunting leases that are hypothesized to be significant contributors to lease value. The flexible Box-Cox functional form is used in contrast to the often utilized linear regression specification. Additionally, the hypothesis of regional differences in slope coefficients of lease attributes is addressed. Results indicate that hunters in the two analyzed regions value lease attributes and services differently.

Key words: hedonic, deer hunting, Box-Cox, lease attributes

Wildlife in Louisiana, as in other states, is considered to be owned by the state and therefore cannot be bought and sold. Access to wildlife, however, can be controlled by private owners of game-supporting land and is often sold. Many states, particularly in the Western U.S., contain enough publicly owned game-bearing land that markets for access to privately owned game-bearing land are relatively less common. In some southern states such as Louisiana, an emerging market for access to privately owned hunting land co-exists with state supported and managed systems of wildlife management areas (WMAs) for which there is no explicit access fee.

Resource management decisions of both public and private land managers in the South are currently limited by the amount of quality of information regarding the economic value of the wildlife resource. Economic information about the value of access to wildlife can be useful to private landowners considering alternative income opportunities from allowing recreational access to their land. Information of this type can also be useful to public land managers interested in the identification and/or justification of management goals that may include biological as well as economic dimensions. For example, economic signals indicating what attributes hunters find important on private lands may be useful in making management decisions regarding biological improvements or provision of amenities on public hunting areas. In the area of wildlife resources, almost all decision processes are strengthened by the integration of biological and economic information.

In order to add to existing economic information on the value of wildlife resources, this study uses a hedonic framework to analyze selected attributes of Louisiana white-tailed deer (*Odocoileus virginianus*) hunting leases that are hypothesized to contribute significantly to lease values. In the empirical analysis, the flexible Box-Cox functional form is employed, in contrast to the often utilized linear regression specification. In addition, regional differences in lease attribute valuations are addressed. The next section describes the regional development of the private market for access to wildlife resources, such as white-tailed deer. The theoretical background of the hedonic framework used to identify attributes of hunting leases that significantly contribute to lease value is then presented. Data collection procedures and model specification are reported in the following sections. Empirical estimates derived from the flexible Box-Cox functional form are then presented. After a discussion of the results of tests for regional differences, the study concludes with some general recommendations regarding selection of functional forms for hedonic analysis and some specific recommendations regarding attributes of deer leases in Louisiana.

ACCESSING WILDLIFE RESOURCES

Until recently, access to private hunting land in Louisiana has not been provided on a fee basis. Within a relatively immature market for recreation access, Louisiana fee-based hunting has not exhibited market functions found in other regions with more developed recreation access markets (Libby). For example, in contrast to Texas where leasing access rights to hunting land has been long estab-

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lished (Pope *et al.*), leasing of hunting access rights in Louisiana appears to have become significant only within the past 10 to 15 years. Louisiana currently lacks institutionalized channels for information on leases, including quality of herds, lease prices, regional availability, and typical lease attributes. This degree of market immaturity can be better understood when compared with regions which publish this sort of fee lease information through official lease registries (Allen).

Due in part to the relatively recent movement to hunting on a fee basis and the lack of market information on these leases, there has been little interest in the economics of wildlife access in Louisiana. However, with the implementation of the conservation provisions of the Food Security Act of 1985 and uncertainties associated with agricultural product prices spanning the mid 1980s, landowners have demonstrated greater interest in alternative income sources (Colyer). Additionally, some public hunting areas have begun to experience a common public goods-related problem—congestion. In Louisiana, a perception of congestion on public land and the resulting potential safety problems are of concern to many public land hunters (Hotvedt and Luzar). Congestion in public areas may contribute to the displacement of hunters from public lands, encouraging them to enter the private market for hunting land access. The recent apparent increase in leasing activity in Louisiana has stimulated the need for empirical analysis of access to wildlife resources to provide information for private landowners and public land decision-makers.

A common method of obtaining access to hunting land is for individual sportsmen to form a hunting club. The primary purpose of the association is to reduce the expense an individual incurs in securing ingress rights to game-supporting land. Legal leasing contracts are formed with landowners, typically stipulating the length of the agreement, game species included, harvest goals (within state game regulations), services to be provided by the landowner, services to be provided by the leasing party, liability of the landowner, the price of the lease, and the legal description of the land involved.

THE HEDONIC FRAMEWORK

The basic hypothesis of hedonic price theory is twofold. First, a commodity such as leased hunting land can be viewed as an aggregation of individual components or characteristics (Griliches). Second, consumers purchase goods embodying bundles of attributes that maximize their underlying utility functions (Rosen). Hedonic theory has its roots in Lancaster's seminal article in which he proposed that goods are inputs in the activity of consumption. The end product of this activity is a set of characteristics. Collections of characteristics, rather than collections of goods, are ranked according to their utility-bearing abilities.

Characteristics, or attributes, are implicitly embodied in commodities and their observed market prices, and the amount or presence of characteristics associated with the commodities defines a set of implicit or "hedonic" prices (Rosen). Estimates of the marginal implicit values of the characteristics are obtained by differentiating the estimated hedonic price function with respect to each characteristic (McMillan *et al.*).

Hedonic price theory has obtained a wide range of applications, including valuing housing and urban amenities (Blomquist and Worley; McMillan *et al.*; Witte *et al.*), agricultural commodities (Brorsen *et al.*; Ethridge and Davis; Wilson), and wildlife resources (Pope and Stoll; Livengood; Pope *et al.*). The housing and agricultural commodity studies pre-date applications in the wildlife area, but by example they demonstrate the analogies and applicability of the technique for valuing wildlife access in areas where markets for access exist.

Housing and hunting leases can share similar attributes. Both involve real estate, the presence or absence of attributes, and are usually distant from other locations of importance in a consumer's activities. Similarly, just as prices of agricultural products are influenced by how their attributes compare to official grades and other standards (Brorsen *et al.*), so also are the prices of hunting leases influenced by their attributes. Marginal implicit prices of hunting leases are analogous to the premiums and discounts used in the trade of agricultural commodities in indicating the market-determined value of attributes (Wilson).

The hedonic technique has recently been used in the analysis of wildlife resources. Pope *et al.* hypothesized that the recreational and aesthetic value of wildlife significantly influences the per acre market value of rural land in Texas. In utilizing the information obtained from a hedonic analysis of deer lease markets in Texas, Livengood estimated the demand for harvested deer. Rather than attempt to value harvested wildlife, Pope and Stoll investigated the value of the right to access white-tailed deer supporting land in Texas and determined the characteristics of a Texas deer hunting lease that significantly contribute to its value. Their results suggest that landowner provision of services and amenities do not generally enhance the value of a white-tailed deer hunting lease as much as sufficiently large parcels of land and availability of addi-

tional game species. This study attempts to identify the attributes of a Louisiana hunting lease that significantly contribute to its value. A hedonic framework is employed in which the observed price paid per hunting club member for leasing access rights is regressed on selected attributes of the leased land and services and facilities provided by the landowner. Selection and specification of the attributes analyzed was done within the theoretical context of a relatively immature market for recreation access.

DATA COLLECTION

Primary data were collected through a 1989 mail survey of hunting clubs which participated in the Louisiana Department of Wildlife and Fisheries (LDWF) administered Deer Management Assistance Program (DMAP) during the 1987-1988 deer hunting season. The questionnaire was designed to obtain information on the physical and biological characteristics of the leased land, services, and facilities associated with the lease, hunting activities, and socio-economic attributes of the respondents. LDWF, which has geographically divided the state into eight game management districts, is responsible for management of Louisiana's wildlife.

In order to address questions of a spatial nature, LDWF provided the addresses of contact persons in 386 DMAP participating hunting clubs from Districts I and IV. District I is characterized by mostly pine woodland. District IV, considered by many to be the prime deer hunting area in Louisiana, is mostly bottomland hardwood. Old hardwood forests still exist in District IV as well as a great deal of land in agricultural production. The two districts were chosen because of their distinctly different biological habitats.

A modification of Dillman's Total Design Method (TDM) for mail surveys was employed in conducting the survey. Dillman developed the TDM as a cost-effective method for maximizing response rates for mail surveys. The overall response rate was 6.7 percent, with District I and IV response rates of 66 and 71 percent, respectively. Complete, usable responses to the survey allowed for a sample size of 137 observations for the District I model (44 percent of surveys mailed to District I) and 25 observations for the District IV model (31 percent of surveys mailed to District IV).

HEDONIC MODEL SPECIFICATION

In addition to the questions addressed in the Pope and Stoll study, this research considered the importance of functional form in the application of hedonic price theory. The study also specifically investigated the effects of location on the significance of the various attributes hypothesized to influence the value of a Louisiana white-tailed deer hunting lease. In this analysis, independent variables (attributes) hypothesized to contribute to the value of a hunting lease were characterized by two broad categories. The first of these involved physical, geographic, and quality characteristics of the lease. Included in this category were lease size in acres divided by the number of members of the hunting club, distance from the respondent's home to the lease, dummy variables representing the presence or absence of squirrels and quail on the lease, and an objective measure of lease quality based on the respondent's hunting experiences on the lease during the 1987-1988 deer hunting season. Dummy variables for the presence of squirrels and quail were selected over the potential game species because both have open seasons in Districts I and IV. Species such as turkey and ducks are not legally hunted in both districts. Squirrels are common game animals throughout Louisiana, while quail are highly regarded game birds. Another aspect of game availability considered but eliminated was the density of a game species on the lease. While Pope and Stoll included a variable representing deer density in the Texas county in which the leases were located, LDWF personnel expressed reservations about using such a variable in reference to the Louisiana deer herd due to the unreliability of population estimates (Farrar).

The second category of independent variables included landowner-provided services and amenities such as road maintenance, overnight lodging, and liability insurance. Liability insurance has been indicated to be of great interest to landowners and hunters. This aspect of leasing has not been studied in previous economic work in Louisiana. Together, these attributes are hypothesized to capture aspects of a relatively less mature market for recreation access. Implicitly, the model was specified as:

PRICE = f(ACPERMEN, DISTANCE, SQUIRREL, QUAIL, ROAD, CABIN, INSUR, QUALITY, ε)

where:

PRICE = Price paid per club member for access rights,

ACPERMEN (+) = Acres of lease per club member,

DISTANCE (-) = Distance in miles of lease from respondent's home,

SQUIRREL (+) = Dummy for presence of squirrels on lease; 1 if present, 0 otherwise,

QUAIL (+) = Dummy for presence of quail on lease; 1 if present, 0 otherwise,

ROAD (+) = Dummy for landowner-provided road maintenance; 1 if provided, 0 otherwise,

CABIN (+) = Dummy for landowner-provided overnight lodging; 1 if provided, 0 otherwise,

INSUR (+) = Dummy for landowner-provided liability insurance; 1 if provided, 0 otherwise,

QUALITY (+) = Lease quality measure; ratio of hunter opportunities to shoot a deer to total number of deer hunting trips to lease, and

ε = Error term.

A priori hypotheses for the signs of variables are represented by (+) and (-) in the implicit specification. Greater acreage per hunter was hypothesized to allow club members to reduce the congestion they might face on smaller leases or leases with high membership relative to the leased area. Presence of game species in addition to white-tailed deer would hypothetically allow for use of the lease over a period of time greater than just the deer hunting season. For these reasons, it was hypothesized that as acreage per hunter increased and the availability of other game species was exhibited, lease price per member would increase. Because of the time involved in traveling to and from a lease, it was hypothesized that as distance from the hunter's home to the lease increased, lease price would decrease.

Landowner provision of amenities and services was hypothesized to increase the value of a lease. Therefore, coefficients of variables representing landowner-provided liability insurance, road maintenance, and overnight lodging were expected to exhibit positive signs. Hunters would also be expected to pay higher lease prices for greater lease quality. Measuring quality as the percentage of hunter opportunities to shoot a deer in total deer hunting trips to the lease may incorporate the individual respondent's hunting skills, but can also give an indication of lease quality. It was therefore hypothesized that the quality variable's coefficient would be positive.

HEDONIC PRICE MODEL ESTIMATION

The choice of functional form to be used in hedonic estimations has been the topic of recent study (Cooper *et al.*; Halvorsen and Pollakowski; Milon *et al.*; Ziemer *et al.*). With no clear guidance from economic theory as to the choice of functional form, early hedonic studies almost exclusively used simple linear model specifications. However, Milon *et al.* suggest that simple linear specifications do not allow for further identification of the underlying structural attribute demand functions, an ultimate objective of some hedonic studies (Blomquist and Worley; Livengood; McMillan *et al.*). Recent research has indicated preference for the use of flexible forms rather than restrictive functional forms. Cooper *et al.* conducted experiments to test for the functional form of choice in hedonic studies. Using 1977-1978 housing sales data from the Baltimore, Maryland, area, they concluded that even under misspecification of the equation and the existence of imperfect information, the Box-Cox functional form is preferred. Specifically recommended for the hedonic price function is the linear Box-Cox transformation:

$$(1) \quad P^{(\theta)} = Z^{(\lambda)}\beta + \varepsilon$$

where P is a vector of known prices, β is a vector of unknown coefficients, Z is a matrix of known attribute quantities, ε is an error vector whose elements are assumed to be normally and independently distributed, and $P^{(\theta)}$ and $Z^{(\lambda)}$ are transformations of the form:

$$(2) \quad Y^{(\gamma)} = \begin{cases} \dfrac{(Y^{(\gamma)} - 1)}{\gamma} & \gamma \neq 0, \quad Y > 0 \\ \ln Y & \gamma = 0 \quad Y > 0. \end{cases}$$

If $\theta = \lambda = 1$, the specification in the equation (1) takes a simple linear form, whereas if $\theta = \lambda = 0$, the transformation is log-linear (Judge *et al.*, p. 556). Dummy variables are not transformed. Other combinations of θ and λ are possible.

Box-Cox models require large sample sizes, especially if separate transformation parameters for each variable are to be estimated (Judge *et al.*). Due to the small number of observations available for District IV, this study's transformation parameters on the dependent and independent variables were constrained to be equal and were first estimated using pooled data from both districts. Dummy variables were not transformed. The estimated θ and λ parameters were then applied to separate regressions for each district. Because power transformations of the variables were linear transformations and were equal for both districts, a Chow test for equality between sets of regression coefficients was an acceptable test for different influences of lease attributes between the two districts. The Chow statistic follows the F-distribution with K and $n + m - 2K$ degrees of freedom where K is the number of estimated parameters and n and m are the number of observations in each of the groupings.

Table 1. Price Equation Estimates: Hedonic Price Model of Louisiana White-Tailed Deer Hunting Leases, 1989 Data.[a]

Variable	Both Districts $\theta = \lambda = -0.08$	District I $\theta = \lambda = -0.08$	District IV $\theta = \lambda = -0.08$	Variable Mean D.I.	Variable Mean D.IV.
PRICE (per member)	-	-	-	256.28	953.33
ACPERMEM	0.697 (9.969)	0.680 (10.144)	0.830 (4.0910)	124.58	163.06
DISTANCE	0.0447 (1.553)	0.0298 (1.116)	0.0496 (0.437)	25.04	35.75
SQUIRREL	0.0334 (0.395)	-0.00170 (0.0226)	0.978 (1.810)	0.97	0.96
QUAIL	-0.157 (2.369)	-0.0854 (1.329)	-0.172 (0.786)	0.51	0.29
ROAD	0.0554 (0.608)	0.0424 (0.481)	0.147 (0.508)	0.16	0.21
CABIN	0.450 (2.921)	0.319 (1.631)	-0.0458 (0.154)	0.03	0.21
INS	-0.273 (1.340)	-0.310 (1.578)	-0.138 (0.232)	0.03	0.04
QUALITY	0.0487 (2.146)	0.0257 (1.115)	0.118 (2.163)	0.36	0.54
INTERCEPT	1.703 (6.388)	1.699 (6.691)	0.800 (0.810)		
n	162	137	25		
ln L	1022.500	-807.56	-172.17		
SSE	26.191	16.802	3.3397		
R^2	0.55	0.55	0.67		

[a]Absolute t-values in parentheses. Critical t-statistics for District I model (df=128) at the 1%, 5%, and 10% levels are 2.326, 1.645, and 1.282, respectively. For District IV model (df=16) at the 1%, 5%, and 10% levels are 2.583, 1.746, and 1.337, respectively.

Results of the empirical estimations are presented in Table 1. The BOX command of the SHAZAM Econometrics Computer Program (White) was used to search for the slope parameters that maximized the likelihood functions of the respective district models, given the previously estimated transformation parameters. R-square values presented were comparable to those of similar studies. At the 5 percent level of significance, acres per member was the only attribute found to be a significant contributor to the value of a deer hunting lease in District I. For District IV, acres per member, the presence of squirrels, and the quality were found to be significant. The intercept term exhibited significance only in the model for District I. District I is popularly perceived as inferior in hunting quality to District IV, a perception apparently supported by comparison of the quality variable between the models for the two districts. One possible explanation for this is that access to wildlife on private land may be of greater relative importance in District I because more public hunting areas lie within and in closer proximity to District IV than District I. Overall, however, the Pope and Stoll assertion that services and facilities associated with a lease have little effect on its price appears to be supported in Louisiana, at least in the two game management districts studied. Table 2 presents the results of the Chow F-test, which suggest that the specified attributes differ across Districts I and IV in their influence on the price paid by individual club members.

SUMMARY AND CONCLUSIONS

This analysis has attempted to identify, within a hedonic framework, attributes of private hunting leases which significantly contribute to their economic value. Two biologically distinct regions of the state were chosen for study in order to test for

Table 2. Chow F-Test for Equality of Parameters Across District I and IV Regressions, Louisiana, 1989 Data

$H_0 : \beta_I = \beta_{IV}$
Test Statistic:
$\frac{(SSE_{BOTH} - SSE_I - SSE_{IV})/K}{(SSE_I + SSE_{IV})/(n + m - 2K)}$
$= 4.805$
$F_{9,144}$ at 1% = 2.41
Null hypothesis of equality of parameters is rejected.

regional differences in slope coefficients of selected lease attributes. A flexible Box-Cox functional form was utilized in the regressions rather than the commonly used simple linear specification.

The results of this analysis indicate that services and amenities provided by landowners in Louisiana are not significant contributors to the value of a Louisiana deer hunting lease. Sufficiently large acreage per member of a hunting club was the only consistent contributor to lease value across regions. In Game Management District IV, the variable for hunting quality of the lease was significant, as might be expected in the region considered to be the state's prime deer hunting area. For private landowners considering the possibility of leasing hunting access rights to their game-supporting land to hunters, the results appear to imply that very little provision of services or amenities is necessary, provided they can offer sufficient acreage to prospective lessees. This result is interesting in light of similar findings by Pope and Stoll in a much more mature market for hunting access.

Previous research regarding the choice of functional form to be used in hedonic analysis of commodity prices indicates a preference for flexible forms over simple linear specifications. In the absence of clear guidance from economic theory as to functional specification, as in hedonic analysis, flexible forms that best fit the data have demonstrated their superiority. Specifically recommended is the linear Box-Cox form because of its performance in experiments against other forms in the presence of misspecification and imperfect information. Use of the Box-Cox functional form in this analysis increases confidence that estimated coefficients reflect the true characteristics of the market for hunting access.

Limitations of the study include issues related to data availability and quality common in similar studies using primary data. Although guided by theory and expert opinion in model formulation, the model as specified did not exhibit significance in a number of attributes hypothesized to contribute to the value of Louisiana deer hunting leases. These results suggest that access to hunting land is valued more by hunter than are owner-provided services and amenities. Further research to determine the consistency of these results across regions as well as levels of market maturity is in order. In addition, the relative contribution of lease management for trophy-quality deer in Louisiana and other states with markets for hunting access rights should be further explored.

In Louisiana, relatively immature markets for access to private hunting land coexist with a state supported and managed system of wildlife management areas for which there is no explicit fee. Economic analysis of the private markets for hunting land access may provide information that is valuable not only to private landowners in the efficient management of their resources, but also to public hunting land managers.

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