FACTORS INFLUENCING LEASE REVENUE AND NON-INDUSTRIAL LANDOWNERS' WILLINGNESS TO ALLOW HUNTING ACCESS*

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* The views in this paper are those of the authors and may not be attributed to Mississippi State University.
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ABSTRACT

Despite the fact that earnings associated with selling hunting leases could significantly contribute to landowners' incomes, only a small minority of them allow access on their lands for a fee. Based on a sample survey of Mississippi state landowners, we analyzed landowners' willingness to participate in supplying leases as well as factors influencing lease revenue per fee acre. While landowners' decision to allow hunting access and factors influencing lease revenue per acre were jointly modeled consistent with Heckman's analysis of sample selectivity bias, the hunting lease revenue function was specified in accordance with Rosen's hedonic pricing theory. Empirical results showed landowners' concerns about control over their land, loss of privacy and damage to property, and accident liability insurance reduced their willingness to allow hunting access; and, in contrast, increase in total land holding, race and residential location increased the probability of participation. With regards to factors explaining differences in lease revenue per fee acre, analysis showed that location, expertise in managing fee hunting enterprise, provision of services, and certain wildlife habitats account for systematic variations in lease revenues. These findings have implications for landowners' management of their lands, the design of extension programs, and public agencies engaged in the provision of natural resource based recreation.

Keywords: Marginal lands, Mississippi, Incentive programs, Recreation, Wildlife enterprises

JEL Codes: Q510, Q260

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INTRODUCTION

Interest in the potential for hunting access on non-industrial private lands is rising for a variety of reasons (Benson 2001; Jones et al. 2001). These reasons include supplemental income for landowners, and incentives to restore marginal or degraded lands as they find it in their interest to engage in wildlife habitat improvement. Especially for the small, non-industrial landowners who have to wait years for timber sale revenues to realize, the flow of annual hunting lease income could be a significant benefit (Yarrow and Yarrow 1998). In addition, hunting access on private lands has implications for hunters' welfare as congestion on public recreation lands rises, and the financial burden on various levels of government to protect marginal lands. However, while all these considerations certainly point to the existence of Pareto superior allocation on private lands from all stakeholders' perspective, there is not much recent research about landowners' willingness to allow hunting access on their lands and the factors that determine why among the small minority of landowners who do allow access for a fee, some are able to realize higher per acre hunting lease income than others. Previous research on hunters' willingness to pay for leases and site attributes they prefer has yielded some insights[1] that are helpful to the debate on hunting access on private lands, especially how private landowners might exploit them to their advantage by investing in those site attributes and thus attracting

[1] See for instance, Livengood, 1971; Pope et al. 1985; Messonnier and Luzar, 1990; Mackenzie 1990, Stribling et al. 1992; Boxall et al. 1996, Gan and Luzar, 1993, and Hussain et al. 2004.

hunters. Direct evidence as to factors that explain observed hunting lease revenues is, however, available from Loomis and Fitzhugh (1989), Baen (1997) and Zhang et al. (2005). Also while one may gain some insights by looking at hunting lease rates charged by large forest industries (Roach et al. 1996), they are not be indicative of observed lease revenues on private lands because forest industries are motivated by other considerations such generating community goodwill that in turn could be instrumental in reducing probability of fire, protection of lands or gaining leverage in anticipation of environmental regulations. This study aims to analyze factors that explain landowners' participation in hunting leases and why certain landowners that allow access are able to earn more than others. In the next section, we conceptualize major aspects of the hunting lease market, followed by a description of the estimation methods we use. Data generation, empirical results and concluding remarks are given at the end.

HEDONIC LEASE FUNCTION AND LANDOWNERS' WILLINGNESS

One may think of hedonic lease function to result from the interaction of the demand and supply of hunting site characteristics. The conceptual framework developed by Rosen (1974) thus provides the guiding construct for this study.[2] The technique uses systematic variation in price associated with characteristics of goods to impute willingness to pay for the characteristics, and assumes that the market for the good is a single integrated market in equilibrium, and that the good in question has a large number of levels of available characteristics from which buyers can choose. While the hunting lease market in the southeast US is not yet not fully integrated and

[2] Earlier applications of the technique to site differentiation include Miranowski, A. John and Brian, D. Hammes (1984) and Palmquist, B. Raymond, and Leon, E. Danielon (1989). See also, Le Goffe, P. (2000) for a recent application.

efficient due to informational constraints and skewed distribution of land ownership, it can reasonably be expected to meet these assumptions.

Of the two economic agents that interact in a hunting lease market, private landowners are the suppliers of hunting sites who maximize profits equating lease rate per unit to its opportunity cost in equilibrium while hunters demand hunting tracts to maximize utility by using hunting tracts along with other market purchased goods and personal time to produce "recreational experience" in a household production framework. In equilibrium, hunters equate willingness to pay for a hunting site to the sum of the value of marginal products of hunting site characteristics.[3] While in the short run, landowners recoup only average variable cost, in the long run they are assumed to supply hunting tracts conditional on fully recovery of relevant opportunity cost.

I. Determinants of hedonic lease function

Hunting lease revenue[4] may vary across regions and individual hunting sites for a variety of reasons. We identify habitat type, investment in habitat improvement, provision of services by

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[3] Ladd, G. W., and M.B. Martin. 1976, p.22. For an earlier application of Ladd and Martin ideas to a forestry issue, see, Puttock, et al. (1990).

[4] Note that hunting lease contracts vary in duration, game allowed for harvest and unit of account. With regards to duration, a hunting lease contract may be for a short term such as 1 day to 3 months, annual or multi-annual; game allowed for harvest may either include waterfowl, turkey, or deer, or any combination thereof. In terms of unit of account, leases may be transacted on per acre, per gun or per hunting club basis. Specificity about the type of hunting lease especially becomes important when one wants to estimate price elasticity: the broadly defined a hunting lease, the lower the lease rate elasticity with respect to changes in a given covariate.

landowners, scale of wildlife enterprise operation, and regional differences to account for variations in lease revenue.

Habitat differentiation: Game abundance, diversity and quality can be expected to positively relate to hunters' willingness to pay. However, while deciding on a lease contract, hunters form their expectations of quality recreation on the basis of site attributes, especially tract size, land use pattern, forest cover type, forest stand structure and age distribution, etc. As this information is at the same time available to landowners, habitat differentiation can reasonably be expected to facilitate convergence of landowners and hunters on a particular lease rate per unit. In this regards, one may think of natural bottomland hardwoods to serve as a benchmark of premium hunting sites as these forests can support two to five times as many game animals as nearby mixed pine and hardwood forests. The richness and high productivity of these forests translate into a comparable richness of wildlife (Harris et al. 1984). Next along the continuum are upland hardwoods, followed by mixed pine hardwoods, and pine lands because unlike pinelands, hardwoods not only provide cover but food as well almost throughout the year.

In areas where agriculture is a major land use activity, orchards especially those of pecan trees, pasturelands, and certain agricultural croplands that attract turkey, deer and other game could support higher game populations and thus generate higher lease revenues. However, the pattern of lease rate on agricultural lands could be very complex given the relatively higher probability of wildlife-agricultural land use conflicts, and variety of agricultural practices with varying wildlife benefits. In the face of this incompatibility, agricultural landowners in certain areas may even have an incentive to charge rather lower rates to control wildlife populations.

Investment in wildlife habitat improvement: Following Palmquist (1989) we may think of wildlife habitat to have certain characteristics that are within landowner's control. Depending on expected net returns, producer rationality implies that landowners may invest in these characteristics. Thus, private lands owners who allocate certain areas to wildlife food plots, and actively/or passively flood others could be expected to fetch higher returns.

Provision of services: Evidence regarding the role of the provision of services by landowners is mixed. While Pope et al. (1985) and Messonnier and Luzar (1990) did not find evidence to support the claim that hunters would be willing to pay more because of this reason, recognizing that services can range from very simple to quite elaborate it is likely that services would influence lease revenues. It is thus important to construct a services index to serve as an explanatory variable while determining lease revenues.

Scale of operation: Many factors bear on the relationship between leases rate and scale of wildlife enterprise operation. First, one would expect elasticity of demand for hunting access to depend on availability of substitute access options such as public land, or opportunities on friends/ acquaintances lands, and land size/ownership distribution pattern in a given region. Second, given that wildlife hunting like other recreation activities is a luxury good, demand for hunting leases is more likely elastic. Consequently, private landowners, especially very large ones, would have an incentive to lower lease rates in order to increase total revenue.

Location and market forces: While recognizing the importance of factors highlighted above in influencing lease rate, there are regional and location level market forces to account for as well. Thus, otherwise similar hunting sites may earn different per acre lease revenues across regions depending on the circumstances such as supply of public recreational lands relative to public demand, overall land use pattern, accessibility considerations, and the manner human population is distributed in a region.

II. Landowners' willingness to allow hunting access

Beyond the obvious reason whether a landowner has sufficiently large tract(s) of land, a diverse set of factors underlie private landowners' willingness to allow hunting access on their lands. One, a majority of landowners may not find potential financial returns associated with hunting access sufficient to offset their opportunity cost of time and other resources. Two, concerns for personal safety, privacy, accident liability insurance, damages to crops, timber and other property (Lynch and Robinson, 1998) could operate as serious constraints and in certain cases as the only limiting factor in whether or not a landowner leases his land. Three, not having enough technical expertise about leasing in terms of its tax and other legal ramifications, and understanding of wildlife habitat management are also important. Lastly, socio-demographics characteristics such as residential location, race, gender, education, and personal idiosyncrasy of being against wildlife hunting on moral or other grounds and past experience with rowdy hunters' behavior have also been pointed out (Guynn and Schmidt 1984) to underlie landowners' aversion to allowing hunting access.

ESTIMATION METHODS

We use a simultaneous equation model of landowners' participation and hedonic lease function consistent with Heckman sample selection model (1979). This choice is motivated by the realization that if the difference between landowners' reservation lease rate and market lease rate is positive, they would not be willing to participate in leasing. But landowners who allow hunting access for the opposite reason would constitute a nonrandom sample. Under these circumstances, the possibility of sample selection arises because unobservable factors determining inclusion in the sub-sample of landowners who lease their lands might be correlated with the unobservable factors influencing the hedonic lease function. Consequently, parameter estimates of the hedonic lease function would be biased and inconsistent unless they are jointly estimated. Further details describing the two equations and their technical relation to each other are given below.

Sample selection model: Let x_i' and w_i' be vectors of observations on predetermined variables, β and α as the associated unknown parameter vectors, σ_μ and $\sigma_\varepsilon = 1$ are standard deviations[5] of μ_i and ε_i respectively and ρ is correlation between μ_i and ε_i. Following Davidson and Mackinnon (2004, p.486) notation, the sample selectivity model is given as

$$\begin{bmatrix} y_i \\ z_i \end{bmatrix} = \begin{bmatrix} x_i'\beta \\ w_i'\alpha \end{bmatrix} + \begin{bmatrix} \mu_i \\ \varepsilon_i \end{bmatrix}, \qquad \begin{bmatrix} \mu_i \\ \varepsilon_i \end{bmatrix} \sim NID\left(0, \begin{bmatrix} \sigma_\mu^2 & \rho\sigma_\mu \\ \rho\sigma_\mu & 1 \end{bmatrix}\right) \qquad \text{Eq-1}$$

The observed variables y_i and z_i are respectively related to latent variables y_i^* and z_i^* such that

$$y_i = y_i^* \quad \text{if} \quad z_i^* > 0; \quad \text{else} \quad y_i = 0$$

$$z_i = 1 \quad \text{if} \quad z_i^* > 0 \quad \text{else} \quad z_i = 0$$

The conditional expectation of observed y_i is $x_i'\beta$, i.e., ordinary least squares estimates of β are unbiased only when the errors μ_i and ε_i are uncorrelated (H_0: ρ=0); otherwise it is affected by variables in the selection equation. To test whether the errors are indeed uncorrelated, note that the incidentally truncated bivariate normal distribution implies (Greene, 2003, p.781) that the conditional expectation of the observed y_i is

$$E[y_i \mid z_i > 0] = E[y_i \mid z_i^* > 0] = E[y_i \mid \varepsilon_i > -w_i'\alpha] = x_i'\beta + E(\mu_i \mid \varepsilon_i > -w_i'\alpha)$$

$$= x_i'\beta + \rho\sigma_\mu \lambda(\alpha_\mu) \qquad \text{Eq-2}$$

[5] As the variance of ε_i is unidentified, commonly a value of 1 is assigned to it.

where $\lambda_i(\alpha_\mu) = \frac{\phi(\alpha_\mu)}{1-\Phi(\alpha_\mu)} = \frac{\phi(-\alpha_\mu)}{\Phi(-\alpha_\mu)} = \frac{\phi(w_i'\alpha/\sigma_\mu)}{\Phi(w_i'\alpha/\sigma_\mu)}$ is the inverse Mills ratio, and $\phi(.)$ and $\Phi(.)$ are respectively the normal density function and normal distribution function. Thus, evidence in support of H_0: ρ=0 exists when the coefficient on $\lambda_i(.)$ is statistically insignificant. Eq-2 suggests that consistent estimates of β can be obtained using ordinary least squares regression of the observed y_i on x_i' and estimated $\lambda_i(.)$ where the unknowns in $\lambda_i(.)$ can be obtained from a probit estimation of z_i on w_i'. Obtaining consistent estimators this way is, however, problematic[6] because it does not impose the constraint $|\rho| \leq 1$ as implied by the underlying model; the standard errors are inconsistent because the regression model is intrinsically heteroskedastic due to selection and assume normality despite that it is not efficient. Thus, maximum likelihood estimates are generally preferred which are consistent and asymptotically efficient under the assumption of normality and homoskedasticity of the uncensored distribution. Davidson and Mackinnon (2004, p. 488) recommend using the two-step estimation method as a preliminary assessment tool to be followed by full information maximum likelihood estimation.

Maximum Likelihood Estimation: Given that there are two types of observations for the sample selection model, the likelihood function is the sum of two probabilities[7]. For observations where z_i =1, the likelihood is the probability of the event that both y_i and z_i >0. For the *i*th observation, this probability is written as

$$\Pr(y_i, z_i > 0 \mid (w_i', x_i') = f(y_i)\Pr(z_i > 0 \mid y_i, w_i', x_i')$$

[6] Hall, H. Bronwyn (2002). Notes on Sample Selection Models, Mimeo.

[7] Ibid.,

$$\Pr(y_i, z_i > 0 \mid (w_i', x_i) = f(\mu_i)\Pr(\varepsilon_i > -w_i'\alpha \mid \mu_i, w_i', x_i')$$

$$\Pr(y_i, z_i > 0 \mid (w_i', x_i') = \frac{1}{\sigma_\mu}\phi\left(\frac{y_i - x_i'\beta}{\sigma_\mu}\right).\Phi\left(\frac{w_i'\alpha + \frac{\rho}{\sigma_\mu}(y_i - x_i'\beta)}{\sqrt{1-\rho^2}}\right). \qquad \text{Eq-3}$$

For observations where z_i =0, the likelihood is just the marginal probability that $z_i \leq 0$, and is written as

$$\Pr(z_i \leq 0) = \Pr(\varepsilon_i \leq -w_i'\alpha) = \Phi(-w_i'\alpha) = 1 - \Phi(w_i'\alpha). \qquad \text{Eq-4}$$

For both set of sample observations, the log-likelihood is then

$$L = \sum_{z=0}\log(\Pr(z_i = 0)) + \sum_{z=1}\log(\Pr(z_i = 1) f(y_i^* \mid z_i = 1))$$

$$L = \sum_{0}\log[1 - \Phi_i(w_i'\alpha)] + \sum_{1}\left(-\log\sigma_\mu + \log\phi\left(\frac{y_i - x_i\beta}{\sigma_\mu}\right) + \log\Phi\left(\frac{w_i'\alpha + \frac{\rho}{\sigma_\mu}(y_i - x_i\beta)}{\sqrt{1-\rho^2}}\right)\right) \qquad \text{Eq-5}$$

Marginal Effects: The possibility that an independent variable may appear both in the selection and outcome equations suggests that the marginal effect of an independent variable on the mean y_i is not β_k but rather

$$\frac{\partial E[y_i \mid z_i^* > 0]}{\partial x_{ik}} = \beta_k - \beta_\lambda\left(\frac{\rho\sigma_\mu}{\sigma_\varepsilon}\right)\left(g\frac{\phi(g)}{\Phi(g)} - [\frac{\phi(g)}{\Phi(g)}]^2\right) \qquad \text{Eq-6}$$

to account for the fact that it influences the mean value of observed y_i through its presence in λ_i as well (Breen, Pp.42-43; Greene p.783). Here g denotes a particular value of $w_i'\alpha$.

DATA AND VARIABLES

Requisite data for this study were collected using a self administered mailed survey of non-industrial landowners owning a minimum of 100 acres in Mississippi. These landowners were identified and randomly selected from the property tax records of 67 Mississippi counties. One hundred acres was chosen as a minimum to target only landowners who participate in wildlife enterprises, and eliminate urban and suburban properties within property tax records. In October 2003, 2000 questionnaires were mailed to a stratified random sample of Mississippi landowners. Consistent with Dillman (1978) survey approach, landowners were mailed a reminder postcard one week afterwards and a second questionnaire 4 weeks later. The first mailing was October 29, 2003 and the last was November 25, 2003.

The sample was stratified into four ownership classes: 1) 100-199 acres, 2) 200-499 acres, 3) 500-999 acres, and 4) 1,000 and more acres. Thirty percent of the sample (n = 600) was sent 100-199 acres ownership class, another 30% (n = 600) of the sample was sent to the 200-499 acres ownership class, 16% (n = 320) was sent to 500-999 acres ownership class, and 24% (n = 480) was sent to the 1,000 and more acres ownership class. To ensure a certain minimum number of large landowners in the sample, those in the 1000 or more ownership class were over sampled. A weighting variable was later constructed and used during estimation to reflect the actual distribution of landowners in various land size classes.

A total of 484 questionnaires were returned implying a 30 percent response rate. However, due to missing data on variables of interest to this study such household income and especially hunting lease revenue, 16 cases were removed resulting in the final useable sample of 468.

Using survey data thus generated, requisite variables consistent with the methodological approach described earlier were constructed. While descriptive statistics of the variables are given in Table 2, certain details follow:

I. Hedonic lease function

Hunting lease market segmentation: Hedonic pricing requires that the market of interest be integrated for estimated implicit prices to be unbiased. Three regional markets were thus identified: eastern Mississippi (EAST) encompassing areas surrounding Tupelo-Columbus, southern Mississippi with Biloxi-Gulfport as the center (SOUTH), and Jackson-Greenville area to the west (WEST). Segmentation along theses boundaries not only ensures buffering how the state population is clustered but conforms to overall land use pattern as well. During estimation, this delineation was forced through a set of 3 dummies, DEAST, DSOUTH, and DWEST, with DWEST to serve as the base category. As an alternative to the above regional delineation, a variable "number of miles" hunting tracts were located relative to 10 major cities in the state was created, but not found helpful.

Lease type: An array of fee arrangements exist in Mississippi including annual and seasonal leases, and brokerage and short term agreements. The dependent variable in this study is gross annual revenue per acre. Annual leases seem to be the norm as of the 77 landowners that leased lands, over 75 percent were annual leases. Differences in gross annual revenue per acre due to fee arrangement were accounted for by defining a dummy variable "LTYP" such that LTYP=1 if the arrangement was brokerage or short term agreement, else LTYP=0.

Scale of operation: The inclusion of this variable is important to obtaining unbiased parameter estimates of the hedonic lease function. Measured by the "number of acres leased" and transformed in logarithms, we include LALSD as an explanatory variable to capture differences in lease rate due to scale of operations. Characterizing the hunting lease market, while on the supply side a minority of landowners owns a significant share of the land, on the demand there are a large number of hunters that have options to access public, own or friends/acquaintances lands. This suggests a market structure more akin to monopolistic competition and the influence of acres leased on gross annual revenue per acre would need to be seen in this context.

Landowners' knowledge of operating wildlife enterprises: To account for differences in gross annual revenue per acre due to differences in landowners' management competencies, we constructed two variables: landowners' experience with hunting leases, and how confident they believed having knowledge of operating a fee-hunting enterprise. Experience as measured by the "number of years lease operations were run" did not prove to be significant and thus discarded. In this study, landowners' management competency is thus captured by asking them to rate the amount of information they had about business planning fee hunting and/ or wildlife related fee access operation on a scale of 1-5 whereby 1, 2, and 3 indicated "no or some information", while 4 and 5 codified "complete information". For estimation purposes, the ratings were later dichotomized so that if landowner's own rating of information at his/her disposal was 4 or 5, the dummy EXPNC=1, and if the rating was 1, 2, or 3, EXPNC= 0.

Provision of services by landowners: The survey form sought information on a wide list of services generally considered to facilitate hunters. In our resulting sample, only 26 of the 77 landowners provided any service or a combination thereof. The following 3 broad categories were identifiable: a) blinds, guides, stands and lodging, represented by mnemonic SERVCS, b) percent of land under waterfowl impoundment (PLWI) and, c) maintenance and/or provision of the percent of land for wildlife food plots (PLWFP). Of these, we think of the last 2 categories of services essentially as aspects of wildlife habitat that are under the control of landowner.

Wildlife habitat differentiation: Alternative characterizations of wildlife habitat exist. For instance, there is a characterization by Brown et al. (1978) and a variation of the same thereof by Clark and Stankey (1979) that identifies factors defining outdoor recreation opportunity settings. This is essentially a system approach to recreation management which is motivated by the need to accommodate diversity. A narrow but more relevant approach to understanding hunting lease rates is by McKee (1990) which is based on the idea that certain habitat features are associated with greater wildlife quality than others. Accordingly, point values are assigned to 15 distinct habitat features, which are then used to construct a composite score for a particular land tract. These scores serve to classify hunting tracts into one of the following land classes: exceptional, excellent, above average, fair and poor, with exceptional tracts commanding highest lease rate while poor tracts to fetch lowest rates[8]. However, note that habitat differences alone cannot account for lease rate variations as McKee scoring of habitat and Baen's approach seems to imply. Factors such as scale of operations, regional considerations, and landowner marketing expertise, and services may also affect lease rate - the approach we follow in this study. Our characterization of hunting sites, with percent of land under bottomland hardwoods and permanent water bodies (PBHWPW) to serve as the base category, is given in table 1.

II. Determinants of landowners' willingness

Factors hypothesized to influence landowners' willingness to allow hunting access may be classified as technical, financial, personal idiosyncratic, and socio-demographic.

Technical constraints: We use total number of acres owned (LAOWD, expressed in logarithm) to proxy technical constraints to participation. Landowners who do not own a certain minimum size tract at one location would be technically constrained because big game including deer, turkey, and wild hog require large tracts to serve as home range. While ideally it is the largest tract size that determines participation, being a large landowner is likely to increase the

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[8] See also Baen (1997) who has constructed hunting lease indices using deer densities, trophy quality and location attributes of hunting sites. Baen argues that his indices could be used by agricultural land investors to quantify the recreational component of the market value of agricultural lands.

probability of having a larger tract. Using total land ownership rather than how large tract a given landowner has should not be a big concern.

*Personal idiosyncratic attributes***:** Codified as a set of dummy variables, we use identify 4 concerns: concern for who is using the land, concern for personal safety and privacy, concern for accident liability insurance, and concern about damage to crops, timber and property to limit landowners' willingness to allow hunting access. Data on these attributes were generated by asking whether any of these have been a problem expressed on a Likert scale of 1 to 5, with 1,2,3 to mean "NO", and 4 or 5 to mean "YES". Accordingly, we defined dummy variables CWUL= 1 if landowner was concerned about who is using land, else 0 CWUL=0; CPVCY=1 if concerned about personal safety and privacy, else CPVCY=0; CADP=1 if landowner was concerned about damage to crops, timber or other property, else CADP=0; CLIN=1 if landowner was concerned about accident liability insurance, else CLIN=0. We experimented with other attributes such as attitude towards wildlife hunting as well but severe estimation problems precluded their inclusion in the final specification.

*Socioeconomic and demographic characteristics***:** Among these we include 4 of them. These are race, RACE=1 if landowner identified himself/herself as Caucasian, else 0; residence, RLOC=1 if landowner lived within 20 miles from his/her land, else 0; education whereby three alternative education levels were codified with EDU_H, EDU_C, and EDU_U that respectively indicate whether a landowner had high school, college or university degree. We use EDU_U to serve as the base category. Lastly, gender with GNDR=1 if male, else GNDR=0. Inclusion of household income and credit constraints as additional socio-demographic factors created severe estimation problems and are thus omitted.

RESULTS AND DISCUSSION

Maximum likelihood estimation results given in Table 3 show that of the total number of 16 coefficients (excluding intercept) in the hedonic pricing function, 9 are different from zero at the conventional level of significance and have the anticipated impact on lease rate. Likewise, of the 11 coefficients in the landowners' participation function, 7 are highly significant and have the right signs. Regression diagnostics revealed multicollinearity among variables as the major culprit of not having still a larger number of significant coefficients - a finding that is typical of hedonic pricing studies. The overall fit is also highly significant suggesting confidence in the appropriateness of included explanatory variables. Specification bias due to the omission of potentially important explanatory variable also does not appear to be a problem either, because based on regression specification error test (RESET) we did not find evidence of inadequacy. Furthermore, as the coefficient on inverse Mills ratio (IMR) is not significant, the null hypothesis of zero correlation (H_0: $\rho=0$) between the hedonic pricing function and participation function cannot be rejected. Thus, there is no selection bias involved and the conditional mean value of the annual lease rate per acre is an unbiased representation of lease rate at the overall market level. Of the various functional forms we experimented with, the specification presented here provided the best fit. Further discussion of the plausibility of estimation results follows:

1. Elaborating on *the estimated hedonic lease function*, the finding that region specific dummy variables are significant agrees with the fact that the hunting lease market viewed at the state level is evolving (Yarrow and Yarrow 1999) and fragmented due to informational constraints. It is only by controlling for market segmentation this way that we can obtain precise estimates of

the influence of variables on lease rate. The percent marginal change[9] in lease revenue per acre in western Mississippi is quite large. Associated figures given in the last column (Table 3) show that relative to eastern and southern Mississippi, this advantage could range from 45 to 60 percent.

The percent response of the lease rate with respect to scale of operations (LALSD) is negative suggesting that for landowners' to lease additional acres, lease rate would need to be lowered. But this finding is not statistically significant indicating that demand for hunting sites is probably strong enough so that landowners do not need to lower rates in order to induce increase in sales. Reflective of the role of management in influencing lease rate, the coefficient on EXPNC is positive and highly significant. Thus, landowner who are knowledgeable about business planning for a fee hunting access operation have a definite advantage (almost 47 percent) over otherwise similar landowners. The coefficient on the variable "provision of services such as blind/stands, guides and lodging" by landowners is statistically significant and has large marginal impact as one would expect.

Regarding the two habitat specific attributes under the control of landowners, i.e., maintenance of permanent waterfowl impoundments by landowners as well as wildlife food plots, the results are statistically significant and have the expected a priori positive signs. It turns out, however,

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[9] As none of the explanatory variables appear both in the hedonic and participation function, the expression for percent marginal effects for hedonic lease function are simpler than Eq-6. For the dummy variable: $\{Exp[(\hat{\beta}_k - 0.5 * V(\hat{\beta}_k)] - 1\} * 100$; ii) $\partial \ln feeacres / \partial \ln LALSD = \hat{\beta}_{feeacres}$; iii) habitat attribute $x_k : \partial \ln rev / \partial x_k = \hat{\beta}_k \bar{x}_k$

that these services only account for 8-12 percent increase in lease revenue and has implications for landowners' incentives to invest in habitat improvement.

Empirical findings regarding the fixed wildlife habitat characteristics are vivid: relative to the base habitat category (of bottomland hardwoods and permanent water bodies such as streams, rivers and ponds), cutover forestland and mixed-pine-hardwoods are less preferred as expected. At the other end of the habitat spectrum, acreages allocated to aquaculture, pastures and orchards are preferred. The only inconclusive finding relates to the role of lands in pine plantations relative to the base category because the expectation was that the associated coefficient on the variable "percent share of pines lands" would be significantly negative. While further analysis in this regards may be warranted, collinearity diagnostics (variance inflation factors and pair wise partial correlations) showed significant correlation between acres leased and land under various agricultural and forestry uses.

2. Turning to the *estimated landowners' participation function*, overall the fit seems to be quite reasonable. The negative intercept coefficient of the probit index suggests that in general landowners are averse to the idea of allowing hunting access.[10] Of the set of independent variables, only the gender and dummy variables representing various levels of education do not appear to have significant relation with landowners' willingness to allow hunting access. Landowners concerns, whether about who is using their lands, privacy and family safety, accident liability insurance and damage to crops, timber and other property, definitely seem to constrain broad based landowner participation. In terms of percent marginal effect[11], a

[10] Because if all other covariates in the participation are assumed to be unimportant, the predicted probability of participation given $\hat{\alpha}_0 = -3.2852,$ is zero, i.e., $\hat{p} = \Phi(\hat{\alpha}_0) = \Phi(-3.2852) \approx 0$

[11] Marginal effects for the participation equation are based on the expression: $[\partial\Phi(w_i'\hat{\alpha}) / \partial w_j].\hat{\alpha}_j$.

landowner who is concerned about who is using his/her land would have 5.20 percent less willingness to allow hunting access. Likewise being a landowner who is concerned about damage to crops, timber and other property reduces such chances by 5.13 percent (table 3, column 3). Except for Zhang et al. (2005) who argue based on their findings that concern for accident liability insurance may not be a factor, probably because of the lack of actual lawsuits against landowners, the results here are consistent with findings by others (See for instance Conover and Messmer 2001). Wright et al. (2002) documents that of the 15 hunting liability insurance cases filed against landowners in the past 4 decades, 9 were in the southeast US with 7 alone were in the adjoining Louisiana state, 1 in Alabama – another adjoining state and 1 in Texas. Thus, concern about accident liability insurance is not just a perception problem; it is a reality landowners need to reckon with.

The significant coefficient on residential location, RLOC, indicates that it is not only landowners who live on their rural property that are averse to allowing access but other rural landowners as well. This finding resonates with findings by Newman, et al.(1996) and Wright et al. (1990, p.193) who showed that in response to the socio-demographic factors, landownership pattern in the southeast US is changing and that new landowners, who generally reside in urban areas, have pecuniary motives to own lands unlike traditional landowners.

Lastly, the significant and positive coefficient on total acres owned, LAOWD, shows that having large ownership does induce landowners' willingness to allow access. Indicated by the estimated marginal effect given in Table 3 (column 3), owning 1 more acre of land increases the probability that a private landowner would allow hunting access on his/her land by about 2 percent. This is understandable because large landowners' are considered to own lands for financial reasons (Newman and Wear 1993). Furthermore, since risk aversion is a decreasing function of wealth, large landowners can be expected to be less risk averse, *ceteris paribus*, and thus more likely to allow hunting access.

CONCLUDING REMARKS

1. The findings of this study suggest that location, expertise in managing and marketing a fee hunting enterprise, and provision of services by landowners largely account for the variation in the hunting unit lease rate in Mississippi. While hunting site attributes, whether fixed or under the control of landowner, explain a relatively less share of the revenue, significant potential exists for enhancing this share. The finding that certain landowners in certain regions of the state realize higher lease revenues than others points to importance of segmenting hunting lease market along regional lines while modeling in order to reduce chances of obtaining bias parameter estimates of hedonic lease function. The positive influence of being knowledgeable about operating a fee hunting enterprise on lease revenues implies that public agencies with mandate for extension and outreach efforts would best advance natural resource based enterprise development if such efforts are focused on facilitating landowners' entrepreneurial skills.

The role of services provision such as blinds, guides and lodging in influencing lease revenues suggests landowners may be able to realize higher returns by investing in such efforts. Given that providing guidance related services could be time consuming, it is likely that landowners with low opportunity cost of time would benefit more.

Evidence that increases in lease revenue are associated with improvements in certain hunting site attributes suggests that landowners would have incentive to make such improvements. The level of such investments would, however, depend on the cost of these improvements relative to potential returns. Public agencies interested in conserving natural resources especially protecting marginal lands would find it helpful to see if enough incentives exist for landowners to make socially desirable levels of improvements.

2. That landowners who do not live near their land are more likely to allow hunting access is insightful. The fact that landownership patterns in the southeast US are dramatically changing such that most new landowners' reside in urban areas, implies that hunting access on private lands in the future might increase. The negative role of existing landowners' concern for privacy, liability insurance, and damage to crops, timber and property, is, however, a fact that those interested in promoting hunting access on private lands must to reckon with.

REFERENCES

Baen, J.S. "The Growing Importance and Value Implications of Recreational Hunting Leases to Agricultural Land Investors." *Journal of Real Estate Research* 14(1997):399-414.

Benson, E. Delwin. "Wildlife and Recreation Management on Private Lands in The United States." *Wildlife Society Bulletin* 29(2001): 359-371.

Boxall, C. Peter., W. L.Adamowicz., J. Swait., M. Williams and J. Louviere. "A comparison of stated preference methods for environmental valuation." *Ecological Economics* 18(1996):243-253.

Breen, R. *Regression Models: Censored, Sample-Selected, or Truncated.* Thousand Oaks, CA: Sage Publications, Inc, 1996.

Brown, P., Driver, B., and McConnell, C. "The Opportunity Spectrum Concept in Outdoor Recreation Supply Inventories: Background and application." *Proceedings of the Integrated Renewable Resource Inventories Workshop.* USDA Forest Service General Technical Report RM-55, 1978:73-84.

Clark, N. Roger, and George H. Stankey. "*The Recreation Opportunity Spectrum: A Framework for Planning, Management and Research."* USDA Forest Service General Technical Report PNW-98, 1979.

Conover, M., and T. Messmer. "Wildlife and Rural Landowners." In Daniel Decker., Tommy L. Brown, and William F. Siemer, eds. *Human Dimensions of Wildlife Management in North American*, Maryland: The Wildlife Society, 2001: 243-268.

Davidson, R., and J. G. MacKinnon. *Econometric Theory and Methods, NY:* Oxford University Press, 2004.

Dillman, D.A. *Mail and Telephone Surveys: The Total Design Method,* NY: John Wiley & Sons, 1978.

Greene, W. H. *Econometric Analysis*, 5th ed. Delhi: Pearson Education, Inc., India, 2003.

Guynn, D. E., and Schmidt, J.L. "Managing Deer Hunters on Private Lands in Colorado." *Wildlife Society Bulletin 12*(1984):12-19.

Harris, D. Larry., Rick Sullivan, and Lynn Badger. "Bottomland Hardwoods." School of Forest Resources and Conservation and U.S. Fish and Wildlife Service.1984

Heckman, J. "Sample Bias as a Specification Error."*Econometrica* 47(1979):153-161.

Hussain, A., D. Zhang, and J.B. Armstrong. "Willingness to Pay for Hunting Leases in Alabama." *Southern Journal of Applied Forestry* 28(2004): 21-27.

Jones, D., I. Munn., S. C. Grado, and J. C. Jones. “A survey to Determine Fee Hunting on Mississippi Non-Industrial, Private Lands.” In James E. Miller, ed. *Proceedings of the First National Symposium on Sustainable Natural Resource-Based Alternative Enterprises,* Starkville: Mississippi State University, 2003, Pp: 261-284.

Ladd, G. W., and M.B. Martin. “Prices and demands for input characteristics.” *American Journal of Agricultural Economics* 58(1976): 21-30.

Le Goffe, Philippe. “Hedonic Pricing of Agriculture and Forestry Externalities.” *Environmental and Resource Economics* 15(2000):379-401.

Loomis, J., and L. Fitzhugh. “Financial Returns to California Landowners for Providing Hunting Access: Analysis and Determinants of Returns and Implications to Wildlife Management.” *Transactions of the 54th North American Wildlife and Natural Resource Conference*, 1989, Pp:196-201.

Lynch, L., and C. Robinson. “Barriers to Recreational Access Opportunities on Private Lands.” In J.S. Kays, P.J. Smallidge, W.N. Grafton, and J.A. Parkhurst, eds. *Natural Resources Income Opportunities on Private Lands Conference,* Maryland: University of Maryland Cooperative Extension Service, 1998, Pp. 210-220.

McKee, C. “Valuation of Wildlife Habitat by Forest Industry: One Firm’s Approach.” In Greg K. Yarrow and D. C. Guynn, Jr, eds. *Proceedings of a Symposium on Fee Hunting on Private Lands in the South,* Clemson: SC: Clemson University , 1989, Pp: 107-116.

Miranowski, J., and B. Hammes. “Implicit Prices of Soil Characteristics for Farmland in Iowa.” *American Journal of Agricultural Economics* 66(1984): 745-49.

Messonnier, M.L., & Luzar, E.J. “A Hedonic Analysis of Private Hunting Land Attributes Using an Alternative Functional Form.” *Southern Journal of Agricultural Economics 22*(1990):129-135.

Newman, D.H., M.E. Aronow., T.G. Harris, Tr., and G. Macheski. “*Changes in timberland ownership characteristics in Georgia.”* In M. Baughman., and N. Goodman, eds. Symposium on nonindustrial private forests: learning from the past, prospects for the future. St. Paul: MN, University of Minnesota, 1996.

Newman, D.H., and D.N. Wear. “Production economics of Private Forestry: A Comparison of Industrial and Nonindustrial Forest Owners.” *American Journal of Agricultural Economics* 75(1993):674-684.

Palmquist, B. Raymond. “Land as a Differentiated Factor of Production: a Hedonic Model and Its Implications for Welfare Measurement.” *Land Economics 65*(1989):23-29.

Palmquist, B. Raymond and Leon E. Danielson. “A Hedonic Study of the effects of Erosion Control and Drainage on Farmland Values.” *American Journal of Agricultural Economics.* 71(1989):55-62.

Puttock, G.D., D.M. Prescott, and K.D. Meilke. “Stumpage Prices in Southwestern Ontario: A Hedonic Function approach.” *Forest Science* 36(1990):1119-1132.

Roach II, F. Don., A. Marsinko, and D. Guynn. “Forest Industry Hunt-Lease Programs in the Southern United States.” In Rhett, Johnson, ed. *A Symposium on the Economics of Wildlife Resources on Private lands*, Auburn, AL: Auburn University, 1996, Pp:

Rosen, S. “Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition.” *Journal of Political Economy* 82(1974):34-55.

Wright, B.A., Kaiser, R.A, and Nicholls, S. “Rural Landowner Liability for Recreational Injuries: Myths, Perceptions, and Realities.” *Journal of Soil and Water Conservation*, 57(2002):183-191.

Wright, A. Brett., Cordell, Ken. H, and Tommy L. Brown. “Public Recreational access: A National Study of Policies and practices of private Landowners.” In Joanne Vining, ed. *Social Science and Natural Resource Recreation Management*, Boulder: Colorado, Westview Press,

Yarrow, G.K., & Yarrow, D.T. *Managing Wildlife*. Alabama Wildlife Federation, 46 Commerce Street, AL: Montgomery, 1998

Zhang, D., A. Hussain, and J.B. Armstrong. “Supply of Hunting Leases from Non-Industrial Private Forestlands in Alabama.” *Human Dimensions of Wildlife* (Forthcoming 2005).

Table 1. List of variables included in estimation

Explanatory variable	Description
Outcome Equation - Hedonic Lease Function	
LNREV	*Dependent variable:* Logarithm of gross annual lease revenue per acre
LTYP	If lease type is permits or short term lease, LTYP=1, else 0;
EXPNC	If landowner is knowledgeable about fee-hunting business, EXPNC=1, else 0;
DEAST	If leased land is located in eastern MS., DEAST=1, else 0;
DSOUTH	If leased land is located in southern MS., DSOUTH=1, else 0;
DWEST	If leased land is located in western MS., DWEST=1, else 0; [BASE Category]
SERVS	If landowner provided blinds, guides and lodging, PBGL=1, else 0;
LALSD	Logarithm of the number of acres leased;
PCROP	Percent of land under row crops and fallow;
PLAQC	Percent of aquaculture & other land;
PLOCD	Percent of land under orchards;
PLOAG	Percent of land under other agricultural activities;
PCUTOF	Percent of cutover forestland;
PLMPINE	Percent of land under managed pine;
PLMPH	Percent of land under mixed pine hardwoods;
PLWFP	Percent of land allocated to wildlife food plots;
PLWI	Percent of land under man made permanent water
PLOAC	Percent of land allocated to other uses (power lines, residence, other);
PBHWPW	Percent of land under bottomland hardwoods/water bodies; [BASE Category]
Selection Equation – Willingness to allow Hunting Access	
LP	*Dependent variable:* LP=1, if landowner leased land for hunting, else LP=0
LAOWD	Logarithm of all acres owned
CWUL	If concerned about who is using land, CWUL=1, else 0;
CPVCY	If concerned about privacy, CPVCY=1, else 0;
CADP	If concerned about damage to property on land, CADP=1, else 0;
CLIN	If concerned about accident liability insurance, CLIN=1, else 0;
EDU_H	If landowners' level of education is high school, EDU_H=1, else 0;
EDU_C	If landowners' level of education is College, EDU_H=1, else 0;
RACE	If race is Caucasian, RACE=1, else 0
GNDR	If gender is male, GNDR=1, else 0;
RLOC	If residential location is rural, RLOC=1, else 0;

Table 2. Summary statistics of variables included in estimation

Variables	Full Sample (n=468) Means	Full Sample (n=468) St.Dev	Lessors (n=77) Means	Lessors (n=77) St.Dev.
I. Hedonic Lease Function				
LTYP	0.041	0.198	0.247	0.434
EXPNC	0.105	0.306	0.130	0.338
DEAST	0.312	0.464	0.312	0.466
DSOUTH	0.194	0.396	0.169	0.377
DWEST	0.494	0.501	0.519	0.503
SERVS	0.026	0.158	0.156	0.365
LALSD	1.016	2.340	6.172	1.180
PCROP	1.508	8.466	9.166	19.216
PLAQC	0.138	2.332	0.841	5.730
PLOCD	0.084	1.559	0.509	3.835
PLOAG	0.027	0.420	0.164	1.029
PCUTOF	0.859	6.723	5.220	15.959
PLMPINE	5.509	19.558	33.483	37.435
PLMPH	5.155	18.320	31.331	35.092
PLWFP	0.218	2.373	1.326	5.756
PLWI	0.264	4.633	1.603	11.389
PLOAC	0.306	3.196	1.861	7.736
PBHWPW	1.958	10.153	11.900	22.661
II. Willingness to allow Hunting Access				
LAOWD	5.963	0.995	6.594	1.037
CWUL	0.562	0.497	0.026	0.160
CPVCY	0.579	0.494	0.039	0.195
CADP	0.498	0.501	0.026	0.160
CLIN	0.577	0.495	0.052	0.223
EDU_H	0.295	0.456	0.182	0.388
EDU_C	0.496	0.501	0.584	0.496
RACE	0.889	0.315	0.948	0.223
GNDR	0.833	0.373	0.844	0.365
RLOC	0.585	0.493	0.506	0.503

Table 3. Empirical results of full information maximum likelihood estimation

Variable	Coef.	*z*-statistics	Marginal Effect (%)
I. Hedonic Lease Function: $X'\beta$			
Constant	2.1563	2.61	
LTYP	-0.0849	-0.56	-9.18
EXPNC	0.4006**	2.12	46.64
DEAST	-0.8572*	-5.65	-58.05
DSOUTH	-0.5706***	-1.84	-46.14
SERVS	0.3829***	1.68	42.87
LALSD	-0.0453	-0.46	-4.53
PCROP	-0.0049	-1.11	-4.49
PLAQC	0.0224*	2.59	1.88
PLOCD	0.1234	1.59	6.29
PLOAG	0.0877*	2.42	1.44
PCUTOF	-0.0087*	-2.46	-4.54
PLMPINE	0.0009	0.37	3.01
PLMPH	-0.0035	-1.56	-10.97
PLWFP	0.0635*	3.82	8.42
PLWI	0.0312*	10.69	5.00
PLOAC	-0.0632	-1.57	-11.76
II. Willingness to allow Hunting Access: $W'\alpha$			
Constant	-3.2852	-4.44	
LAOWD	0.4049*	3.90	1.88
CWUL	-0.8530*	-2.93	-5.20
CPVCY	-0.5287**	-2.13	-2.73
CAPD	-0.9557*	-2.62	-5.13
CLIN	-0.5398**	-2.04	-3.00
EDU_H	-0.0506	-0.18	-0.16
EDU_C	0.1904	0.79	0.93
GNDR	-0.1232	-0.41	-0.63
RACE	0.9945*	2.68	2.38
RLOC	-0.3837***	-1.73	-1.90
ρ	-0.2101	-0.39	
σ	0.5675*	-5.47	
λ	-0.1192	0.40	
Wald $\chi^2(16)$	5178.5800		
Log pseudo-likelihood	-2330.2980		
Sample observations	468		
Censored	391		
Uncensored	77		

Wald test of independent equations ($\rho = 0$): $\chi^2(1)$=0.15; $\Pr ob > \chi^2 = 0.6959$.

* Significant at 1 percent;

** Significant at 5 percent;

*** Significant at 10 percent.