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Supply of Hunting Leases from Non-Industrial Private Forest Lands in Alabama

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We used a two-step approach to jointly analyze participation of non-industrial private forest landowners in hunting leases and the determinants of hunting lease fees. Data for this study were obtained from a survey of landowners in Alabama (n = 227). The results show that land ownership type, tract size, and landowners' place of residence, employment status, and concern for personal safety are determinants of participation in hunting leases. Factors influencing hunting lease fees include site-specific characteristics such as share of agricultural land relative to forest land, tract size, year-round water availability, type of access, and enhanced features such as streamside management zone, habitat improvement desirable to wildlife, and provision of services. The study has implications for landowners' land use decisions and economic returns.

Keywords hunting lease, hedonic pricing, lease fee, non-industrial private forest lands, sample selection bias

Introduction

Leasing hunting rights on non-industrial private forest (NIPF) lands is increasing in the southern United States as social and economic factors interact to make it attractive to both hunters and landowners. Given that NIPF landowners own some 70% of forest lands in southern United States, understanding the availability of NIPF lands for hunting lease is important for wildlife management (Morrill, 1987; Noonan & Zagata, 1982). Hunting leases could also benefit landowners and rural economies (Smith, Berner, Cuthbert, & Kitts, 1992) and reduce the need for governmental regulatory measures and subsidies for landowners to afforest marginal agricultural land and to protect ecologically diverse forests and wetlands (Jones, Munn, Grado & Jones, 2001). However, after the initial works by Livengood (1983), Pope and Stoll (1985), Loomis and Fitzhugh (1989), Messonier and Luzar (1990), and Taff (1991), we only found two articles (Baen, 1997; Benson, 2001) and a few conference papers (McGlincy & Durham, 1996; Lynch & Robinson, 1998) on landowners' participation in hunting leases and determinants of hunting lease fees.

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Hunting lease participation and hunting lease fees are conceptually related, but often treated as separate issues. Guynn and Schmidt (1984), Brown, Decker, and Kelly (1984), Marion (1989), Ruff and Isaac (1987), and Jordan and Workman (1989) are examples of studies on hunting lease participation. Loomis and Fitzhugh (1989), Guynn and Steinbach (1987), and Steinbach, Conner, Glover, and Inglis (1987) represent studies on factors influencing hunting lease fees. These two issues constitute the supply of hunting lease, and ideally, need to be modeled jointly. Failure to consider the correlation between them may lead to incorrect inference regarding the impact of various factors on hunting lease fees.

In this study, we jointly analyze NIPF landowners' hunting lease decision and the role of tract characteristics, habitat improvements made by landowners, and provision of services (such as food, lodging, stands or guidance) in influencing hunting lease fees. Identifying hunting lease participation will enhance our ability in solving problems that result in non-leasing while understanding factors influencing lease rates would enable landowners to target appropriate improvements consistent with prospective financial returns.

Determinants of Hunting Lease and Lease Fees

Factors Influencing NIPF Landowners' Hunting Lease Decision

Concern for Personal Safety and Damage to Property. Landowners' concern for personal safety and damage to property is often a decisive factor in whether to allow hunting access (Wright & Kaiser, 1986). This is especially true for landowners who reside on a tract that could be leased (Wright, Cordell, & Brown, 1990). Although these landowners can economize their time in supervising hunters, they may be reluctant to lease the tract because of personal safety concerns. Other things being equal, the higher the concern for personal safety and property damage, the lower the chance of landowner participation in hunting leases.

Liability Considerations. Possible liability associated with hunting-related injuries makes hunting lease a risky proposition for landowners (Copeland, 1998; Shelton, 1987). Although state laws in the southern United States limit the legal liability in recreational injury, some landowners either do not know the law or are not convinced (Wright, Cordell, & Brown, 1990). Even with knowledge about liability rules, landowners may still not allow access on their lands for fear of litigation that may outweigh the financial benefits of leasing (Lynch & Robinson, 1998). Landowners who are less knowledgeable about liability rules or fearful of litigation are less likely to participate in hunting lease.

Economic Considerations. Compatibility of hunting leases with other land uses,[1] opportunity cost of landowners' time (Ruff & Isaac, 1987), tract size, form of ownership (individual or joint), and household income can be important. Other things being equal, large landowners are more likely to participate in hunting lease. Although landowners with small tracts can combine their lands and market them together for hunting leases, transaction costs may hinder this process and thus lower their probability of participation. Similarly, landowners with low opportunity cost of time (unemployed, part-time employees), joint ownership, and low income are expected to be more likely to lease their land for hunting.

Landowners' Experience with Leasing and Hunters' Behavior. Inappropriate behavior by hunters such as the use of alcohol and vandalism have been noted as major disincentives to landowners leasing land for hunting (Guynn & Schmidt, 1984). In addition, landowner attitudes toward hunting access are influenced by their personal experiences and the experiences of their friends and neighboring landowners. A landowner's past experience is thus likely to be factor in influencing his or her participation.

Landowner's Characteristics. Family composition, age, education, and social characteristics such as participation in wildlife management programs might influence landowners' hunting lease decision. Although all these characteristics are important, a priori it is hard to predict how they are likely to shape a landowner's attitude toward land leasing for hunting. For instance, one may argue that highly educated landowners who participate in wildlife-related programs and have a better knowledge about liability issues are more likely to allow access. Others may argue just the opposite: these landowners may not see the need to lease their lands for income generation. Variables used in the hunting lease participation regression along with hypothesized effect on participation are presented in Table 1.

Determinants of Hunting Lease Fees

Determinants of hunting lease fees have been analyzed from various perspectives. Livengood (1983), Pope and Stoll (1985), Messonnier and Luzar (1990) used data generated from interviews of hunters and drew conclusions on factors that determine lease rates. Loomis and Fitzhugh (1989) and Baen (1997), on the other hand, used data generated from farm and ranch hunting surveys. Collectively, they identified *supply side factors* such as site location and biophysical characteristics, game diversity and abundance, tract size, congestion, provision of services by landowners, and *demand side factors*, including satisfaction (quality of hunting experience as measured by hunters' harvest success, percent of trophy animals) and income that influence lease rate.[2]

In this study we hypothesized that lease fee per acre can be modeled as hedonic pricing function with hunting land characteristics, game diversity, wildlife enhancing improvements, and provision of services by landowners as arguments

$$L_i = f(A_i, G_i, I_i, S_i) \tag{1}$$

where

L_i = hunting lease fee or lease rate per acre,
A_i = site characteristics specific to the tract of land owned by landowner i, including the share of land in agricultural use relative to forestry use; tree species and age; stream side management zone, type of access, and site quality consistent with Clark and Stankey (1979) conceptualization,
G_i = game diversity specific to the tract of land owned by landowner i,
I_i = habitat improvements made by landowner i, such as food plots, wildlife feeders, streamside management, and species/age diversity of plants beneficial to wildlife,
S_i = services, including food, lodging, stands or guidance provided by landowner i.

Hunters are interested in harvest success and hunting experience. Based on their knowledge of the aforementioned attributes, hunters form expectations as to whether the site in question offers the desired experiences and make a decision to pay a certain lease

Table 1
Factors Influencing NIPF Participation in Hunting Leases—Selection Mechanism

Variable	Definition	Description	Hypothesized effect on participation
Dependent			
z_i	Participation in hunting lease	Yes = 1; 0 otherwise	
Explanatory			
w_1	Ownership type	Dummy: 1, if individual; 0 if jointly owned	Owning land individually reduces the probability of hunting lease for lack of time.
w_2	Log-Tract size	Continuous, logarithm of acres	Owners having large tracts are more likely to participate in hunting lease.
w_3	Employment status	Dummy: 1, if retired, part-time worker or unemployed; 0 otherwise	Landowners who are retired, part-time workers or unemployed are more likely to lease lands than those who are full-time employed.
w_4	Residence	Dummy: 1, if landowner resides off-farm; 0 otherwise	Indeterminate
w_5	Concerned for safety	Dummy: 1, if landowner expressed concern; 0 otherwise	Those concerned for safety would be reluctant to allow access.
w_6	Concerned for liability	Dummy: 1, if landowner expressed concern; 0 otherwise	Those afraid of being sued would be less likely to allow access.

rate at the time of leasing. In other words, site attributes are used here as proxies of harvest success and hunting experience.[3] When certain site attributes are associated with higher success and better hunting experience than others, hunters would be willing to attach a premium to them. These factors hypothesized to influence lease fees, along with their hypothesized impacts, are listed in Table 2.

The underlying motivation for the assumed impact of the variables listed in Table 2 come from how they influence deer habitat, game abundance, and diversity. For instance, vegetated roads are preferred by wild turkey and deer over paved and gravel roads. Whereas some hunters may prefer paved or gravel roads for human movement, vegetated roads attract diverse and abundant game. Habitat improvement, year-round water supply and streamside management zones can, likewise, be expected to command a premium because of their positive impact on wildlife abundance and game diversity. In fact, wildlife organizations in the southern United States derive tract- and location-specific lease rates by assigning scores to hunting sites based on certain characteristics (see for instance, Yarrow & Yarrow, 1999, p. 404). We exclude hunters' characteristics because landowners may not know hunters' income class and their hunting successes and experiences.

Methodology

Participating in hunting leases and setting up a hunting fee are related issues for landowners. Following Heckman (1979) we analyzed the issues jointly. Formally, assume there exists a latent selection variable z_i* that determines whether or not land is leased by landowner i. Generally, z_i* cannot be observed; rather, only the sign of z_i* can be inferred. If a parcel of land is leased, then z_i* is assumed to be positive and z_i takes on the value 1; otherwise, z_i* is zero or negative and $z_i = 0$. Assuming that the discrete choice probit model holds as to whether NIPF landowners participate in hunting leasing, their land leasing decision (or selection mechanism stage) can be formalized (Greene, 1993, pp. 710–713) as:

$$
\begin{aligned}
& z_i^* = (\gamma' w_i) + \mu_i && \mu_i \sim N[0,1] \\
& z_i = 1 && \text{if } z_i^* > 0 \\
& z_i = 0 && \text{if } z_i^* \leq 0 \\
& \mathrm{Prob}(z_i = 1) = \Phi(\gamma' w_i) \\
& \mathrm{Prob}(z_i = 0) = 1 - \Phi(\gamma' w_i)
\end{aligned}
\tag{2}
$$

where Φ denotes cumulative normal distribution function, w_i is the set of factors influencing landowners' hunting lease participation, and γ is the parameter vector to be estimated. The determinants of lease fees (L_i) [Equation (1)] can be written as:

$$
L_i = \beta' x_i + \varepsilon_i \tag{3}
$$

where x_i represents the set of factors that explain lease fees, with β as the associated vector of parameters to be estimated. It is assumed that u_i and ε_i have a bivariate normal distribution with means of zero and correlation coefficient ρ. That is, u_i and ε_i are N (0, 0, 1, σ_ε, ρ). Assume that z_i and w_i are observed for a random sample of hunting lands, but L_i is observed only when $z_i = 1$, then the model can be written as:

$$
E[L_i | z_i = 1] = \beta x_i + \rho \sigma_\varepsilon \lambda(\gamma' W_i) \tag{4}
$$

Table 2
Factors Influencing Lease Fee—Outcome Stage

Variable	Definition	Description	Hypothesized effect
Dependent			
$Log(L_i)$	Log of lease rate per acre	Continuous	
Explanatory			
x_1	Log-Tract size	Continuous	Larger land holdings are associated with a lower lease rate per acre possibly due to management problems.
x_2	Lease type	Dummy: 1 if annual; 0 otherwise	Compared to leases sold for multiyear period, annual leases would be expected to have lower rate.
x_3	Site quality	Dummy: 1 if semi-modern; 0 otherwise	Lands offering secluded site quality are expected to have higher lease rates.
x_4	Paved access road	Dummy: 1 if paved; 0 otherwise	Paved access roads are expected to have lower rates than those that have vegetated access roads.
x_5	Gravel access road	Dummy: 1 if gravel; 0 otherwise	Gravel access roads are expected to have lower rates than those that have vegetated access roads.
x_6	Habitat improvement	Dummy: 1 if yes; 0 otherwise	Improvements by landowner are expected to influence lease rates positively.
x_7	Year-round water supply	Dummy: 1 if yes; 0 otherwise	Year-round water supply is expected to impact rates positively.
x_8	Stream side management	Dummy: 1 if yes; 0 otherwise	Stream side management is expected to impact rates positively.
x_9	Services provided	Dummy: 1 if yes; 0 otherwise	Provision of services, including stands, lodging, food, or guidance, is expected to have positive effect.
x_{10}	Land under creek, rivers, wetlands, swamp, and ponds relative to forestry	Continuous	Indeterminate
x_{11}	Land under crops relative to forestry	Continuous	Indeterminate
x_{12}	Land under crops relative to forestry squared	Continuous	Indeterminate

where $\lambda(\gamma' w_i)$ is the inverse Mill's ratio (IMR) given by $\varphi(\gamma' w_i)/[1-\Phi(\gamma' w_i)]$, and where φ and Φ, respectively, denote the normal density and cumulative normal distribution functions (Jud & Seaks, 1994). The IMR is constructed based on the estimated participation model for each observation and serves as a proxy for the unobservable variable that links the participation and fee models. The presence of the variable $\lambda(\gamma' w_i)$ in equation (4) is a proxy for the omitted variable that would otherwise get ignored if it is estimated from only the leases that are sold.[4] The *t*-test on the null hypothesis H_0: $\rho = 0$ is a test on sample selection bias.

The relation between and Lamda (λ) and Rho (ρ) is better understood by rewriting the fee model as:

$$E[L_i | z_i = 1] = \sim \beta x_i + \theta \lambda(\gamma' w_i)$$

where $\theta = \rho\sigma_\mu$ and ρ is the correlation between μ (error term associated with the participation model) and ε (error term associated with the fee model), and σ_μ is the standard deviation of μ. Given that σ_μ is always positive, the sign on θ is determined by the sign on the ρ. Thus, if ρ is negative and statistically significant, independent estimation would result in upwardly biased parameter estimates. If ρ is positive and statistically significant, independent estimation would result in downwardly biased estimates. The errors term in the participation and fee models are likely to be correlated if factors influencing participation influences lease rate in some way. The intuitive basis of this correlation is the same as encountered in the context of seemingly unrelated regression and arises due to omitted variable bias.

Data

The data for this study were generated from a survey of NIPF landowners in Alabama in the spring 2002. The survey covered 950 landowners who owned 100 or more acres of forest land, randomly selected from a total of 119,715 landowners in 55 of the 67 counties in the state. The sample was drawn from county tax records of landowners who paid a $0.05 per acre state fire tax.

To reduce the potential for non-response bias, we sent a reminder to all landowners two weeks after the initial mailing and a second mailing after a month to those who did not respond to the first mailing. Of the 950 survey forms we sent out, 25 were retuned as undeliverable, and another 10 respondents did not provide any information as they had sold their land. We received 250 responses for an overall response rate of 27%. Of these responses only 227 were usable as 23 survey forms were incomplete.

Details specific to hunting access were confined to the largest tract. This includes the size of the tract; relative shares of forest, crops, swamps and creek, rivers, and ponds; age distribution of trees; composition of trees distinguished as hardwood and softwood; game abundance and diversity (affording opportunities for waterfowl, deer, turkey and quail hunting versus deer, turkey, and quail hunting); water supply (year-round or intermittent); site quality (secluded versus semi-modern); streamside management zones; accessibility to the tract (by 2-wheel or 4-wheel vehicle) and on the tract (paved, gravel or vegetated); and investment in habitat improvement such as the installment of feeders, planting of food plots, encouragement of plant species and age diversity beneficial for wildlife. Landowners also indicated any services such as food, lodging, or guidance, and site quality (secluded versus semi-modern) that they provided (Clark & Stankey, 1978).[5] Table 3 presents the means and standard deviation of selected variables used in this study.

Table 3
Statistics of Variables Used in the Full Information Maximum Likelihood Estimation

		All (n = 227)		Participants (n = 57)	
Variable	Variable definition	Mean	Std. Dev.	Mean	Std. Dev.
	Determinants of landowners' participation—Selection mechanism				
w_1	Ownership type	0.82	0.39	0.68	0.47
w_2	Log-Tract size	5.42	1.23	6.28	1.28
w_3	Employment status	0.49	0.50	0.49	0.50
w_4	Residence	0.74	0.45	0.88	0.33
w_5	Concerned for safety	0.66	0.48	0.49	0.50
w_6	Concerned for liability	0.54	0.50	0.40	0.49
	Determinants of hunting lease fee—Outcome stage				
L_i	Annual gross lease rate per acre	1.38	2.88	5.68	3.08
x_1	Log-Tract size	5.42	1.23	6.28	1.28
x_2	Lease type	0.21	0.41	0.82	0.38
x_3	Site quality	0.67	0.47	0.63	0.49
x_4	Paved access road	0.37	0.49	0.39	0.49
x_5	Gravel access road	0.24	0.43	0.25	0.43
x_6	Habitat improved	0.61	0.49	0.81	0.40
x_7	Water supply	0.88	0.32	0.77	0.42
x_8	Streams managed	0.43	0.50	0.56	0.50
x_9	Services provided	0.03	0.16	0.11	0.31
x_{10}	Land under creek, rivers, wetlands, swamp, and ponds relative to forestry	0.11	0.25	0.09	0.18
x_{11}	Land under crops relative to forestry	0.83	2.38	0.35	1.30
x_{12}	Land under crops relative to forestry squared	6.34	32.89	1.78	9.26

Results and Discussion

We used both the Heckman two-step and the full information maximum likelihood methods. Although both the Heckman two-step and full information maximum likelihood methods yield estimates with expected signs, not all of the coefficients generated from the Heckman method were significant. This finding is consistent with Stolzenberg and Relles (1990) who reported that the Heckman method reduces the accuracy of coefficients in Monte Carlo studies and that even under conditions in which the method works well, it generates smaller estimates. Similar concerns were raised by Breen (1996). However, the difference between estimates obtained from the two methods would get smaller as sample size increases. We used ordinary least squares (OLS) and estimate the participation and fee models separately. These estimates and the full information maximum likelihood estimates of equations (2) and (4) are reported in Table 4. The full information maximum likelihood estimates obtained through the joint estimation of participation and fee model are superior to the corresponding OLS estimates.

Table 4

FIML Estimates of the Determinants of Hunting Lease Participation and Lease Fee

	Coefficient	t-ratio	Coefficient	t-ratio	Marginal effect (%)
	Probit estimation of landowners' participation				
Variable	Independent estimation		Joint estimation		
Constant (γ_0)	–3.6271*	–5.12	–3.7453*	–6.00	
Ownership type(γ_1)	–0.4390**	–1.72	–0.4687*	–1.99	35.91
Log-Tract size (γ_2)	0.5213*	5.37	0.5579*	5.81	42.75
Employment status(γ_3)	0.4953*	2.23	0.6476*	3.14	49.65
Residence (γ_4)	0.6418*	2.42	0.3061	1.41	23.45
Concerned for safety (γ_5)	–0.6302*	–2.64	–0.5454*	–2.77	41.79
Concerned for liability (γ_6)	–0.0303	–0.13	0.1278	0.62	0.99
	Regression results of the lease fee model				
	Independent estimation		Joint estimation		
Constant (β_0)	–945.8675*	–13.87	4.3304	1.23	
Log-Tract size (β_1)	19.6345	1.59	–0.2732*	–9.09	27.32
Lease type (β_2)	877.9036*	25.77	–0.0423*	–3.57	4.15
Site quality (β_3)	–32.0399	–1.14	–0.0079*	–5.20	0.79
Paved access road (β_4)	7.8107	0.26	–0.1934*	–5.42	17.64
Gravel access road (β_5)	6.2845	0.19	–0.0987*	–4.85	9.42
Habitat improved (β_6)	42.4630	1.46	0.2911*	4.80	33.61
Year-round water supply (β_7)	–103.9139*	–2.56	0.3827*	4.99	46.33

Continued

Table 4
Continued

	Coefficient	*t*-ratio	Coefficient	*t*-ratio	Marginal effect (%)
Streams managed (β_8)	–16.2009	–0.61	0.1986*	6.09	21.91
Services (β_9)	460.1886*	5.66	0.5533*	2.86	72.04
Land under creek relative to forestry (β_{10})	–38.9639	–0.71	0.0510	1.11	5.13
Land under crops relative to forestry (β_{11})	–17.5095	–1.14	0.1335*	2.05	14.07
Land under crops relative to forestry squared (β_{12})	0.9599	0.90	–0.0019*	–13.42	0.19
σ_ε			1.4917	4.41	
ρ (μ,ε)			–0.6563	–11.21	
Log-Likelihood			–137.20		
$F(12,214)$	84.3100				
R-squared	0.8254				

*, ** Significant at 5 and 10 percent level, respectively.

Hunting Lease Participation

Factors playing an important role in landowners' decisions to supply hunting leases included land ownership type, tract size, landowners' employment status, place of residence, and concern for safety. Except for the "concern for liability" coefficient, all other variables were significant and have the expected signs. The finding that "concern for liability" was not significant corroborates the findings by Wright and Kaiser (1986) and Jones, Munn, Grado, and Jones (2001). However, our results deviated from those reported by Lynch and Robinson (1998). A possible explanation for this difference might be the lack of actual law suits against landowners in the southern United States.

Joint ownership, not being a full-time employee, and being an off-farm resident increased the probability of hunting lease participation. Other variables, including landowners' concern for damage to their property by potential lessees, age, education, and household income, were initially included in the model but dropped in the final model as they were not significant, and unlike concern for liability, their exclusion did not affect the results.

Determinants of Hunting Lease Fees

Results of the log-log lease rate equation (4), where the dependent variable "lease fee per acre" and the explanatory variable "tract size" are in natural logarithm, are presented in bottom half of Table 4. The estimated correlation coefficient ($\rho = -0.656$) was significant, implying that the hypothesis of no sample selection bias is rejected and that jointly estimating participation and lease fees was better than estimating them separately. In terms of the relative significance of factors influencing lease rate per acre, results showed that as the share of land under crops relative to the share of forest land increased, expected lease rate per acre increased (indicated by the sign of the variable "share of land under crops relative to forest land"). However, as shown by the negative sign on the variable "share of land under crops relative to forest land squared," there were limits to this pattern. From management perspective, this finding points to the compatibility between agricultural, forestry, and wildlife activities.

While game diversity may be expected to positively influence lease rate, it could not be included as an explanatory variable because it correlates with tract size. The correlation of game diversity and tract size is understandable as large tracts are more likely to have diverse game. Regression results also showed that lands with vegetated access roads, year-round water supply, hunting lands with secluded site quality command differentially higher rates. Further, landowners who keep managed stream side zones, provide services (such as food, lodging, stands, or guidance) and invest in habitat improvement earn comparatively higher returns. Finally, the negative coefficient on tract size suggests that the per-acre price decreases with increases in tract size, possibly due to management constraints.

Conclusions

NIPF landowners' decision to lease their lands for hunting were related to their opportunity cost of time, competing land uses, and perception of risk associated with fee hunting. Landowners who have joint landownership, who have a large tract of land but do not live there, and those who are either retirees or part-time workers were more likely to participate in hunting lease. Similarly, those who were less concerned for personal safety were more likely to participate in hunting lease. However, we did not find that landowners' concern for property damage, previous experience with hunters, and characteristics such as age, household income, education, and membership of wildlife-related organizations had any significant impact on hunting lease participation, contrary to the assertion of Brown, Decker, and Kelly (1984) and Guynn and Schmidt (1984). These differences could be attributed to local conditions unique to Alabama, study period, or measurement problems.

Our results indicated that site characteristics, type of access, and provision of services were important factors influencing lease fees. Our result on the role of services (food, lodging, stands, or guidance) was at variance with findings by Pope and Stoll (1985), Loomis and Fitzhugh (1989), and Messonnier and Luzar (1990) who found that services provided by Texas and Louisiana landowners did not significantly contribute to lease rates. This difference, however, is more likely due to the way services were defined. Whereas we defined services as provision of food, lodging, stands, or guidance, Messonnier and Luzar (1990) defined them to mean lodging, liability insurance, and road maintenance. Pope and Stoll (1985) defined them as facilities such as blinds, towers (stands), landing strips, as well as services such as planted fields, guides, field dressing, and meals. Loomis and Fitzhugh (1989) defined them as guide, a vehicle, airport pickup and drop off, cabins, fishing, and meals.

There are several practical and policy implications for this study. First, as the hypothesis of no sample selection bias was rejected, inferences based on the set of landowners who sold hunting leases cannot be extended to those landowners who did not lease their lands unless corrections are made for sample selection bias. In other words, jointly estimating participation and lease fees is better than estimating them separately. Second, as our dependent variable was gross hunting fee per acre without adjustments for cost incurred by landowners to make improvements to their land, further research is needed to find out what levels of investment in habitat improvement and time commitment would be commensurate with hunting fees in order to maximize net financial return from a hunting lease. Finally, although the hedonic price method assumes that the observed price is an equilibrium price, the validity of this assumption may not be strictly defensible in Alabama's hunting lease market, which is not well developed at this stage. In other parts of the southeast United States, hunting lease market may also be thin and fragmented. From a policy perspective, this suggests dissemination of information to both hunters and landowners would have a high return in the future.

Notes

1. As correctly pointed out by one of the reviewers, landowners have four choices available to them in this regard: sell a lease, hunt the tract himself, allow others to hunt the tract for free, and do nothing (no hunting on the tract).
2. In empirical applications of hedonic pricing method, the price of a composite or differentiated good is regressed on all of the supply side factors (attributes or characteristics that affect the value of the good) to obtain *implicit price function (IPF)*. Some researchers (see e.g., Livengood, 1983) go one step further and estimate the *marginal implicit price function (MIPF)* or willingness to pay function for an additional unit of the attribute. The MIPF of attribute A_i is the partial derivative of the implicit price function with respect to attribute A_i. This derivative will be a function of A_i, possibly other attributes and demand side factors unless the IPF is linear. See Rosen (1974) for application of hedonic pricing model in differentiated commodities, Palmquist (1989) in differentiated land, and Garrod and Willis (1992), Zhang (1996), Le Goffe (2000), and Scarpa, Buongiorno, Hseu, and Abt (2000) in forestry and wildlife issues.
3. Note that whereas Loomis and Fitzhugh (1989) use harvest success, hunters' experience, and income as explanatory variables in their final specification, we use site attributes and services.

The underlying rationale for our choice is that landowners can be expected to have reasonable knowledge about site attributes and services, but not hunters' experiences and income class. The approach adopted by Loomis and Fitzhugh is appropriate as they interviewed face-to-face a small sample of 55 well-established ranch enterprises who probably knew their customers well.

4. The second step in the Heckman estimation is complicated in that the standard errors have to be adjusted to account for the first step estimation. Another concern relates to identification. Although the inverse Mills ratio is nonlinear in the single index ($\gamma' w_i$), the function mapping this index into the inverse Mills ratio is linear for certain ranges of the index. Accordingly, the inclusion of additional variables in w_i in the first step can be important for identification of the second step estimates (Vella, 1998).
5. Clark and Stankey (1979) define semi-modern recreational settings as those characterized by not so difficult road access, low but visible concentration of other users and other activities, invoking moderate challenge and risk. Secluded settings are characterized by difficult road/trail access, low concentration of users and other activities, and offering opportunity for isolation from the sight and sounds of people, allowing one to feel a part of the natural environment, invoking a high degree of challenge and risk. Secluded and semi-modern are aspects of recreation opportunity spectrum (ROS) where ROS is a framework within which to explicitly vary situational attributes to produce different recreation opportunity settings. From these opportunity settings, recreationists participating in different kinds and styles of activities derive different satisfactions, experiences, and benefits.

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