Forest Policy Center

Internal
Working Paper Series
No. 124

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

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ABSTRACT

This study uses a two-step approach to jointly analyze participation in hunting leases and the determinants of hunting lease fees in Alabama. The results show that type of land ownership, tract size, and landowners' place of residence, employment status, concern for personal safety, and personal hunting use of land are determinants of participation in hunting leases. Factors influencing lease fees include site specific characteristics such as share of agricultural land relative to forest land, game diversity, year-round water availability, type of access, and enhanced features such as streamside management zone, habitat improvement desirable to wildlife, and provision of services.

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

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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 percent of forest lands in southern U.S., understanding the degree of accessibility to NIPF lands is a pre-requisite in estimating land availability for hunting and other recreational opportunities (Wright et al. 1990). Hunting leases could not only benefit landowners, but also help wildlife management (Noonan and Zagata 1982, Morrill 1985) and rural economies (Smith et al. 1982) and reduce the need for governmental regulatory measures associated with environmental protection (Jones et al. 2001). However, few studies have been conducted on NIPF landowners' participation in hunting leases and factors influencing hunting lease fees since academic interest in this area started only two decades ago.[1]

Factors influencing NIPF landowners' decision to allow hunting access on their lands and determinants of lease fees have traditionally been considered as separate issues. Studies on hunting lease participation include Guynn and Schmidt (1984), Brown et al. (1984), Marion (1989), Ruff and Isaac (1987), and Jordan and Workman (1989). Studies on factors influencing hunting lease fees include Loomis and Fitzhugh (1989), Guynn and Steinbach (1987), and Steinbach et al. (1987). These two issues constitute the supply of hunting lease, and ideally, they need to be modeled jointly. Failure to consider the correlation between factors influencing hunting lease participation and factors affecting lease fees may lead to incorrect inference regarding the impact of various factors on lease fees.

[1] See Taff (1991) for a succinct review.

The objectives of this study were to analyze NIPF landowners' decision in allowing hunting access for fee and to estimate the impacts of various land characteristics and improvements made by landowners on hunting lease fees jointly. Identifying hunting lease participation will enhance our ability in solving problems that result in non-leasing. Understanding which attributes of land and improvements made by landowners impact lease fees would help landowners increase hunting related revenue. The methodology can be applied to other parts of the world.

The next section presents a review of factors underlying NIPF landowners' decision to lease land for hunting and lease fees. This is followed by a section on the methodology of jointly analyzing NIPF landowners' hunting lease participation and the determinants of hunting lease fees. Data collection, empirical results and conclusions are given in the remaining sections.

DETERMINANTS OF HUNTING LEASE AND LEASE FEES

Factors Influencing NIPF Landowners' Hunting Lease Decision

Liability considerations. The possibility of being sued due to hunting related injuries makes hunting lease a risky proposition for some landowners (Shelton 1987, p.112). Although landowners' liability for someone who suffers an injury on their lands depends on the person's legal classification of entrance at the time of injury, state laws in the southern U.S., designed to eliminate fear of legal liability in recreational injury are somewhat ineffective in convincing landowners to lease out land for hunting (Wright et al. 1990, p.195). Thus, landowners who are concerned about liability will be less likely to lease their land.

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 and Kaiser 1986). This is especially true for landowners who reside on a tract which could be leased

(Wright et al. 1990, p.184). Although these landowners can economize their time in supervising hunters, they may not lease the tract for personal safety concern.

Economic considerations. Compatibility of hunting leases with other land uses,[2] opportunity cost of landowner's time (Ruff and Isaac 1987), tract size, form of ownership (individual or joint), and household income could be important. Other things being equal, large landowners are more likely to participate in hunting lease. Although landowners who do not have large tract of land can make a deal with adjacent landowners for leasing purposes, transaction cost may hinder this process and thus lower their probability of participation.

Landowners' past 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 and Schmidt 1984, p.13). In addition, landowner attitudes toward hunting access are influenced by their personal experiences and the experiences of their friends and neighboring landowners.

Landowner's characteristics. Family composition, age, education, and social characteristics such as participation in wildlife management programs might influence landowners' hunting lease decision. Variables used in the hunting lease participation regression along with hypothesized effect on participation are presented in Table 1.

Determinants of Hunting Lease Fees

Loomis and Fitzhugh (1989) hypothesized that lease fees depended on the quality of hunting experience as measured by harvest success, percent of harvest made up of trophy animals, hunting services, management inputs, and percent of hunters in the wealthy or high

[2] Landowners who reserve land for themselves and friends to hunt are be negatively correlated with public access (Brown et al. 1984) and hunting lease.

income range as determined by landowners' knowledge of the clients. Thus, when demand is a given, lease fee can be modeled as a hedonic pricing function on hunting land characteristics, game diversity, wildlife enhancing improvements, and services by landowners:[3]

$$L_i = f(A_i, G_i, I_i, S_i) \qquad (1)$$

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,

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 provided by landowner i,

The implicit contribution of each individual characteristic can be found by differentiating equation (1) with respect to that characteristic. If the function is linear, the implicit price of a characteristic will be constant. However, non-linearity may exist. Possible factors influencing lease fees, along with the hypothesized direction of impact, are provided in Table 2.

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.

[3] See Rosen (1976) for application of hedonic pricing model in differentiated commodities, Palmquist (1989) in differentiated land, and Puttock (1990), Garrod and Willis (1992), Zhang (1996), Goffe (2000), and Scarpa et al. (2000) in forestry and wildlife issues.

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, landowners' land leasing decision (or selection mechanism stage) can be formalized (Greene, 1993, p.710-713) as

$$z_i^* = (\gamma' w_i) + u_i \qquad u_i \sim N[0,1] \qquad (2)$$

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

$$z_i = 0 \qquad \text{if } z_i^* \leq 0$$

$$\text{Prob}(z_i = 1) = \Phi(\gamma' w_i)$$

$$\text{Prob}(z_i = 0) = 1 - \Phi(\gamma' w_i)$$

where Φ denotes cumulative normal distribution function, w_i is the set of factors influencing landowners' hunting lease participation, and γ is the associated parameter vector to be estimated.

The determinants of lease fees (L_i) [Equation (1)] can be written as

$$L_i = \beta' x_i + \varepsilon_i \qquad (3)$$

where x_i represents the set of factors that explains 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). If it is assumed 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

$$E[L_i | z_i = 1] = \beta x_i + \rho\sigma_\varepsilon \lambda(\gamma' w_i) \qquad (4)$$

where $\lambda(\gamma' w_i)$ is the inverse Mill's ratio given by $\varphi(\gamma' w_i)/[1-\Phi(\gamma' w_i)]$, and where φ and Φ respectively denote the normal density and distribution functions (Jud and Seaks 1994). The

presence of the variable $\lambda(\gamma' w_i)$ in equation (4) reveals the omitted variable bias that will result 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 of the presence of sample selection bias.

DATA

Following the total design method (Dillman 1978), we conducted a survey of NIPF landowners in Alabama who owned 100 or more acres of land in spring 2002. The list of landowners was provided by the Private Forest Management Team at the School of Forestry and Wildlife Sciences, Auburn University, which covered 55 of the 67 counties in the states. Our sample size was 2%. Of the total of 950 survey forms that were mailed, 360 responses were received, resulting in an overall response rate of 38 percent. Of these only 227 were usable.

While information on total land ownership was sought in the survey, details specific to hunting access were confined to the largest tract. This included the size of the largest tract; relative shares of forest, crops, swamps and creek, rivers and ponds; age distribution of trees; composition of trees distinguished as hardwoods and softwoods; 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)

[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, p. 134-135).

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. Table 3 presents the means and standard deviation of variables used in this study.

RESULTS AND DISCUSSION

Initially we used both the Heckman two-step and the full information maximum likelihood methods. The full information maximum likelihood estimates of equations (2) and (4) were better[5] and are reported in Table 4.

Hunting lease participation

Table 4 shows that factors playing important role in landowners' decisions to supply hunting lease opportunities included type of land ownership, tract size, employment status, place of residence, concern for safety, and hunting land reserved for own use. Except for the "concern for liability" coefficient, all other variables were significant and had the expected signs. The finding that "concern for liability" was not significant corroborates with findings by Wright and Kaiser (1986, p.32). Joint ownership, not a full-time employee, and off-farm residence increase the probability of hunting lease participation. Other variables, including landowners' concern for

[5] While both the Heckman two-step and full information maximum likelihood methods yielded estimates consistent with the hypothesized signs, none of the coefficients generated from the Heckman method were significant. This finding is consistent with Stolzenberg and Relles (1990, p.12) who reported that the Heckman method reduces the accuracy of coefficients in their Monte Carlo studies and that even under conditions in which the method worked well, it generated smaller estimates. Similar concerns were raised by Breen (1996, p.42). However, the difference between estimates obtained from the two methods would get smaller as sample size increases.

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.

The marginal effects of all independent variables are reported in Table 4. Thus, an increase of one acre in the tract size increases the probability of hunting leasing participation by approximately 0.02 percent. Everything else being equal, landowners who are "concerned for liability" are 3 percent less likely to lease out land than those who are not. Likewise, those who reserve land for their own hunting use have lower probability (by 18.6 percent) of supplying a hunting lease than those who do not.

Determinants of lease fees

Results of the lease rate equation (4), where lease fee per acre is in natural logarithm, are presented in bottom half of Table 4. The estimated correlation coefficient (ρ= -0.31) is not significant, indicating that the hypothesis of no sample selection bias cannot be rejected. Since the dependent variable is measured in logarithms, the coefficients are interpretable as percentages only in the case of continuous independent variables. In the case of a dummy independent dummy variable, however, the relative impact on the dependent variable is 100*[exp(c)-0.5*Var (c)-1], where c is the estimated coefficient and Var(c) is the estimated variance (Giles 1982, Kennedy 1981, Halvorsen and Palmquist 1980).

Interpreting the impact of changes in the continuous independent variables on Log (L_i) first, notice that as the share of land under crops relative to the share of forest land increases, expected lease rate per acre increase (indicated by the sign of the variable "share of land under crops relative to forest land") but at a decreasing rate as shown by the sign of the variable "share of land under crops relative to forest land squared." Setting all the other variables at their means and evaluating the derivative of lease rate Log (L_i) with respect to the share of land under crops

relative to the share of forested area, estimates suggest that lease rate per acre reaches the optimal level when the share of land under crops is 12 percent. This finding has implications for the compatibility of forestry and agricultural land use in hunting lease.

Effects associated with changes in the dummy independent variables on the Log (L_i) are shown in column 5. Everything else being equal, hunting lands that offer the opportunity to hunt deer, turkey and quail and waterfowl (WDTQ) would be expected to have rates that are 39 percent higher than those that offer only the opportunity to hunt deer, turkey and quail (DTQ). Landowners that do invest in habitat improvement are likely to earn 51 percent more than those who do not.

CONCLUSIONS

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

We find that lands with game diversity (providing opportunities to hunt waterfowl, in addition to deer, turkey and quail), vegetated access roads, year-round water supply, hunting

lands with secluded site quality command differentially higher rate per acre. Further, landowners who keep managed stream side zones, provide services and invest in habitat improvement earn comparatively higher returns. The share of land under crops relative to forest land also influence lease rate. Based on the estimated lease rate equation, our calculations show that lease rate per acre increases at a decreasing rate until the share of land under crops reaches 12 percent. This finding points to the zone of compatibility between agriculture, forestry and wildlife activities.

Finally, as the hypothesis of no sample selection bias could not be rejected, inferences based on the set of landowners who sold hunting leases are valid for the overall sample. As a caveat, note that hunting fee per acre considered in this study is a gross number and that opportunity cost of landowners who participate in hunting leasing is not documented in this study. 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 the net financial return from a hunting lease.

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Table1. 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 allowing access
w_2	Tract size	Continuous, acres	Owners having large tracts are more likely to participate in hunting lease than owners with a small tract.
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.
w_7	Hunting land reserved for own use	Dummy: 1, if land reserved for own use; 0 otherwise	Landowners who are avid hunters themselves or want to allow only friends would be expected to have lower chances of allowing access.

Table 2. Factors influencing lease rate – outcome stage

Variable	Definition	Description	Hypothesized effect
Dependent			
$Log(L_i)$	Log of lease rate per acre	Continuous	
Explanatory			
x_1	Lease type	Dummy: 1 if annual; 0 otherwise	Compared to leases sold for multi-year period, annual leases would be expected to have lower rate.
x_2	Game diversity	Dummy: 1 if tract has deer, turkey, quail and waterfowl; 0 otherwise	Lands offering the opportunity to hunt waterfowl, deer, turkey and quail (WDTQ) are expected to have higher rates than those that offer only deer, turkey and quail hunt (DTQ) opportunity.
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	Dummy: 1 if yes; 0 otherwise	Provision of services, including cabin, lodging, food and guidance, is expected to have positive effect.
x_{10}	Land under creek, rivers, wetlands, swamp, and ponds relative to forestry	Continuous	Increasing at a decreasing rate
x_{11}	Land under crops relative to forestry	Continuous	Increasing at a decreasing rate
x_{12}	Land under crops relative to forestry squared	Continuous	

Table 3. Statistics of variables used in the full information maximum likelihood estimation

Variable	Variable Definition	All(n = 233)		Participants (n = 57)	
		Mean	Std. Dev.	Mean	Std. Dev.
	Hunting Participation- Selection mechanism				
w_1	Ownership type	0.82	0.39	0.68	0.47
w_2	Tract size	563.91	1368.29	1273.18	2469.57
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
w_7	Hunting land reserved for own use	0.23	0.43	0.11	0.31
	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	Lease type	0.21	0.41	0.82	0.38
x_2	Game diversity	0.36	0.48	0.39	0.49
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

Table 4. FIML estimates of the determinants of hunting lease participation and lease fees.

Variable	Variable Definition	Coefficient	t-ratio	Marginal effect**
	Hunting Participation- Selection mechanism			
	Constant (γ_0)	-0.6386*	-1.81	-0.1966
w_1	Ownership type(γ_0)	-0.5567*	-2.12	-0.1682
w_2	Tract size (γ_0)	0.0006*	4.10	0.0002
w_3	Employment status(γ_0)	0.5045*	2.35	0.1256
w_4	Residence (γ_0)	0.5507*	2.32	0.1591
w_5	Concerned for safety (γ_0)	-0.7187*	-3.33	-0.2163
w_6	Concerned for liability (γ_0)	-0.0276	-0.13	-0.0282
w_7	Hunting land reserved for own use (γ_0)	-0.7952*	-3.40	-0.1863
	Determinants of Hunting Lease Fee-Outcome stage			
	Constant (β_0)	3.1210*	2.35	
x_1	Lease type (β_1)	-0.2336*	-3.81	29.07
x_2	Game diversity (β_2)	0.0599*	4.19	39.06
x_3	Site quality (β_3)	-0.2075*	-5.20	29.87
x_4	Paved access road (β_4)	-0.2389*	-4.90	28.94
x_5	Gravel access road (β_5)	-0.2746*	-3.99	27.89
x_6	Habitat improved (β_6)	0.4021*	4.65	54.79
x_7	Year-round water supply (β_7)	0.3377*	4.76	51.44
x_8	Streams managed (β_8)	0.0509*	5.98	38.71
x_9	Services provided (β_9)	0.4179*	2.38	55.02
x_{10}	Land under creek relative to forestry (β_{10})	0.5255	1.16	
x_{11}	Land under crops relative to forestry (β_{11})	0.2016*	1.86	
x_{12}	Land under crops relative to forestry squared (β_{12})	-0.0084*	-12.27	
	σ_ε	1.9587*	6.72	
	ρ	-0.3069	-1.28	
	Log-Likelihood	-139.05		

* Significant at the 10 percent level.

** Marginal effect associated with the dummy variables in the outcome equation was calculated as: 100*[exp(c)-0.5*Var (c)-1]