The Supply of Private Acreage for Public Recreational Use in Southern and Central Appalachia

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Abstract

Public lands in Southern and Central Appalachia (SCA) available for outdoor recreational pursuits are limited relative to the rest of the county. This study identifies factors that encourage private land owners to permit public access to their land for recreational purposes and determines how much acreage would be offered in the Southern and Central Appalachia region. The Tobit and Heckman's sample selection models suggest that the probability of offering land to the public is correlated with the number of acres offered. Having acreage suited for recreation is a positive determinant of acres leased but attributes developed by the landowner act as a disincentive. Type of recreational activity has no effect on the landowner's decision and the supply of recreational acreage is inelastic with respect to price.

Keywords: private land lease, recreational activities, Tobit model, Heckman's sample selection model, public recreational use

JEL: Q24, Q26

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Introduction

Land area suitable for recreational use in Southern and Central Appalachia (SCA) has increased over the past fifty years – forested acres grew from 60-82% of land cover, resulting from a decline in agricultural use and shrinking urban areas (Wear and Bolstad, 1998).[1] However, the growth occurred primarily on privately-owned property that was not accessible to the general population.[2] Public land holdings, which support most of the outdoor recreational activities in the U.S., did not change perceptibly nor did the distribution of land cover on those lands.

The demand for outdoor recreational activities has exploded in recent years. Cordel et.al. (1999) report a continuously increasing demand within a three-fold increase in national demand for outdoor recreation between the years of 1962 and 1983. This growth is attributed to both an increase in the number of outdoor recreationists and an increase in outdoor recreational activities. A growing demand and a fixed supply of recreational land can lead to conflicts among recreationists and crowded outdoor recreation sites. Congestion and conflict, in turn, can lead to diminished utility from recreational activities and may result in fewer recreation trips on average (Stewart and Cole, 2001; Manning and Valliere, 2001).

In the SCA region, far more potential recreation land (PRL) area is privately owned than is true in any other region of the U.S. Across the U.S. there are, on average, 987 persons/ km^2 of PRL while in the SCA region there are 2,720 persons/ km^2, and in the Non-SCA region there are 958 persons/ km^2. In other words, the availability of PRL land on a per capita basis in the SCA region is about one third less than the availability of PRL land on a per capita basis outside this region.

If public and private lands that are currently open to the public in SCA do not supply sufficient acreage to provide the level of outdoor recreational pursuits, and there are no plans to increase public holdings, then additional privately held lands must be considered to meet the shortfall. -- Several attributes have been found to be important in determining lease value for hunting. In Louisiana, variables significant in explaining lease price for deer hunting were the number of acres per hunter and the perceived quality that area's biological habitat for hunting (Messouier and Luzar, 1990). Hunting decisions have been also analyzed in Coronado, California (Creel and Loomis, 1990).

One would expect that a shortage of suitable public land would provide an incentive for recreationists to pay a fee for access to privately held land. This, then, begs two questions: "Are landowners willing to open their land to the public?" and "At what fee would private land owners in SCA be willing to permit access to their land and how much land would be made available for recreational pursuits?" Neither one of these questions have been addressed before. Many factors beyond the access fee influence this decision, including costs of maintaining the land for recreational purposes, development and liability costs, opportunity costs of the land, and constraining demographic factors.[3] Furthermore, many landowners use their land for their own recreation as well as that of their family and friends.

The data used in this investigation are from the National Private Land Ownership Survey (NPLOS). NPLOS was a joint effort between the USDA's National Resource Conservation Service, the U.S. Forest Service Southeastern Experiment Station, and the University of Georgia. In it, data were collected from a national sample (excluding Hawaii and Alaska) of owners of rural tracts of land exceeding 4 hectares (10 acres).

Although the data was collected in 1996, no analysis was made from this data. Furthermore, no previous analyses address the supply of land by private landowners for recreational purpose. In this study, we identify several factors that would influence private land owners to offer their land to the public for recreational purposes. This decision depends in part on the suitability of land for recreation. Their perceived net benefit from using the land for their own needs versus offering land to the public affects the landowner's decision. The amount of land offered for different recreational purposes will also have to be consistent with present uses of that land (i.e., crops and livestock). Thus, the size of the tract of land offered by the landowner for recreational purposes is whatever acreage is suitable for specific recreational purposes and at the same time represents a minimal opportunity cost of forgoing agricultural uses.

In this analysis, the factors explaining the private landowner's choice of acreage they are willing to offer to the public for recreational activities are identified and a determination is made as to whether the decisions to open and how much acreage to offer are two distinct decisions or not.

Theoretical Development

The private landowner must decide whether or not to offer acreage for recreational purposes for a fee (BID) and how much to offer (a dichotomous choice decision).

The landowner offers or leases acreage (Ac_L) by utilizing acreage that is suited to recreational purposes (Ac_S). Some of this suitable acreage Ac_S may or may not be currently used to generate income ($Ac_{Other\ uses}$) and some can be from converted acreage devoted to agricultural production (Ac_{Agr}) (Equation 1). Other uses of land include forested land and land used for their own recreational purposes:

$$Ac_L \leq Ac_S = Ac_{Agr} + Ac_{Other\ uses} \qquad (1)$$

Acres suitable for recreational use have attributes that may include the presence of native vegetative cover, topography, caves, scenic vistas, and streams or rivers.

The private landowner will choose to lease acreage if leasing earns a profit (π_L). However, the profit earned from leasing must exceed the average opportunity cost (AOC) from employing the land in agricultural uses and the benefits (net of agricultural opportunity cost) that the land owner receives from enjoying that land for recreational activities for themselves, their family and friends. Landowners must weigh the value of the benefits received for keeping the public off their land (B) versus the net returns they will receive (π_L) from offering acreage for recreational purposes to the public.

Thus it follows that the private landowner will lease land if π_L is positive and exceeds the benefits received from keeping the land for himself, family or friends. In Equation 2, L represents the private landowner's choice to lease given $\pi_L > B$ and not to lease given $\pi_L \leq B$. A unique set of socio-economic and demographic variables describe the landowner (Z). In the case where L = 1 the landowner has chosen to open land because the resulted π_L^* exceeds some positive benefit B. In the case where L = 0 the landowner has chosen to not open land because π_L^* is equal to B or less.

$$L \sim \{[\pi_L^* > B], Z\} = 1 \text{ and } L \sim \{[\pi_L^* \leq B], Z\} = 0 \tag{2}$$

It is assumed that the private landowner only has a fixed amount (Ac_S) of acreage with suitable attributes that can be leased and that the private landowner is unable to acquire additional suitable acres in the short run. The problem faced by the landowner is to choose Ac_L to maximize (π_L – B) given recreational attributes of suitable acreage (Ac_S), AOC, BID and Z.

Empirical Models

Since the dependent variable is censored from below (number of acres ≥ 0), a Tobit model can be used. Suppose the actual observed acreage offered by respondent i can be denoted as Y_i. It is only observed when the latent acreage Y_i* is positive:

$$\begin{cases} Y_i = 0 & \text{when} \quad Y_i* \leq 0 \\ Y_i = Y_i* = \mathbf{X_i \beta} + \varepsilon_i & \text{when} \quad Y_i* > 0 \end{cases} \tag{3}$$

where $\mathbf{X_i}$ are the explanatory variables; $\boldsymbol{\beta}$ is a vector of unknown coefficient to be estimated; and ε_i is a normal distributed iid noise such that $\varepsilon_i \sim N(0, \sigma_\varepsilon^2)$ with unknown variance σ_ε^2 to be estimated. The Tobit model does not differentiate the two decision stages (whether or not and how much). The Heckman's selection model relaxes this restriction.

If we use $W = 1$ to denote those individuals who would like to open their land and $W = 0$ otherwise, this decision process can be written as:

$$\begin{cases} W_i = 0 & \text{when} \quad W_i^* = \mathbf{Z_i}\boldsymbol{\gamma} + e_i \leq 0 \\ W_i = 1 & \text{when} \quad W_i^* = \mathbf{Z_i}\boldsymbol{\gamma} + e_i > 0 \end{cases} \tag{4}$$

where W_i^* is a latent variable similarly defined as Y_i^* but can be explained by a set of factors in $\mathbf{Z_i}$. $\boldsymbol{\gamma}$ represents the vector of coefficients to be estimated and e_i is another iid normally distributed term: $e_i \sim N(0, \sigma_e^2)$. Given this, the Heckman model could be defined as:

$$\begin{cases} Y_i = 0 & \text{when} \quad W_i = 0 \\ Y_i = Y_i^* = \mathbf{X_i}\boldsymbol{\beta} + \varepsilon_i & \text{when} \quad W_i = 1 \end{cases} \tag{5}$$

Notice that $\mathbf{Z_i}$ and $\mathbf{X_i}$ could contain different variables. We define the first expression in (5) as the participation equation and second expression as the level equation.

The Heckman model assumed a bivariate normal distribution for ε_i and e_i in the form of $[\varepsilon_i, e_i] \sim BN[0, 0, \sigma^2, 1, \rho]$. In this expression, the variance of the error term in the participation equation is normalized to 1 leaving the variance of the level equation σ^2 and correlation factor ρ to be estimated.

For any regressor that is common to both $\mathbf{Z_i}$ and $\mathbf{X_i}$, the marginal effect is:

$$\frac{\partial E[Y_i / \mathbf{X_i}, W_i = 1]}{\partial X_{ik}} = \beta_k + \rho\sigma_\varepsilon(-\lambda_i \gamma X_{ik} - \lambda_i^2)\gamma_k \tag{6}$$

where $\lambda_i = \dfrac{\phi(\mathbf{Z_i}\boldsymbol{\gamma})}{\Phi(\mathbf{Z_i}\boldsymbol{\gamma})}$. It is straightforward to see that marginal effects include two components: the direct effect is represented by β_k, which is also the effect of those variables only appear in $\mathbf{X_i}$;

and the indirect effect takes the form of the second term at the right hand side in (6), which is the effect of those variables only appear in $\mathbf{Z}_i$. For a dummy variable, no differentiation can be taken. Differences in predicted dependent variables when the dummy variable is 1 or 0 respectively are taken as the marginal effects. Transforming the marginal effects into elasticities is straightforward.

The estimation of the Tobit model provides the basis for model specification tests. A Lagrangian Multiplier test can be conducted to test between the Tobit versus the Heckman models (Lin and Schmidt, 1984).

Data and Variables for the Analysis

The sample contains 408 landowners with complete data, who controlled 163.48 km^2 (40,398 acres), or approximately 0.10%, of non-PRL. Of this acreage, 25% (4,024 km^2 or 9,944 acres) were opened to friends and family for recreational purposes, 2% (303 km^2 or 748 acres) were opened to the public for a fee, and 18% (2,883 km^2 or 7,124 acres) were opened to family, friends and the public without a fee. The remaining acreage (45%) was not opened for recreational purposes.

Through a series of questions, the survey established that landowners who were leasing land to the public did not have multiple leases but a single lease each. Almost all the leases were to individuals. On average, the annual number of visits by people leasing land was 7.5. The NPLOS questionnaire asked "If an individual or group were interested in leasing additional acres just for hunting and/or fishing" or for "camping, hiking, walking, or some use other than hunting or fishing”, and “they offered you $(X) per acre, per year, would you be willing to sign a lease granting them and their guests access in the upcoming 12 months, with the stipulation that they would care for the land and not damage roads, fences, or other improvements?” The (X) was randomly selected values between $2 and $20 and the stated amounts were recorded as BID. Note that, although the questionnaire differentiated between hunting and (or) fishing (lethal) recreational activities versus camping, hiking, walking, etc. (non-lethal) recreational activities, the bids given for these recreational activities were the same. The average offered bid for those that opened land to the public was $11.16 versus $8.07 for those that did not.

The response to the offered bid, either yes (1) or no (0) was then recorded. If the respondent answered “yes,” the next question was “how many additional acres would you be willing to lease at the above dollar amount?” The open-ended responses were recorded as Ac_L.

Acreage suitable for recreational activities (Ac_S), is calculated from the. NPLOS survey which reports the acreage that is currently opened (i.e., is currently suitable) for recreational access. The sum of acreage with access to only friends and family, acreage with access to those who pay to lease, and acreage with access to the public is used as a proxy measure of Ac_S. This sum represents the minimum acreage potentially suitable for recreational access at the time of the NPLOS survey.

Much of the acreage in SCA, being steep and timbered, is unsuited for crop production unless it is “bottom ground.” Thus, SCA acreage is not generally associated with the high opportunity cost crops like tobacco, corn, and soybeans. The average opportunity cost (AOC) for the 408 surveyed SCA landowners is $21.25 per acre ($8.60 per ha).[5]

To examine land attributes, we defined 5 indices that range of from 0-100 and contain attributes of the individual land holder level that were featured in the survey: Property Attributes Index (PATTI); Surrounding Property Attributes Index (SATTI); Index of Property Attributes that Detract from Recreational Development (DETRAC); Developed Attributes Index (DEVI); and Index of Property Attributes that could be Naturally Occurring or Developed (NDATTI).

The index PATTI includes naturally occurring attributes like topography, presence of streams or rivers, and native vegetation and wildlife that occur on the landowner's property. The index SATTI is like PATTI except that the naturally occurring attributes are on adjacent property. However, some attributes that might be naturally occurring like ponds, lakes, wildlife, and timber can be developed as well. These attributes, where it is hard to distinguish if they are naturally occurring or developed, are included in the index NDATTI. Developed attributes included in the index DEVI include anything that the landowner engages time and (or) money in to change the natural condition of the land such as a dam on a stream to form a pond or lake, management of naturally occurring vegetation to attract more wildlife, the introduction of wildlife to enhance the native population, and (or) the construction of trails or other structures to improve the recreational value of the property.

The index DETRAC includes attributes that take away from the recreational experience of the acreage including a residence on the property, proximity to a residential development, or the presence of livestock on the acreage (Table 1). The average respondent was 58 years old and white (92%) with a high school education and some college education (13 years). Majority of the land owners in the sample were male and the average household annual income was about $50,000. Slightly more than half of the land owners would consider open their land for hunting.

Estimation Results

Table 2 presents the baseline Tobit model estimation and Table 3 presents the estimation results of the Sample Selection Model. The Tobit model shows that there exist several significant factors affecting the decision to lease acreage: the lease price (BID); suitable acreage for recreational activities (Ac_S); some specific property attributes for recreational use (such as wildlife, ponds, timber etc.) and some demographic variables. The Lagrangian Multiplier test strongly rejects the Tobit model and favors the Heckman model specification. Thus we conclude that the resulting estimation favors the hurdle in representing the decision process of landowners: they decide whether to open land to the public for recreational use and how many acres to offer for that purpose. Since the sample selection model is superior to the Tobit model, we focus the discussion on the former.

Table 3 presents the results of the estimation of the Heckman model. Demographic variables were introduced in the participation equation and gave similar results with the Tobit estimation, but were not included in the level equation. This was based on the assumption that individual characteristic variables such as the demographic information may affect the decision on whether to open the land. Characteristics of the land rather than land owners would play more direct roles in determining how much land to open. The inverse mill ratio λ is significant at 1% level, suggesting that selection bias exist and the two-stage approach recognizes this bias.

The results show that the offered price for leasing (BID), the availability of suitable acreage for recreational purpose (Ac_S) and attributes that are naturally occurring on the landowner's property (NDATTI) are important determinants on both of the decision to lease land and the acreage they would lease. With higher leasing price (BID), landowners are more likely to lease the land to the public, and lease more acreage as well. Naturally, Ac_S has a positive impact on both decisions meaning that more acreage suitable for recreational purposes will improve both the likelihood of opening land and the amount of land to be opened. The decision to lease and how much acreage to lease are also based on the recreational characteristics of the landowner's parcel of land. The attributes that favor recreational use and provide an incentive in leasing land to the public and leasing more acreages tent to be naturally occurring on the landowner's property (NDATTI), such as ponds, timber, wildlife etc. Finally, the variable DEVI is marginally significant in the level equation indicating that if private land owners have implemented land improvements to their property, they will be less likely to open their land to the public for recreational purposes.

Agricultural average opportunity cost (AOC) does not have a significant effect in the landowner's decision to lease land, neither does the type of recreational activity (hunting, fishing, camping, etc) for which the land will be leased. It is interesting that those characteristics that could be considered as not favoring recreational activities (proximity to populated areas, livestock, etc or variable DETRACT) have no statistically significant effect on the landowner decisions. Characteristics of surrounding land to the landowner's property (SATTI) do not affect the decision to lease either.

Landowners with more years of education (EDUY) and landowners with higher income (INCOME) are more likely to open land to the public whereas white landowners (WHITE) are less likely to allow public access for a fee for recreational activities on their land.

Complete calculation of the elasticities of different variables to the leasing behavior will need to consider both direct impact (from the level equation) and indirect impact (from the participation equation). However, the calculated elasticities using this approach are not realistic (they varies excessively across variables), and as a result, only the level equation coefficients will be interpreted. The variables shown in the level equation are conditional on opening the land for recreation but do not include the indirect effects from the variables shown in the participation equation (Table 3).

Table 4 provides estimates of the elasticities for the amount of leased land with respect to the significant variables in the level equation. The calculated point elasticity of the supply curve measured at the mean for BID is 0.50 (i.e., inelastic). The intercept for the level equation is significantly different from 0 as are the parameter estimates for Ac_S, BID, NDATTI and DEVI. Results show that a 1 acre (0.40 ha) increase in Ac_S (suitable acreage) will increase Ac_L (offered acreage) by 0.74 acres (0.31 ha). When acreage is better suited for recreational activities, by virtue of having certain attributes (i.e., ponds, lakes, timber, and wildlife) that could be the naturally occurring attributes or developed by the land owner, there is incentive for landowners to lease more acreage. In this case increasing NDATTI by 1 unit, increases leased acreage Ac_L by 0.52 acres (1.43 ha).

The variable DEVI is marginally significant in the decision of how many acres to open for public recreation. Thus, it appears that fewer acres are offered to public when the landowner has developed certain attributes for recreation on their land, probably preferring to enjoy some of them with their family and friends. Increasing the index suggested by DEVI by 1 unit, the suggested leased acreage will decrease by 0.34 acres (0.14 ha).

It appears that landowners in SCA are reluctant to open additional acreage to the public at going rental rates. From these results we conclude that the supply of private acreage for public recreational use is inelastic because there are few substitutes for suitable acreage. Increases in the availability of recreationally suitable land may yield relatively small acreage for public use for a fee because of the inelasticity in price and the general reluctance of landowners to open acreage to the public. Increasing recreational attributes suitable for recreational use can be achieved by conservation programs, many of which are already in place such as set-aside acres, conservation reserve program, wetlands preservation, riparian habitat restoration, conservation districts, purchase of development rights, enhancement of ecosystem services, etc. In all, however, it appears that, given the small elasticities obtained in this study, recreationists in SCA are destined to higher concentration on an acre of PRL relative to the rest of the country and higher fees.

Conclusions

This study identified the factors that would lead private land owners to open their acreage to the public for recreational purposes and determine how much acreage these landowners actually open to the public. Better suited land for recreational activities especially when certain attributes are present (ponds, lakes, timber wildlife etc.), provides some incentive to offer recreational land to the public. An interesting finding of this study is that “type” of recreational activity is not important in terms of private acreage opened for a fee. Two types of recreational activity were investigated, lethal or consumptive (hunting and/or fishing) and non-lethal or non-consumptive (hiking, backpacking, swimming, bird watching, etc.).

It appears that landowners in SCA are reluctant to open acreage to the public at going rates and that any naturally occurring or developed recreational attributes are enjoyed by the landowners, their family, and friends. Developing additional recreational attributes contribute to the decision to open acreage, but the contribution is small. The landowner is not willing to offer much additional acreage at sequentially higher prices even if these prices are higher than his/her agricultural opportunity costs.

To increase the area available for recreational activities in SCA, thus reducing the concentration of persons on an acre of potential recreational land, policy makers must either increase public land or rely on the only other source of suitable and available recreational land; that is land held by private landowners. Given the small elasticities obtained in this study, people in SCA will likely continue to see increased competition for recreational land. Private groups may purchase and use land for recreation at higher cost.

Footnotes

1. South Central Appalachia (SCA) is a much larger area than is the area represented by the counties of the Appalachian Regional Commission (ARC) that are in SCA. The ARC is a federal designation that includes only severely impoverished or otherwise resource limited counties (ARC, 2009). Counties from the states of Alabama (35 counties), Georgia (37 counties), Kentucky (51 counties), Mississippi (24 counties), North Carolina (29 counties), Tennessee (50 counties), South Carolina (5 counties), Virginia (14 cities and 17 counties), and West Virginia (9 counties) are included in this study. (Appalachian Regional Commission).
2. The SCA region comprises 3.3% (324,279 km^2) of the total U.S. land area of 9,826,630 km^2. Only 10.03% of the SCA region (32,525 km^2) is potential recreation land (PRL) meaning that it meets all three of the following criteria: 1) designated as protected areas; 2) owned by the federal, state, or local governments; and 3) not designated for use by the military. In contrast, 20.09% of the entire U.S. land area (1974170 km^2) and 20.44% of the non-SCA land area (1942281 km^2) is PRL. Of the PRL owned by the federal, state, or local governments, 78.69% (25,594 km^2) is under federal ownership (with U.S. Forest Service owning 72.3%, or 23515.6926 km^2, of the federal land holdings), 20.75% is under state ownership (6,752 km^2) and 0.56% is owned by local governments (182 km^2). This data were determined using Geographic Information System data layers compiled by Dr. Roger Brown, University of Kentucky, Department of Agricultural Economics.
3. Previous studies have identified numerous ranch price influencing factors beyond agricultural income (Sengupta and Osgood, 2003; Sunderman et al., 2000). Torell et al. (2005) find that consumptive and quality-of-life influences on land value appear to have grown in

economic important. They find that ranch values vary significantly and consistently with high value placed on ranch location in the mountains (scenic views) and with recreational opportunities.

4. Liability insurance does not vary within the SCA region. The issue of the importance of liability insurance and need for it has been discussed in Wright et al.
5. The survey identified 6 land types and asked landowners to indicate how many acres of each land type they owned. The 6 land types were defined to be “Forest or Wood Land,” “Range Land,” “Crop or Hay Land,” “Pasture Land,” “Other Land Being Farmed or Cultivated,” “Water Bodies,” and “Barren Land.” From the University of Kentucky, the University of Tennessee and Virginia Polytechnic Institute and State University Extension Service, the following opportunity costs were determined for each category of acreage: $17.50 per acre ($7.08 per ha) for Forest or Wood Land; $25.00 per acre ($10.12 per ha) for Range Land; $55.00 per acre ($22.26 per ha) for Crop and Hay Land; $25.00 per acre ($10.12 per ha) for Pasture Land; and $10.00 per acre ($4.05 per ha) for Other Land Being Farmed or Cultivated. Acres described as Water Bodies or Barren Land were determined to have no opportunity cost associated with them although there is some aquaculture in SCA and even freshly cut timber land, often described as “barren land,” has some return. AOC is the sum of the product of the opportunity cost and the acreage of the associated land type divided by the sum of the acreage of the associated land types.

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Table 1. Descriptive Statistics of Variables Used in the Analysis

Variable	Definition	Mean	Std. Dev.	Min.	Max.
Ac_L	Number of Acres Leased	18.250	85.209	0.000	700.000
OPEN	Dummy; =I if would like lease the land	0.076	0.265	0.000	1.000
BID	Per Acre Price of Access	8.071	4.725	2.000	20.000
Ac_S	Acreage Suitable for Public Access	64.061	144.845	0.000	1400.000
AOC	Per Acre Agricultural Average Opportunity Cost	21.249	10.183	0.000	55.000
PATTI	Property Attributes Index	49.118	19.758	0.000	100.000
SATTI	Surrounding Acreage Attributes Index	27.328	20.900	0.000	100.000
DEVI	Property Development Index	12.386	11.284	0.000	65.400
NDATTI	Index of Property Attributes that could be Naturally Occurring or Developed	19.583	19.653	0.000	100.000
DETRAC	Index of Property Attributes that Detract from Recreational Development	16.014	11.818	0.000	45.500
EDUY	Education Year	13.027	3.834	4.000	22.000
AGE	Age of the Land Owner	57.956	12.818	27.000	97.000
WHITE	Race: Caucasian = 1 (White)	0.924	0.265	0.000	1.000
MALE	Gender; = 1 if male	0.794	0.405	0.000	1.000
INCOME	Annually income of the Land Owner (thousand dollars)	50.067	38.377	2.500	175.000
HUNT	Dummy; =1 if allow to do hunting in the open land	0.525	0.500	0.000	1.000

N=408

Table 2. Coefficient Estimates of the Tobit Model for Leased Acreage

Variable	Coeff.	Std. Err.
Constant	-1273.873***	351.939
BID	17.569***	6.391
Ac_S	0.914***	0.167
AOC	3.622	3.395
SATTI	-0.548	1.458
NDATTI	3.132*	1.693
PATTI	-1.793	2.058
DEVI	-2.875	3.452
DETRAC	1.333	2.863
EDUY	23.489**	11.676
AGE	4.645	2.899
MALE	131.667	114.532
WHITE	-272.455**	111.120
INCOME	1.604*	0.894
HUNT	-14.134	64.542
Sigma (σ) (Std. dev)	308.463***	46.689
Log likelihood (LL)	-270.199	
LM test [df][1]	33.993[15]	

*, **, and *** represent significance at the 10%, 5%, and 1% significance levels respectively.

[1]LM test: Critical value with 15 degrees of freedom is 25.00 (p=0.05). Since 33.993> 25.00, it means the Tobit model is rejected in favor of a hurdle model.

Table 3. Estimation Results of the Sample Selection Model for Leased Acreage

	Participation Equation Y=OPEN		Level Equation Y= Ac_L	
Variable	Coeff.	Std. Err.	Coeff.	Std. Err.
Constant	-3.867***	1.080	-560.296**	259.363
BID	0.064**	0.021	10.777*	6.230
Ac_S	0.003***	0.001	0.756***	0.167
AOC	0.014	0.012	1.979	3.355
PATTI	-0.005	0.007	1.168	1.884
NDATTI	0.010*	0.006	3.529**	1.523
SATTI	-0.002	0.005	-	-
DEVI	-0.007	0.013	-4.569*	2.933
DETRAC	0.007	0.010	2.643	2.887
EDUY	0.098**	0.038	-	-
AGE	0.008	0.010		-
MALE	0.303	0.383	-	-
WHITE	-1.206***	0.355	-	-
INCOME	0.006*	0.003	-	-
HUNT	-0.092	0.226	-	-
λ			234.528***	77.407
ρ	1.000			
LL	-73.903			

*, **, and *** represent significance at the 10%, 5%, and 1% significance levels respectively.

Table 4. Elasticity of the Explanatory Variables for Leased Acreage

Variable	Coeff.	Elasticity
BID	10.777	0.501
Ac_S	0.756	0.741
NDATTI	3.529	0.521
DEVI	-4.569	-0.337