A Double Hurdle Approach to Evaluating Non-Residential Wildlife Watching in the United States

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A Double Hurdle Approach to Evaluating Non-Residential Wildlife Watching Expenditures in the United States.

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In 1996, over 62 million U.S. residents participated in wildlife watching and spent in excess of 29 billion dollars in this recreational activity. Wildlife watching can be defined as the observation, study, and enjoyment of natural areas and its wild fauna and flora. Residential wildlife watching takes place within one mile of the participant's residence and is often an incidental or secondary activity. Non-residential wildlife watching refers to recreation taking place at a distance of at least one mile from the participant's residence. In recent years, a sharp decline in the number of wildlife watchers has been noted. Between 1991 and 1996, the number of wildlife watchers decreased by 17 percent. During this time interval, the largest decline in participation was observed in non-residential viewing. The number of non-residential wildlife watchers declined by 21 percent. This trend is damaging to towns and communities, especially rural communities which largely depend on recreation dollars. The mitigation or reversal of this trend hinges upon the identification of factors affecting participation and expenditures on wildlife viewing. The determining role of several socioeconomic attributes in explaining participation and expenditures on nature-related recreation has been widely studied in the leisure and recreation literature. However, most of these past studies have focused on fishing and hunting activities rather than the equally important non-residential wildlife watching. Hence, this study evaluates participation decisions and the extent of the participation in non-residential wildlife watching in the United States.

Area: Natural Resource Economics

Keywords: wildlife watching, limited dependent variables, double hurdle

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Introduction

In 1996, United States residents spent in excess of $100 billion in wildlife-related recreation. Although fishing and hunting expenditures account for most of the expenditures, a significant percentage of these recreation dollars is spent on wildlife watching activities. Expenditures on wildlife watching recreation by U.S. residents totaled $29.2 billion in 1996 (U.S. Fish and Wildlife Service, 1996). Wildlife watching, also known as non-consumptive[1] recreation or appreciative outdoor recreation(Loomis and Walsh, 1997) is the observation, study, and enjoyment of natural areas and its wild fauna and flora.

Non-consumptive recreation is classified as residential wildlife watching when it takes place within one mile of the participant's residence. Non-residential wildlife watching refers to nature-based recreation taking place at a distance of at least a mile from the participant's residence (U.S. Fish and Wildlife Service, 1996). Non-residential wildlife watching is also called nature-based tourism or ecotourism by the travel industry.

Wildlife watching expenditures greatly impact the local economy of many localities (Caudill and Laughland, 1998). Several rural communities and small towns heavily rely on non-residential wildlife watching dollars, especially trip-related spending, for their economic development. For example, in 1992, the 6,000 birdwatchers who visited High Island, a small town in Texas, spent around $2.5 million in the area (Dickinson and Edmondson, 1996). Despite the important revenues generated by non-residential wildlife watching, this recreational activity has received limited attention from researchers and fish and wildlife managers (Rockel and Kealy, 1991; Chi, 1997). The

[1] The term non-consumptive has fallen out of use (Duda, 1998; USFWS, 1996).

management and research emphasis has been placed on fishing and hunting activities. This research evaluates decisions to participate as well as the extent of the participation in nature-based tourism in the United States. Trip-related expenditures are used to measure the level of participation in non-residential wildlife watching[2]. Hence, this study provides information on the determinants of participation and expenditures to researchers, policy makers, and fish and wildlife managers.

The remainder of this paper is divided into five sections. The following section provides an overview of non-residential wildlife watching activities in the United States. Section three and four present the model and the data used in the study, respectively. Estimation results are presented and discussed in section five. Concluding remarks are offered in the last section.

Non-Residential Wildlife Watching

Wildlife watching is the most widespread nature-related form of recreation in the United States. In 1996, more Americans participated in wildlife watching activities than in fishing and hunting combined. The number of wildlife watchers totaled 62.9 million in 1996. In comparison, anglers and hunters were estimated at 35.2 million and 14 million, respectively (U.S. Fish and Wildlife Service, 1996).

In recent years, participation in wildlife watching activities has shown a significant downward trend in the United States. Between 1991 and 1996, the number of wildlife watchers decreased by 17 percent, from 76.1 to 62.9 million. During this time interval, the largest decline in participation was observed in non-residential viewing. The number of non-residential wildlife watchers declined by 21 percent, from 30 to 23 million (U.S. Fish and Wildlife Service, 1996).

[2] Only trip-related expenditures were considered because equipment purchased may also be used for residential wildlife-watching and, in many cases, are used during several years.

Expenditures on wildlife watching recreation by U.S. residents totaled $29.2 billion in 1996. Trip-related expenditures, which accounted for 32 percent of wildlife watching expenditures, were estimated at $9.4 billion in 1996. Food and lodging expenses, which are of major interest to small communities, were estimated at $3.4 billion (U.S. Fish and Wildlife Service, 1996).

Model

As in most expenditure analyses, the data set used in this study includes individuals who did not participate in non-residential wildlife watching and thus, reported zero expenditures. Due to the presence in the sample of observations with zero expenditures, limited dependent estimation techniques are required to explain trip-related expenditures in non-residential wildlife-watching. The use of standard ordinary least square estimation under these conditions yields inconsistent estimates (Maddala, 1991; White, 1993). The Tobit model (Tobin, 1958) is the most widely used estimation approach among econometric models accounting for the censoring in the data. The Tobit model is formulated as (Greene, 1993):

$$Y_i = \alpha X_i + \varepsilon \quad if \quad \alpha X_i + \varepsilon > 0; \quad \varepsilon \sim N(0, \sigma_\varepsilon)$$

$$otherwise \quad Y_i = 0$$

However, the Tobit model is restrictive because it assumes that an individual's decision to participate and the extent of his participation in a given activity are similarly affected by a same set of explanatory factors (Bockstael et al., 1990). This study uses Cragg's two-step estimation procedure (1971), a flexible approach which allows the modeling of a sequential decision process in which an individual

first decides whether he will participate in the activity and then determines the dollar amount to spend [3]. The participation decision and the expenditure equation may be affected by different sets of explanatory factors (Blaylock and Blisard, 1993). In contrast with the Tobit specification, in this two-step approach, an explanatory factor may differently impact the participation and expenditure equations (van Ravenswaay, 1999). The brief presentation of Cragg's model provided below is drawn from Bockstael et al (1990):

$$Z_i = 0 \quad if \quad Y_i = \alpha X_{i2} + \varepsilon \leq 0$$

$$conditional \quad upon \quad Y_i > 0 \ ;$$

$$Z_i = \beta X_{i1} + \mu \quad if \quad \beta X_{i1} + \mu > 0$$

$$Z_i = 0 \quad if \quad \beta X_{i1} + \mu \leq 0$$

with Yi = discrete participation decision variable; Zi = expenditures; α , β = unknown parameters; X_{i1} and X_{i2} = explanatory variables; and ε, μ = error terms.

The participation and expenditure equations estimated in this study are given by equations 4 and 5, respectively. These equations can be estimated independently because of the separability in parameters of the corresponding likelihood function.

Participation = F (Age, Gender, Black, Hispanic, Education, Rural, Mid Income, High Income, Married, Northeast, West, South, Nature, Organization, Cross-Over, ε) (4)

Expenditure = H(Age, Gender, Black, Hispanic, Education, Rural, Mid Income, High Income, Married, Northeast, West, South, Nature, Organization, Cross-Over, μ) (5)

[3] To test the hypothesis that the use of Cragg's two-step approach is warranted in modeling wildlife watching participation and expenditures, a Fin -Schmidt (1984) likelihood ratio test is performed.

where:

Participation	=	1 if respondent participated in non-residential wildlife watching; 0 otherwise
Age	=	Respondent's age (in years)
Gender	=	Respondent's gender; 1 if male; 0 otherwise
Black	=	1 if respondent is African-American; 0 otherwise
Hispanic	=	1 if respondent is Hispanic; 0 otherwise
Education	=	Respondent's education level (in years of schooling)
Rural	=	1 if respondent resides in a rural area; 0 otherwise
Mid Income	=	1 if respondent's household income between $30,000 and 50,000; 0 otherwise
High Income	=	1 if respondent's household income greater than $50,000; 0 otherwise
Married	=	1 if respondent is married; 0 otherwise
South[4]	=	1 if respondent resides in the South; 0 otherwise
West	=	1 if respondent resides in the West; 0 otherwise
Northeast	=	1 if respondent resides in the Northeast; 0 otherwise
Nature	=	1 if respondent maintained natural areas around his home; 0 otherwise
Cross-Over	=	1 if respondent fished or hunted; 0 otherwise
Organization	=	1 if respondent belongs to an environmental organization; 0 otherwise
Expenditures	=	Trip-related expenditures on non-residential wildlife watching activities (expressed in log form)

[4] The 4 Census regions are defined and illustrated in Appendix I.

ε, μ = Error terms

Data

Data used in this study were extracted from the 1996 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (U.S. Fish and Wildlife Service, 1998). The survey is conducted every five years by the U.S. Bureau of Census for the Fish and Wildlife Service and gathers extensive information on fishing, hunting, and wildlife watching participation, expenditures as well as socioeconomic characteristics of respondents. This study uses the wildlife watching data set, one of the three data sets generated upon compilation of the survey results[5]. Statistical analyses of the survey data must be weighted (U.S. Fish and Wildlife Service, 1996) to correct for the multi-staged and stratified nature of the survey sample. The sampling design, survey procedures and calculated weights are described in detail in the survey report (U.S. Fish and Wildlife Service, 1996). Overall, 14,400 individuals were selected in the United States for the wildlife watching survey. The response rate was 82 percent. The data set is composed of 11,759 observations, including 3424 individuals who reported participation and positive trip-related expenditures in non-residential wildlife watching in 1996. Summary statistics for the variables used in the empirical model are provided in Table 1.

[5] Compilation of the survey results yields three separate data sets: sportsman (fishing and hunting), wildlife-watching, and screener data sets.

Table 1: Selected Averages For 1996 Wildlife Watching

	All Sample Average	Non-Residential Wildlife Watching Participants
Age	46.0 years	42.2 years
Gender	47.4 % male	51.5 male
Black	3.8 %	1.9 %
Hispanic	3.7 %	4.3 %
Education	13.6 years	14.3 years
Rural	33.6 %	34.1 %

Table 1: Selected Averages For 1996 Wildlife Watching (continued)

	All Sample Average	Non-Residential Wildlife Watching Participants
Mid Income	19.2 %	22.4 %
High Income	14.2 %	18.2 %
Married	66.4 %	68.1 %
Northeast	18.1 %	18.3 %
West	21.5 %	24.6 %
South	33.6 %	30.0 %
Nature	17.5 %	28.8 %
Organization	16.3 %	28.1 %
Cross-Over	11.6 %	18.6 %
Expenditures		$440

Results and Discussion

Due to the sample design, all models were estimated via weighted maximum likelihood with adjusted covariance (Manski and McFadden, 1982; Rockel and Kealy, 1990) using Limdep version 7.0 (Greene, 1998). The Fin-Schmidt likelihood ratio test performed suggested that the use of the

double-hurdle approach was more appropriate than the Tobit estimation [6]. Probit estimation results for the participation decision are given in Table 2. Results include parameter estimates, marginal effects [7] and the corresponding standard errors. Preliminary testing indicated the presence of heteroscedasticity which, if left uncorrected, would lead to inconsistent estimates (Greene, 1993). Thus, estimation results presented were corrected for heteroscedasticity.

[6] For comparison, Tobit estimation results are included in Appendix II.

[7] For probit models, parameter estimates only indicate the direction of the relationship between the participation probability and the explanatory factor. The magnitude of the relationship is given by the marginal effects or changes in probability (Greene, 1993; Judge et al 1982).

Table 2: Participation Decision - Probit Estimation Results

Variable	Estimate	Standard Error	Marginal Effect	Standard Error
Constant	-0.6831 [a]	0.0819	-----	-----
Age	-0.0094 [a]	0.0018	-.0044 [a]	0.0006
Gender	0.0373	0.0229	0.0155	0.0095
Black	-0.3806 [a]	0.0818	-0.1585 [a]	0.0327
Hispanic	-0.1438 [c]	0.0789	-0.0599 [c]	0.0326
Education	0.0422 [a]	0.0061	0.0175 [a]	0.0020
Rural	-0.0205	0.0229	-0.0085	0.0095
Mid Income	0.0234	0.0288	0.0097	0.0119
High Income	0.0345	0.0344	0.0143	0.0142
Married	-0.0038	0.0243	-0.0015	0.0101
North East	-0.0534	0.0349	-0.0222	0.0145
West	0.1035 [a]	0.0338	0.0431 [a]	0.0135
South	-0.1451 [a]	0.0310	-0.0604 [a]	0.0126
Nature	0.435 [a]	0.0499	0.1813 [a]	0.0150
Organization	0.4914 [a]	0.0556	0.2046 [a]	0.0159
Cross-Over	0.2655 [a]	0.0392	0.1105 [a]	0.0154

Log Likelihood Function = -6788 ; χ^2 (with 16 d.f.) = 1443.2 ;
a: statistically significant at the 0.01 level; b: significant at the 0.05 level; c: significant at the 0.1 level.

As suggested by the likelihood ratio test performed (calculated $\chi^2 = 1433.2$ with 16 degrees of freedom), the participation model proposed is significant at the 0.01 level. Parameter estimates indicated that a respondent's age had a negative and significant impact on the likelihood to participate in wildlife watching. Results indicated no statistically significant difference in participation probability

between male and female respondents. Minority ethnic origin was found to significantly impact the likelihood of participation. African American respondents were less likely than Caucasian ones to participate in wildlife viewing. All other factors being equal, an African American's likelihood to participate in non-residential wildlife watching is 0.16 smaller than the participation probability of an individual of Caucasian descent. Similarly, individuals of Hispanic

descent were also found to be less likely than Caucasian respondents to participate in wildlife watching activities. Belonging to the Hispanic community decreased the likelihood of participation by 0.06. One's level of education was also found to significantly and positively influence one's likelihood to engage in nature-based tourism. Each additional year of education increases the participation probability by 0.017. Participation decisions were not significantly affected by respondents' marital status. In addition, no statistically significant difference in participation probabilities was noted between rural and urban residents. Individuals with mid or high income levels were equally likely to participate in non-residential recreation than low income individuals. Estimation results suggested that geography significantly impacted the participation decision. Statistically significant differences in participation probabilities were noted between residents of the 4 census regions. Compared to individuals residing in the Mid-West, Western residents had a significantly higher likelihood of participation. The likelihood of participation by a Western resident is 0.043 higher than a Mid-Westerner's participation probability. In contrast, residing in the Southern region had a significant and negative influence on the participation likelihood. Residing in the South decreased the participation probability by 0.06.

The planting and maintenance of natural areas in or around the home and the enjoyment of fishing or hunting activities were found to have significant and positive effects on the probability to

participate in wildlife viewing. Increases in participation probability attributable to the planting and maintenance of natural areas and to the enjoyment of fishing or hunting amounted to 0.18 and 0.11, respectively. A significant and positive impact on participation probability was observed for respondents belonging to an environmental organization. Their participation probability was 0.20 higher than the participation likelihood of respondents who did not join an environmental organization.

For the expenditure equation, parameter estimates, marginal effects and standard errors are given in Table 3. Most socioeconomic variables included in the model had a significant impact on expenditure levels. Factors that significantly influenced the level of expenditures on wildlife watching included respondents' age, gender, ethnic origin and education level. Estimation results indicated that older participants spent significantly less on trip-related items than younger ones. In comparison to male respondents, female participants spent significantly less on trip-related commodities and services. Results suggested a positive association between the number of years of education and the level of trip-related spending. Similarly, trip-related expenditures on wildlife watching recreation were positively related to income levels. African American wildlife viewers were found to spend significantly less than Caucasian ones on trip-related items. Hispanic origin had no significant impact on the level of spending. Rural residence had a negative and significant impact on expenditure levels. Spending levels for married participants were significantly lower than single wildlife viewers' expenditures. Estimation results highlighted significant regional differences in trip-related expenditures. Western and Southern residents spent significantly more than Midwestern and Northeastern inhabitants on non-residential wildlife watching. Participants in non-residential wildlife watching who were members of an environmental organization spent significantly more

Table 3: Expenditure Equation-Estimation Results

Variable	Estimate	Standard Error	Marginal Effect	Standard Error
Constant	3.4087 [a]	0.2297	-----	-----
Age	-0.0044 [c]	0.0024	-0.0041 [c]	0.0023
Gender	0.1401 [b]	0.0685	0.1339 [b]	0.0655
Black	-0.4487 [c]	0.2414	-0.4291 [c]	0.2308
Hispanic	0.2458	0.1621	0.2351	0.1550
Education	0.0589 [a]	0.0138	0.0563 [a]	0.0132
Rural	-0.3109 [a]	0.0715	-0.2973 [a]	0.0684
Mid Income	0.1950 [b]	0.0837	0.1865 [b]	0.0800
High Income	0.4592 [a]	0.0957	0.4391 [a]	0.0915
Married	-0.0228 [a]	0.0726	-0.2180 [a]	0.0694
North East	0.0283	0.0980	0.0271	0.0937
West	0.6615 [a]	0.0905	0.6326 [a]	0.0865
South	0.2867 [a]	0.0854	0.2742 [a]	0.0817
Nature	0.4044 [a]	0.0750	0.3867 [a]	0.0717
Organization	0.4249 [a]	0.0750	0.4063 [a]	0.0717
Cross-Over	0.3957 [a]	0.0835	0.3784 [a]	0.0798
Log Likelihood Function = -6803.7 ; a: statistically significant at the 0.01 level; b: significant at the 0.05 level; c: significant at the 0.1 level.				

on trip-related items than non-members. The complementarity between fishing and hunting activities and wildlife viewing noted in the participation equation is reinforced by estimates of the expenditure equation. Results indicated that sportsmen, i.e., anglers and hunters, who participated in non-residential wildlife viewing spent significantly more than participants who did not take part in fishing or hunting activities.

Summary and Conclusions

Wildlife watching is the most popular form of nature- related recreation in the United States. Its importance is well illustrated by the number of its participants and their expenditure levels. However, the popularity of wildlife viewing is in marked contrast with the relatively limited interest of researchers and fish and wildlife managers in this recreational activity.

This research evaluated the determinants of participation and expenditures on non-residential wildlife watching using the 1996 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. Participation decisions and expenditure levels were modeled using Cragg's double-hurdle approach.

Results indicated that several socioeconomic factors significantly influenced the participation decisions and the level of spending. The number of years of formal education, residency in the Western region, belonging to an environmental organization, and the planting and maintenance of natural areas, and the enjoyment of fishing and hunting activities were factors that positively impacted the participation in non-residential wildlife watching. The likelihood of participation was negatively affected by an individual's age, minority status, and residency in the South.

Factors that positively impacted expenditures on trip-related commodities and services included the participants' gender, education and income levels, Western or Southern residency, membership in an environmental organization, the maintenance of natural areas, and the participation in fishing or hunting. African American heritage and marriage were the two socioeconomic attributes

that negatively impacted participants' expenditures on non-residential wildlife watching.

Results presented in this study and changing demographics in the United States, especially the rapid aging of the population and the increase in the proportion of Americans that are minorities suggest a future decline in participation rates and expenditure levels on wildlife watching. Fish and wildlife managers may consider aggressive marketing campaigns geared towards senior citizens and minorities to increase their participation and spending in this form of recreation.

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Appendix I - Tobit Estimation Results

Variable	Estimate	Standard Error	Marginal Effect	Standard Error
Constant	-6.090	0.486	-----	-----
Age	-0.076	0.005	-0.020	0.001
Gender	0.614	0.145	0.163	0.038
Black	-2.029	0.436	-0.539	0.115
Hispanic	0.953	0.363	0.253	0.096
Education	0.320	0.029	0.085	0.007
Rural	0.135	0.154	0.035	0.040
Mid Income	0.265	0.183	0.070	0.048
High Income	0.290	0.212	0.077	0.056
Married	0.087	0.155	0.023	0.041
North East	-0.180	0.211	-0.047	0.056
West	0.782	0.200	0.207	0.053
South	-0.403	0.183	-0.107	0.048
Nature	2.613	0.178	0.694	0.047
Organization	2.715	0.182	0.721	0.048
Cross-Over	1.966	0.201	0.522	0.053

Log Likelihood Function = -13,674.45 ;
a: statistically significant at the 0.01 level; b: significant at the 0.05 level; c: significant at the 0.1 level.

Appendix II - U.S. Census Regions

[Map Here]