Determinants of Demand for Participation in Wildlife Hunting: A County level Analysis

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Abstract

We developed an economic demand model of wildlife hunting and found that sociodemograpahic and ecological characteristics of county are its strong predictors. Result shows that the hunting is not popular among younger generation; and promoting hunting clubs and lease-hunting, recruiting young hunters could be effective policy considerations for retaining/promoting hunting.

Keywords: Wildlife hunting; License sales; Demand model

JEL Classification: Q21, Q26, L83

Introduction

The hunting business in the United States has an important social and economic contribution. In addition to price of the license itself, cost of a hunting trip includes expenses for various equipment, transportation and accommodation. For example, expenditure of about 13 million people for hunting and related service activities contributed over $ 20 billion in 2001. Average expenditure of a hunter on trip and equipments was about $ 800 (US fish and wildlife service, 2001). Such expenses certainly have a multiplier effect on local and regional economy. Economic impact of hunting in some of the southern states such as Georgia is estimated to be higher than that of some famous agriculture crops ie; peanuts (IAFWA, 2002). In addition to economic impact of the hunting, hunting is found to be helpful in regional ecology as the hunters harvest the overpopulated numbers of a species every season (Shaw, 1985).

As there is a growing concern of low hunting adaptation among younger generation, studies such as Mehmood et al (2003) reported that no policy instrument could re-motivate the hunters to bring back once they quit hunting. Recently the wildlife management agencies in the United States have experienced revenue loss due to decline in license sale (Sun *et al* 2005; Anderson *et al* 1985). The revenue from sale of these licenses is a major source of budget for the conservation agencies that have the challenge to meet the growing demand of nature conservation with limited fund (Anderson *et al* 1985; Teisl *et al* 1999; Floyd and Lee 2002). The drop in license sales can have twofold effects. First is declining budget for conservation agencies. Second is increasing human-wildlife conflict around rural-urban interfaces due to overpopulation of species.

Unlike other consumer commodities, price of hunting license is determined by state agencies rather than market equilibrium. Because of the very small share of the license price in

the total expense for hunting, one could argue that the hunters might be relatively less responsive to price change. As Teisl et al. (1999) concluded that the increase in price would not have significant effect on the demand of license among resident hunters. So, there might be factors other than price that determine the demand for hunting licenses. Bissell et al. (1998) concluded that broad demographic and social changes in the country are influencing the hunting participation. The need of an empirical study stems out from the fact that such factors on hunting demand are still not well understood. Moreover, there is a need for developing a hunting demand model to predict future demand of licenses and revenue associated with them. Besides, understanding the social and economic factors associated with the hunting activities have implication for various issues such as social support for hunting promotion and recruitment and retention of hunters. The state agencies might be interested in such studies because the total number of hunters in a state partly determines the conservation fund to be allocated for that state (Floyd and Lee 2002).

Despite of long list of literature on the recreational demand studies, very little has focused on hunting demand. Because the hunting is different from other recreational activities such as wildlife viewing and cycling, the results from other recreational demand studies may not applicable to understand hunting demand. During the recent decades, many studies have discussed the issues related to demand of sportsman hunting and related outdoor recreation (Anderson et al. 1985; Walsh et al. 1992; Heberlein and Thompson 1996; Bissel et al. 1998; Floyd and Lee 2002; Sun et al. 2005; Ziemer et al. 1980; Miller and Hay 1981; Mehmood et al. 2003; and Brown and Connelly 1994). Floyd and Lee 2002 used a logistic regression model and survey data to find the demographic characteristics of respondents who purchased the hunting license. They found age and race as the major predictors of hunting and fishing participation.

Result from other surveys used a model to describe gender wise participation in hunting (Heberlein and Thompson 1996; Bissel et al. 1998). Heberlein and Thompson (1996) pointed out that conducting telephone or questionnaire survey is often considered time consuming and expensive. Thus a cost effective model that uses the readily available data on license sales and demography is needed.

Many of the studies in hunting and outdoor recreation have estimated the linear and log-linear demand model with ordinary least square (OLS) method. Anderson et al. 1985; Brown and Connelley 1994; Sun et al. 2005; and Ziemer et al. 1980 have used such models. These studies explained the number of licenses sold as the function of primarily license fee, demographic variables and other variables related with hunting resources such as deer density. One of the limitations of the earlier studies was on the questions of the generalization of their findings because the studies did not cover a large geographical area.

This paper examines the determinants of demand for wildlife hunting of Southern United States at the county level. The focus of this study is to identity the socio-economic, ecological and institutional factors and their extent of association with the hunting demand. Finding from this study will be useful to forecast how the ongoing trends in social and demographic factors are likely to affect hunting demand and revenue from license sales in the future.

Empirical Model

In contrast to the previous models of hunting or fishing recreation, the proposed model uses a cross sectional analysis of hunting license demand at the county level. Different from the other models, it includes both the demand and supply related factors that determine the equilibrium quantity of license demand and supplied in the counties. Following Sun et al *(*2005), Brown and Connelley (1994), and Anderson et al. *(*1985), we apply an equation of hunting

license demand on a cross-sectional data of large geographical coverage of Southeast United States. We estimate a log-linear model, which is one of the most popular functional forms in recreation demand models (Ziemer et al. 1980).

$$LnY = \beta_0 + \sum_k \beta_k \mathrm{X} \ + \varepsilon \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

Where, $\ln Y_i$ is a N by 1 vector of the natural logarithm of number of license sold in counties*;* X is a N by K matrix of the explanatory (demographic or ecological) variables explaining the socio-demographic and ecological characteristics of the county. Similarly, the last term ε is N by 1 vector of the residual capturing errors. A test on heteroscedasticity rejected the null hypothesis of homoscedasticity (F- value of 259.20, degree of freedom 151 and p-value of less than 0.0001). Although the estimations in presence of heteroscedasticity are unbiased and consistent, they will not be efficient. In such case, the OLS cannot be used. Since the exact form of heteroscedasticity is unknown, the above specified model was estimated using feasible generalized least square (FGLS) method (Greene, 2003). Using FGLS, the parameters are estimated using the following equation.

$$\hat{\beta} = (X'\hat{\Omega}^{-1}X)^{-1}X'\hat{\Omega}^{-1}y \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2$$

Where, the term Ω is a N by N diagonal matrix of error term. Note that the y in error term is in logarithmic form as modified by equation 1. The estimated error variance and specification of the model is found in Greene (2003).

Since, we adopt the concept of economic demand model, the model explains the demanded quantity of hunting license as a function of price, availability of substitutes as well as complements and other socio-demographic factors. We used a set of economic and demographic variables those are commonly found in existing literatures on hunter's characteristics, survey of hunting demand. Following the literature (Heberlein and Thompson 1996; Mehmood et al. 2003;

Floyd and Lee, 2002; Bissell et al. 1998), variables including age, education, income, race, and residence have been considered in the model. The detail definition and description of the explanatory variables has been presented in table 1. We also used variables including employment status and family status such as households with children but no wife. According to Mehmood et al. (2003), the families with childcare responsibilities might influence the time for participation in hunting trips. Likewise, the proportion of people in the county with full time employment has been used to capture the effect of employment status. Based on the literatures, we expect that the county dominated by the white population will have higher demand for hunting than anywhere else. The natural log of personnel income has been used to estimate the income elasticity of demand among resident hunters. It is expected that the people with higher level of economic prosperity are likely to participate in hunting.

Regarding education, we used two different variables to see how the people with different level of education influence the demand for participation in hunting activities. Given the opportunity cost of time, we expect that the people with higher level of education are more likely to participate in hunting as compared to those with less income. We have used two sub-categories of likely hunters population in this study. Since there is a growing concern of non-adoption of hunting activity by younger generation as a means of recreation, analyzing the individual effect of younger and elder population might give clear policy. For this purpose, we have separate variables capturing the proportion of people between 16 and 35 years, and between 35 and 65. A dummy variable capturing whether the county is metro or non-mtero is included. We expect that the urban residents are less likely to be involved in hunting as they have access to various alternative recreational opportunities.

We used the percentage of public forest land in the county assuming that the easy accessibility of public hunting grounds influences the demand for hunting, as traveling further away increases the cost. Since the pasture and wetlands are the essential components of habitat for commonly hunted deer and bird species (Shaw, 1985), we include the proportion of these habitat types to capture the availability of hunting site and abundance of species to be hunted. Inclusion of such factors in the model is also in line with Mehmood et al. (2003), who found that lack of public hunting ground was one of the reasons for quitting hunting. Since the hunting and fishing share some common features that people can recreate from, easy access and availability of fishing resources in the neighborhood might influence the people's participation on hunting. Therefore, we used the availability of fishing camps in county to captures such substitution effect. Similarly, the hunting is a trip-based outdoor recreation activity; we expect that the availability of ancillary amusement and recreation attractions in the county might influence people's decision to plan for joint outdoor trips. So, number of other amusement/sports attractions in the county has been included to capture such complementary effect.

As the price of license is not fixed at county level but state, we used a state level fee proxy to capture the price effect of license on demand for participation. As the different license types do have different price level, we used a general proxy of per hunter capita cost for license fee. This means the total revenue from license sale in the state was divided by total resident hunters for that particular year. Even though, this is not an exact measure of license price, we believe that this can at least measure the state level variation in price and is the best proxy available. Also, the exclusion of price from the model can induce omitted variable bias, this proxy instrument, which changes with price among state but not with error term, is expected to correct the endogeneity issue. Since, we have taken the natural log of this variable, it gives the

elasticity measure of license price. Another variable measuring the number of hunting clubs in the county has been included in the model. We expect that such institutional platforms can have direct relationship with the demand for participation in hunting activities.

Although the heteroscedasticity was corrected using GLS method, there is another empirical issue of multicollinearity, we have to control for. Multicollinearity is caused by the strong relationship among independent variables in the model, and can often overestimate the variance thereby limiting the accurate estimation (Greene, 2003). Literatures suggest variance inflation factor ie; $1/(1-R^2)$ as a measure of multicollinearity and values exceeding 20 is considered to induce serious statistical problem (Greene, 2003). We used VIF to eliminate some other demographic variables including rural-urban population ratio, number of kids in the family to address this issue. We also omitted variables such as average precipitation and temperatures in the county because of this issue, and also because Teisl et al. 1999 argued that those do not have effect on license sales. So, we used a set of explanatory variables, which is considered to be free of multicollinearity in our final model. The VIF value for each of the independent variable included in model has been given in table 3.

Data Sources

This study used data from different sources. The state offices responsible for hunting license sales were requested to provide the county level sales record of all kind of residential hunting permit sold to county residents in year 2000. The quantity of licenses sold under different license types were summed to get the total quantity of license sold for county residents. In that sense, we treat this county sum as total demand for participation in hunting. Since, the total sale of license varies greatly among the counties, we take the natural log of quantity to minimize empirical issues of outlier effect, heteroscedasticity etc. Counties from ten southern

states including Alabama, Georgia, North Carolina, South Carolina, Tennessee, Virginia, Kentucky, Arkansas, Lousiana and Texas have been included in this study. It should also be noted that couple of counties in Georgia and Texas has been excluded from this study because the zero license sale in those counties in 2000 could not fit into our log-linear empirical model. Sales record by county was available for Florida only after 2004, which we did not include here whereas we failed to receive sales record from Mississippi State even after several correspondences. We assume that exclusion of Florida and Mississippi from the study does not seriously affect the empirical validity of the model we estimate here. Total number of county included in the analysis is 1066.

Data on demographic and economic variables including age, education, race, employment, and family with children status were obtained from the US Census 2000 and Economic Research Service (ERS) of USDA. Since, the demographic variables can have a big variation according to size of county population, the demographic variables were computed in percentage. Those include percentage of white people living in county, college graduates and full time employees each as a percentage of county population. Similarly, people with 9 or less years of schooling, and those with college degree as proportion of county population; and households having children but no wife as a percentage of county total were among other variables in percentage. Binary information on rural or metropolitan status of county was obtained from the ERS. A county is considered of metro status if the total population exceeds 100, 000. The per hunter capita expenditure was obtained from the National Shooting Sports Foundation (NSSF). The foundation keeps the record of resident and non-resident hunting license sales by state, obtained from the US Fish and Wildlife Services.

Another dataset used in this study is ecological information capturing the availability and abundance of hunting species. The proportion of pastureland and wetland in each county was obtained from the national outdoor recreation supply information system (NORSIS 1998). NORSIS database program provides the county level database of outdoor recreation resources in USA under Renewable Resources Planning Act (RPA) assessment of recreation and wilderness. Data on number of hunting clubs, fishing camps, and availability of amusement and sports part in the county were also obtained from NORSIS. We believe that although the NORSIS dataset was compiled for 1998, those can be used for 2000 proxy since unequal and dramatic change in ecological information are very unlikely in such a short period.

The average demand of license in the county was 3,913 with a minimum of 5 and a maximum of 61,882. The average of per hunter capita expenditure on license fee was $ 13.76 with the minimum of $ 9.11 and maximum of $ 18.54. Similarly, the average number of hunting clubs and fishing camps were respectively 0.02 and 0.01 with minimum of 0 and maximum of 2 in each case. The average proportion of public forest ground was 0.70 while that of pasture and wetlands were 13.21 % and 7.40 % respectively. About 27 % of the counties were in metropolitan status. The detail descriptive statistics of the variables has been given in table 2.

Empirical Results

As expected, most of the variables are statistically significant and quite consistent with the earlier literatures. The fitted model reveals that excluding any of these variables would result in model misspecification. The estimated coefficients are presented in table 3. Estimation shows that the non-metro counties are likely to have more demand of hunting license while opposite is true in case of metro counties. An analysis of racial perspective shows that the counties with higher proportion of white people are likely to have higher demand of hunting license. As

expected, it reveals that the white people are more likely to hunt as compared to others. This finding is in line with conclusion of Floyd and Lee 2002's survey of hunters, who found that the African American and Hispanics are less likely to purchase hunting license. Similarly, the counties with higher proportion of resident with full-time job are less likely to participate in wildlife hunting. The casual observation behind this might be due to the lack of time. The household with children but without wife has significant and negative effect is an evidence of that. It can be interpreted that the time needed for intensive childcare in the family is likely to affect people' participation in hunting. This is consistent with Mehmood et al. 2003, since they found that the time, money and energy required to rear children could influence the people's willingness to participate in hunting.

We found that the personal income is one of the strong predictor of demand for wildlife hunting. Our analysis shows that the income elasticity of license demand among resident hunters is as high as 0.83. That means a percentage increase in average personal income of resident can increase the license demand by 0.83 %. This indicates that the hunting in recent days is a kind of luxury good due to its recreation value, although it used to be a traditional way of gathering subsistence food. Similarly, the counties with higher proportion of people with fewer years (below 9) of schooling are more likely to hunt in contrast to college graduates who are less likely to hunt. We speculate that the higher opportunity cost of time for college graduates might be the reason behind this, as hunting trips often require commitment of time and physical efforts. The college graduates with white-collar job might find other time saving and less physically involved means of entertainment. In addition, hunting is considered often a traditional pride in some rural communities, where population of farmers or less educated people predominates.

As expected, the percentage of public forests in the county has significant and positive effect in demand of hunting license. It might be because of the availability and easy access to public hunting ground. Mehmood et al. 2003 concluded that the Alabama hunters quit hunting due to lack of public grounds. Lack of such forest areas might need hunters to lease private forests involving extra cost of hunting trips. Likewise, we noticed higher license demand in the counties with higher proportion of areas in pasture and wetlands. Intuitively this is true, because the pasture and wetlands are the habitats for many game and bird species. Increase in proportion of land under such cover types might increase the abundance of game and bird species in the county. This can further ensure the hunting success of hunters, which further encourages the hunters to come in next season. We had expected the availability of fishing camps to have negative effect on hunting license demand, because the fishing could be a close substitute of hunting, as it is another physically involved wildlife related recreation. Insignificant coefficient reveals that hunting activities might not be affected by increased supply of fishing resources.

Interestingly, result indicates that there is a significant variation in the behavior of younger (16-34) and elder (35-65) population of potential hunters. The coefficient of elder hunter group was significant and positive but it was not significant in case of younger. However, there was a similarly in sign ie; positive in both case. It reveals that the younger people might not be adopting the hunting as a recreation activity. This result supports the ongoing debate that the hunting is not being popular in young generation, for which some state agencies are now considering recruitment policies. If younger generation is not joining hunting, then the state agencies will face even more decline in hunting license demand in days to come, which could result into more revenue loss. To keep the hunting business alive, the state agencies might focus in this age group for hunting promotion and hunter's recruitment.

The proxy for the license fee was found to have a negative but insignificant effect. The negative effect found here is consistent with the findings of Teisl et al. 1999; Sun et al. 2005. Although, the sign is consistent with the economic intuition of inverse relationship between price and quantity demanded, the insignificant effect suggests that the price does not have much effect in license sales. There might be few possible reasons behind this. First, the hunting involves a lot of logistic and trip related costs, compared to which the price of a license worth very less to hunters. Assuming this to be true, the state agencies might have potential to increase their revenue for nature conservation by raising the license price reasonably. However, it needs a cautious interpretation, as the variable is proxy. Second, this price is fixed at state level rather than counties; the proxy used might not have much variation in price itself among the states. In addition, unlike other commodities where market determines the price, the state agencies control the license price and also there is not a perfect substitute of hunting adventure, buyers might have very little influence on its equilibrium price. Purchasing license from neighboring state would not make them better off sine they will be charged the non-resident fee in those states.

Our result also indicates that the hunting clubs can be effective institutions for retaining and promoting hunting activities. The counties with higher number of hunting club were found to have higher demand of license. The casual intuition behind it is that these clubs might offer more companions and organized trips in the counties. Increasing either price or the quantity can increase the revenue. State agencies might have long-term benefit by increasing the quantity, which also ensures the sustainability of hunting business. For this, state agencies could plough back a small portion of license revenue in promoting such clubs in the counties to increase hunters and license demand both. We also found the availability of ancillary outdoor attractions such as sports and amusement parks to have positive effect on hunting license demand. Since, all

of those recreations are outdoor activities like hunting, cultural fabric of such recreations in counties might motivate people to jointly organize hunting trips with other activities.

Conclusion

Since, the hunting is beneficial for generating operating budget of conservation agencies and maintaining the optimum population of wildlife species, noticed decline in sale of hunting license has been a matter of concern in recent days. Unlike other commodities, price of hunting permits are fixed by state agencies and consumers have little or not control on it. Understanding what determines the demand of hunting license is important to project demand for license and shooting game population. This paper developed an economic framework for analysis demand of hunting license among resident hunters in US south counties. The proposed model could be used in analyzing the effect of any particular sociodemogrpahic or economic attribute on the license demand in further researches. Particularly, this model can serve as pioneer model for predicting hunting demand of some specific license types or animals. Agencies could use this model to compare the hunter's response to alternative license combinations for eg; individual license vs. combo licenses.

In addition, our study provides some empirical evidence on relationship between sociodemogrpahic factors and demand for wildlife hunting. The social and demographic factors are the strong predictors of hunting license sales in American communities. We also draw some policy implication relevant for state agencies in hunting promotion, revenue adjustment and new hunters' recruitment. As there might not be a close substitute of hunting experience, the insignificant effect of price reveals that the resident hunters might be relatively less responsive to slight increase in license fee. Since, the availability of public hunting ground matters much, some incentive policy to motivate private forest landowners could provide hunters more hunting land

in a reasonable cost. Promoting the leasing option could be an alternative. Furthermore, the issues like decreasing license sales and low adoption of hunting activity by young generation could be better addressed by promoting institutional mechanisms such as hunting clubs, and adopting some policy instruments to encourage younger people to join hunting (eg; awareness, campaign, fairs and recruitment programs). Assuming that the hunters are less responsive to price of license itself, a reasonable increase in fee could raise revenue, a part of which could be ploughed back to recruit younger hunters, promote hunting clubs and encourage the lease hunting in non-industrial private forests.

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Table 1. Definition of Variables

Variable	Description
Demographic and economic Variables	
Personal income	Average Personal income of the county residents
Employment	Percentage of people in the county holding full time job positions
Low education	People with less than 9 year of schooling as a percentage of county population
College graduate	College graduates as a percentage of county population
Population (16-34)	Percentage of county population between 16 and 34 years
Population (35-65)	Percentage of county population between 35 and 65 years
Children but no wife	Households with underage children but no wife as a percentage of county total
White	White population as a percentage of county total
Ecological Variables	
Public forest	Land under public forest type as a percentage of county area
Pastureland	Land under pasture cover type as a percentage of county area
Wetland	Area under wetland cover type as a percentage of county area
Institutional and Other Attraction Variables	
Hunting clubs	Number of hunting clubs in the county
Fishing camps	Number of fishing camps in the county
Amusement	Number of ancillary amusement and sports park
Other Variables	
Price Proxy	Per hunter capita expenditure on license fee in the state. (Revenue from resident license sale divided by total number of resident hunters of that year)
Metro	Dummy variables, if county is in metropolitan area 1, otherwise 0

Table 2. Descriptive Statistics

Variables	Mean	Standard Deviation	Minimum	Maximum
Demographic and economic Variables				
Personal income (in thousands dollar)	1774.715	6068.661	4.188	12800.000
Employment	43.709	6.975	22.610	71.640
Low education	7.338	3.381	0	22.380
College graduate	12.203	4.957	4.420	40.370
Population (16-34)	21.975	3.986	4.480	47.660
Population (35-65)	38.661	2.969	25.240	59.700
Children but no wife	3.152	1.008	0	10.140
White	77.981	16.886	13.960	99.290
Ecological Variables				
Public forest	0.700	1.845	0	23.830
Pastureland	13.216	12.743	0	71.810
Wetland	7.408	11.593	0	65.530
Institutional and Other Attraction Variables				
Hunting clubs	0.026	0.171	0	2
Fishing camps	0.018	0.155	0	2
Amusement	0.163	1.090	0	24
Other Variables				
Price proxy	13.763	2.922	9.115	18.541
Metro	0.271	0.444	0	1

Table 3: GLS Estimation of Parameters

Variables	Coefficient	VIF`
Intercept	-4.542***	---
	(0.606)	
Demographic and economic Variables		
ln(Personal income)	0.830***	2.872
	(0.022)	
Employment	-0.013***	1.691
	(0.003)	
Low education	0.034***	2.270
	(0.007)	
College graduate	-0.036***	2.878
	(0.006)	
Population (16-34)	0.010	1.924
	(0.006)	
Population (35-65)	0.021**	2.008
	(0.008)	
Children but no wife	-0.054***	1.165
	(0.019)	
White	0.014***	1.783
	(0.001)	
Ecological Variables		
Public forest	0.024*	1.042
	(0.013)	
Pastureland	0.007***	1.259
	(0.001)	
Wetland	0.008***	1.488
	(0.001)	
Institutional and Other Attraction Variables		
Hunting clubs	0.205**	1.049
	(0.091)	
Fishing camps	0.029	1.013
	(0.117)	
Amusement	0.015**	1.156
	(0.006)	
Other Variables		
ln(Price proxy)	-0.053	1.147
	(0.101)	
Metro	-0.202***	1.988
	(0.055)	
Adj. R- Square	0.72	

Number of Observations	1066

*Note: ***, ** and * indicates the statistical significant of parameter at 1%, 5% and 10% level respectively. The numbers in parenthesis are the standard errors.* ` Variables with VIF values exceeding 20 can induce the multi-collinearity.