Three Essays on the Valuation of Natural Resources in Recreation and Tourism

by

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Abstract

This dissertation examines the demand behavior of recreational participants, their preference for resource attributes and their valuations of nature-based outdoor activities and related natural resources. The results are presented in the form of three separate chapters (2, 3 and 4) in journal publication formats.

In the context of a recent controversy over the trend in nature-based recreation demand, Chapter 2 estimates the demand for and welfare value of consumptive nature-based recreation (CNR) in the United States and examines if this value changed between 1996 and 2006. Demand is estimated using the travel cost model framework and the standard, truncated and zero-inflated count data models. The hypothesis that the demand for CNR trips was identical in the two sample years is rejected. A demand-supply model shows a downward shift in demand for CNR trips along a negatively sloped long-run supply curve between the two study years implying that CNR is a decreasing cost industry. Although total participation declined between 1996 and 2006, results suggest that per capita willingness to pay (WTP) for CNR, in 2006 constant dollars, was higher in 2006. However, declined participation offset the higher per capita WTP in 2006 and resulted in an aggregate economic value of CNR not significantly different from that in 1996. An important unresolved issue regarding inconsistencies in welfare measures from truncated and untruncated count data models is also addressed in this paper. Results suggest that welfare estimates from truncated models may not be appropriate for extrapolating to the general population and justify efforts in collecting additional data on nonparticipants.

Chapter 3 examines the influence of state attributes on the choice of destination states by freshwater anglers. Using revealed preference data on anglers who participated in freshwater fishing in twelve southeast states in 2006, this paper estimates the values that anglers place on social, infrastructural and environmental characteristics of states and examines how these values vary by angler characteristics. Estimated mixed logit models suggest that anglers are less likely to participate in freshwater fishing in states where toxic releases to surface water and air, crime rate, and the extent of urbanization are high. On the other hand, anglers prefer states with more sunshine and greater recreational and forest acreages. Willingness to pay for state attributes varies significantly in the population of anglers. Although angler characteristics do not fully explain this variation, results suggest that urbanites and males place higher values on state attributes than their rural and female counterparts, respectively. Willingness to pay also increases with income.

Finally, Chapter 4 estimates the monetary value of urban forests' non-price benefits to tourists. Data collected by face-to-face self-administered survey of urban tourists in Savannah, Georgia is used to estimate tourists' willingness to pay (WTP) for urban forests by the contingent valuation method. WTP is found higher among tourists with graduate school education and higher income. Results also suggest that tourists with family are willing to pay less, likely because of lower disposable income in larger households. Positive perceptions about the importance and quality of urban forests increase WTP. Loyal tourists are found to be willing to pay more for urban forests. The

estimated annual value of urban forests to tourists in Savanna ranges from a minimum of US $62 million to a maximum of US $117 million.

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CHAPTER 1

Introduction

Recreation and tourism both are primarily, although not exclusively, leisure activities (Williams, 2003, p. 2). Recreation is a voluntary leisure time activity for the primary purpose of pleasure without any obligation, compulsion or economic benefits (Pigram, 1983, p. 3). Tourism refers to traveling away from home for a variety of purposes, such as pleasure, recreation, visiting friends or family, business, education, health or religion (Williams, 2003, p. 7). Thus tourism may include recreation. People may, on the other hand, travel for the sole purpose of recreation.

The interrelationship between recreation and tourism can be described by the Venn diagram in Fig. 1.1. Most of the recreation and tourism are undertaken as leisure

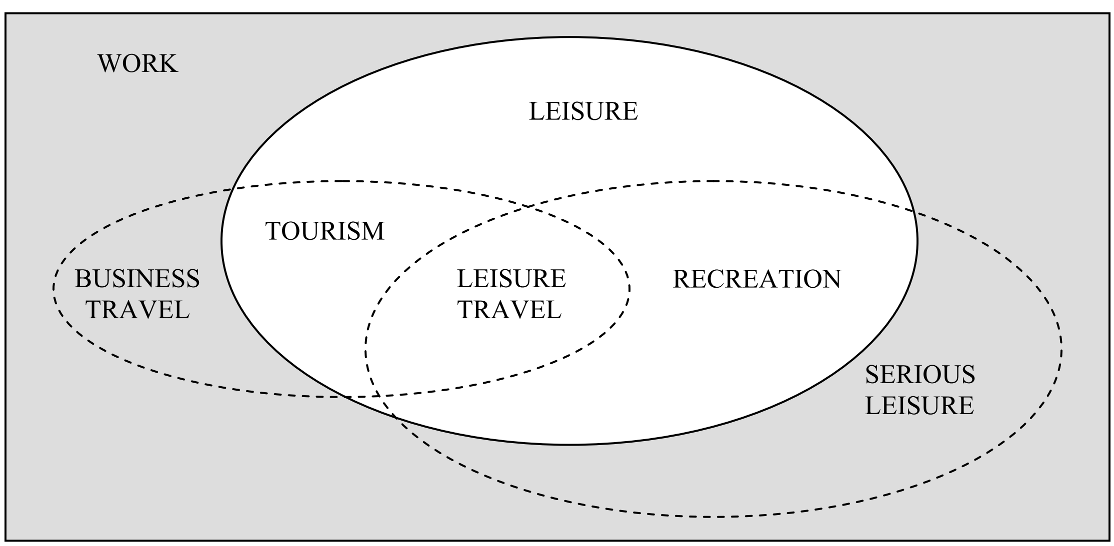

Fig. 1.1. Relationship between recreation and tourism (after Hall and Page, 2002).

time activities (Williams, 2003, p. 7). Some recreation and tourism, however, extend to the areas of work. These include business travels and serious leisure activities. Serious leisure is characterized by professional competence in the recreational activity in question, such as competitive sportfishing. Finally, a considerable overlap between recreation and tourism also exists. This dissertation primarily concentrates on nature-based outdoor recreation and the relationship between natural resources and recreation and tourism.

The economics of (outdoor) recreation is a branch of natural resource economics focusing on the use of natural resources for recreational purposes (McConnell, 1985). From an economic point of view, there are two important issues related to the services provided by these natural resources (Freeman, 2003, p. 417). Firstly, the attributes of the natural resources determine the economic value of the services provided by them. Pollution and management policies influence those resource attributes. It is thus important to understand the values of the services provided by natural resources for efficient management decisions. Secondly, nature-based recreation is typically not marketed and has open access with zero or a very low entrance fee that is completely unrelated to the actual cost. To address these issues, economists often examine the behavior of recreational participants, estimate demand for recreation and place valuations on sites and resources associated with recreation.

Increasing affluence and population growth after World War II triggered the emergence of outdoor recreation as an important element of American lifestyle (Cordell, 2008). The popularity of outdoor recreation activities in the United States (US) grew ever since. Although outdoor recreation in the US covers a wide range of resources, its traditional view concentrates primarily on natural resources, such as parks, forests, lakes, rivers and mountains (Betz et al., 1999). Nature-based recreation activities, such as fishing, hunting, wildlife viewing, hiking and camping, and nature-based tourism produce tremendous economic benefits and part of these benefits is used for the management and preservation of natural resources of the country. Economic impact of nature-based recreation ranges from equipment and license sales to state and federal tax revenues.

Enjoying the nature is not always the primary purpose of tourism. Natural resources can still play very important roles in tourism. Urban forests, for example, significantly contribute to the beauty of urban areas and improve the quality of urban tourism, traditionally considered as "gray tourism" because of the highly developed nature of urban recreational resources (Deng et al., 2010). Urban forests work both as a major appeal to tourists and as a complement of other attractions in cities.

Despite the significance of the relationship between natural resources, recreation and tourism, at least two threats to its long-term sustainability can be identified. The first is the changing public attitude towards nature-based activities and the increasing influence of electronic media (Louv, 2005; Pergams and Zaradic, 2006). The second is the continual pressure put on natural recreational resources by rapid population growth and urban development. It is thus important for resource managers and planners at all levels, local, state and national, to understand the demand and choice behavior of the recreational participants and tourists. Information on the monetary value of non-price benefits of nature-based recreation and tourism and the associated natural resources are also crucial for them to make better land use and resource management policies.

The objective of this dissertation is to examine and understand the demand behavior of recreational participants and tourists, their preference for resource attributes and their valuations of nature-based recreational activities and related natural resources. To achieve these objectives, this dissertation conducts three separate studies.

1. The second chapter of this dissertation explores the nature of demand for consumptive nature-based recreation (CNR) in the US, estimates the aggregate welfare value of CNR at the national level and examines if these values changed between 1996 and 2006. This chapter also compares welfare measures from truncated count data models using truncated data with welfare measures from untruncated count data models using untruncated data. The zero inflated count model is used with the untruncated data to improve on the comparisons done by previous studies. I define CNR as fishing and/or hunting and nonconsumptive recreation (NNR) as wildlife watching. Demand for CNR is estimated by applying the travel cost model (TCM) and using data from the 1996 and 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (NSFHWAR).
2. The third chapter examines the influence of state characteristics on choice of destination states by anglers participating in recreational freshwater fishing in the US southeast. I quantify the value that anglers place on social, infrastructural and environmetal characteristics of states. Mixed logit models estimated by Bayesian procedures are used to examine anglers' choice decisions. Revealed preference data on anglers obtained from the 2006 NSFHWAR are used in empirical estimation.

3. The fourth chapter estimates the monetary value of non-priced urban forest benefits to tourists. The contingent valuation method is used to estimate tourists' value for urban forests in Savannah, Georgia. The influence of tourists' perceptions of urban forests' importance and quality on their willingness to pay is examined. An important question often asked in tourism literature is whether loyalty pays. In this paper I investigate if destination loyalty of tourists, measured by repeated trips, pays for urban forests. A maximum likelihood technique is used for econometric estimation of payment card willingness to pay data.

CHAPTER 2

Consumptive Nature-based Recreation in the United States: Welfare Measures from Truncated and Untruncated Count Data Models

2.1. Introduction

A controversy over the demand for nature-based recreational activities in the United States (US) has emerged in recent years. Several authors (for example, Louv, 2005; Pergams and Zaradic, 2006, 2008a, 2008b) have suggested a declining trend in nature-based recreation. Using visitation data from the National Park System (NPS), Pergams and Zaradic (2006) claimed that per capita demand for nature-based recreation had been declining since the mid 1980's. Pergams and Zaradic (2008a) found longitudinal declines in long-term time series representing different forms of nature-based recreation on various types of public lands in the US and concluded a fundamental shift away from nature-based recreation. Using data from the National Survey on Recreation and the Environment (NSRE), Cordell (2008), however, claimed that demand for nature-based recreation in the US was strong and growing. Balmford *et al*. (2009) also found limited support for declines in nature-based activities based on visitation data from 51 protected areas in the US.

Recent research reports also suggest dissimilar participation trends in consumptive (CNR) and nonconsumptive (NNR) nature-based recreation. In general, it is found that the popularity of and demand for NNR, such as wildlife watching, is increasing while they are declining for CNR, such as fishing and hunting. Pergams and Zaradic (2008a) found a downward trend in per capita fishing and hunting license sales since 1950. Cordell (2008) found declines in some forms of fishing, but dramatic growth in NNR between 2000 and 2007. US Fish and Wildlife Service (USFWS, 1997, 2007) reported a decline in the percentage of US population 16 years old and older who participated in fishing and/or hunting from 19.6% in 1996 to 14.8% in 2006. The percentage of wildlife watching participants remained stable at 31% in 1996 and 2006. In absolute terms, however, although the number of fishing and/or hunting participants declined, there was an increase in wildlife viewing participants between the two years.

A conclusion of a decline in nature-based recreation demand is critical as this can have important consequences such as reduced federal, state, and other funding for natural resource conservation and for recreation management (Cordell, 2008). Revenue generated from CNR activities, such as fishing and hunting, provides substantial financial assistance to the conservation of wildlife in the country and supports hundreds of thousands of jobs in allied industries and businesses in the US (Floyd and Lee, 2002; Loveridge *et al*., 2007; USFWS, 2007). Declining CNR participation has raised concerns about the long run sustainability of recreational resource management programs (Floyd and Lee, 2002). Thus it is important to understand the characteristics of CNR participants at the national level, the nature of their demand and the economic welfare from CNR. Although previous studies have analyzed the trend in the demand for CNR based on visitation rate, economic analysis of demand for and welfare from CNR at the national level is lacking.

The positive integer nature of trip data has led researchers to widely use the truncated count data models in recreation demand studies (see, for example, Chakraborty and Keith, 2000; Creel and Loomis, 1990; Grogger and Carson, 1991; Martinez-Espineira and Amoako-Tuffour, 2008; Shrestha *et al*., 2002). According to Loomis *et al*. (1991), truncated count data models can be suitable for estimating welfare measure for a particular group of users. However, the demand parameters of users and nonusers may not be the same (Hellerstein, 1991).   Truncated models do not allow nonusers to influence estimation and thus may not be appropriate for estimating economic welfare value for the general population.

Yen and Adamowicz (1993) investigated differences in welfare measures based on truncated and untruncated count data models applied to truncated and untruncated data collected from bighorn sheep license holders in Alberta, Canada in 1981. They found much higher values with higher standard deviations of welfare measures estimated from truncated models. Zawacki *et al*. (2000) compared welfare measures from truncated and untruncated count models using the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (NSFHWAR) data on wildlife watching participants in the US in 1991. Contrary to Yen and Adamowicz's (1993) findings, they obtained smaller welfare measures from truncated models. Previous studies have used standard Poisson and negative binomial models for estimating untruncated models. These models, however, do not account for the two stage process of first deciding whether to participate and then deciding the number of trips to take (Mullahy, 1986). The issue of inconsistencies in welfare measures from truncated and untruncated count data models is important because the cost of collecting additional information on the nonparticipants can be significant.

This paper intends to analyze the nature of demand for CNR in the US, estimate the aggregate economic value of CNR at the national level and examine if this value changed between 1996 and 2006. This paper also compares welfare measures from truncated count data models using truncated data with welfare measures from untruncated count data models using untruncated data. Zero-inflated count data models, which account for the two stage decision process, are used for estimating welfare value from untruncated data. The use of zero-inflated models provides a more appropriate framework for comparing welfare values from truncated and untruncated models. CNR is defined as fishing and/or hunting and NNR as wildlife watching in this paper. Demand for CNR is estimated by applying the travel cost model (TCM) and using data from the NSFHWAR. The next section describes the economic and econometric frameworks and the data used in this paper. The following section presents the results and then the final section concludes the paper.

2.2. Methods

2.2.1. The travel cost model

The TCM is a nonmarket valuation technique widely used to estimate economic values associated with recreational sites. TCM is a revealed preference approach; that is, the actual expenditures by recreational participants are used to derive demand and economic benefits (Fix and Loomis, 1998). Although the demand for a recreational site can be modeled as aggregate or market demand, usually demand functions are estimated at the individual level and an aggregate value is estimated as the sum of individuals' values (Freeman, 2003, p. 419). This model can be further modified to treat all observations to multiple sites as belonging to a single demand equation (Freeman, 2003, p. 426).

Rockel and Kealy (1991) and Zawacki *et al*. (2000) estimated national TCM of nonconsumptive wildlife watching recreation using the single equation approach for multiple sites TCM. The basic conceptual framework for estimating demand for recreational trips using this model is

$$Trips_{ij} = f\,(E_i, C_{ij}, W_{ij}, R_j) \tag{1}$$

where *Trips* is the number of recreational trips taken, *E* is socioeconomic characteristics of individuals, *C* is the cost of a trip, *W* is the cost of substitutes, *R* is resource supply information and the subscripts *i* and *j* indicate the i^{th} individual and the j^{th} state, respectively. Consumer surplus (CS) is usually estimated as a measure of economic welfare (Zawacki *et al*., 2000). CS is the difference between a consumer's willingness to pay (WTP) for a good or service and the actual expenditure. In the TCM framework, CS is the area under the estimated demand curve for trips but above the price line.

2.2.2. Count data models

Standard Poison (POI) and negative binomial (NB) count data models have been used in recreational demand studies to account for the integer nature of trip data (see, for example, Fix and Loomis, 1998; Hellerstein, 1991; Shaw, 1988). Since a few recreational participants usually make a large number of trips compared to the others, the variance is often larger than the mean for trip data (Martinez-Espineira and Amoako-Tuffour, 2008). This phenomenon is called overdispersion. In the presence of overdispersion the POI model gives biased and inconsistent estimates (Grogger and Carson, 1991). The NB model is appropriate to use with overdispersed data.

The NB probability model can be written as

$$P[Trips_i = y_i] = F_{NB}(y_i) = \frac{\Gamma(y_i + \alpha^{-1})}{\Gamma(y_i + 1)\,\Gamma(\alpha^{-1})}(\alpha\lambda_i)^{y_i}(1 + \alpha\lambda_i)^{-(y_i + \alpha^{-1})} \qquad (2)$$

where $Trips_i$ is the count variable measuring the number of trips taken by the i^{th} individual, y_i= 0,1, 2,3, ... are the possible values of $Trips_i$, $F_{NB}(y_i)$ is the NB distribution function evaluated at y_i, $\Gamma(.)$ is the gamma function, $\alpha > 0$ is a nuisance parameter that determines the degree of overdispersion, and $\lambda_i > 0$ is a parameter.The NB distribution transforms to POI distribution[1] if $\alpha = 0$. The null hypothesis of no overdispersion ($\alpha = 0$) can be tested using a likelihood ratio (LR) test (Cameron and Trivedi, 1998, p. 78). The LR test statistic, calculated as -2 times the difference in the fitted log likelihoods of the POI and the NB models, follows a χ^2 distribution with 1 degree of freedom (DF). The NB model can be used in a regression framework by allowing for different λ_i which vary according to

$$\lambda_i = e^{X_i\beta} \qquad (3)$$

where X_i is a 1 by h vector of explanatory variables and β is an h by 1 vector of parameters to be estimated.

Data on number of recreational trips are often truncated at zero because non-users are usually not sampled. Biased and inconsistent estimates are obtained if the presence of this truncation is not accounted for (Shaw, 1988; Creel and Loomis, 1990; Grogger and Carson, 1991; Yen and Adamowicz, 1993). The zero truncated negative binomial

[1] Since overdispersion is very common in recreational trip data and for the sake of brevity, the detailed discussion in this section is limited to the negative binomial models.

(ZTNB) model is appropriate to use with overdispersed and truncated data. The ZTNB probability model can be written as

$$P[Trips_i = y_i | Trips_i > 0] = \frac{\Gamma(y_i + \alpha^{-1})}{\Gamma(y_i + 1)\,\Gamma(\alpha^{-1})}(\alpha\lambda_i)^{y_i}[1 + \alpha\lambda_i]^{-(y_i+\alpha^{-1})}[1 - F_{NB}(0)]^{-1} \qquad (4)$$

where y_i= 1,2,3, ... are the possible values of *Trips*$_i$. The LR test for the standard count data models can also be used to test the null hypothesis of no overdispersion ($\alpha = 0$) and to choose between zero truncated Poisson (ZTP) and ZTNB models.

Yen and Adamowicz (1993) showed that good estimates of population parameters are not always provided by truncated count data models. They suggested that benefits from collecting additional data on non-users can be significant. Yen and Adamowicz (1993) applied standard untruncated count data models to estimate recreation demand using untruncated data. However, standard count data models assume that an identical process generates both the zero and the positive integer values of number of trips taken (Englin *et al*., 2003). They ignore the two step decision-making process in which individuals first make decision on whether to participate and then decide on the amount of participation. The zero-inflated count models relax this restriction.

Since the zero-inflated negative binomial (ZINB) and the zero-inflated Poisson (ZIP) are nested models, the LR test used for standard and truncated count models can be applied to compare them by testing for overdispersion (Long and Freese, 2001). In the presence of overdispersion the ZINB is a better model than the ZIP. The ZINB probability model for *Trips* can be represented as

$$P[Trips_i = y_i] = \begin{cases} \psi_i + (1-\psi_i)F_{NB}(0) & \text{for } y_i = 0 \\ (1-\psi_i)F_{NB}(y_i) & \text{for } y_i = 1,2,3,... \end{cases} \qquad (5)$$

where ψ is the probability of non-participation. The ZINB density function (5) is a mixture of two distributions, a distribution whose mass is concentrated at zero trips and an NB distribution (Stephan *et al*., 2007). The probability of a corner solution by potential trip-takers is $(1-\psi_i)F_{NB}(0)$. The zero inflation parameter, ψ, can be modeled as a logit function

$$\psi_i = e^{Z_i\delta}/(1+e^{Z_i\delta}), \tag{6}$$

where Z_i is a 1 by m vector of explanatory variables that influence participation decision and δ is an m by 1 vector of parameters to be estimated. The vector Z_i may or may not share variables with X_i.

Unlike in linear models, estimated coefficients in count data regression models are not directly interpretable (Cameron and Trivedi, 2005, p. 669). That is, the coefficients β are not interpreted as the effect of a one-unit change in explanatory variables on the conditional mean of the dependent variable. In NB and ZTNB models

$$\frac{\partial E[Trips_i \mid X_i]}{\partial X_{iq}} = \beta_q e^{X_i\beta}, \tag{7}$$

where q indicates the q^{th} explanatory variable. The elasticity of number of trips with respect to an explanatory variable X_{iq} in NB and ZTNB models can thus be estimated as

$$\varepsilon_q = \left(\frac{\partial E[Trips_i \mid X_i]}{\partial X_{iq}}\right)\left(\frac{X_{iq}}{E[Trips_i \mid X_i]}\right) = \left(\beta_q e^{X_i\beta}\right)\left(\frac{X_{iq}}{e^{X_i\beta}}\right) = \beta_q X_{iq} \tag{8}$$

If an explanatory variable, X_{iq}, is included in both X_i and Z_i of a ZIP model,

$$\frac{\partial E[Trips_i \mid X_i, Z_i]}{\partial X_{iq}} = (1-\psi_i)\beta_q e^{X_i\beta} - \psi_i(1-\psi_i)\delta_q e^{X_i\beta} \tag{9}$$

It is assumed here that X_{iq} is also the q^{th} variable in Z_i. The elasticity of number of trips with respect to X_{iq} is then

$$\varepsilon_q = \left(\frac{\partial E[Trips_i \mid X_i, Z_i] / \partial X_{iq}}{E[Trips_i \mid X_i, Z_i] / X_{iq}} \right) = \frac{(1-\psi_i)e^{X_i\beta}(\beta_q - \psi_i \delta_q)}{(1-\psi_i)e^{X_i\beta} / X_{iq}} = (\beta_q - \psi_i \delta_q) X_{iq} \tag{10}$$

However, if an explanatory variable only enters the NB portion of a ZINB model, calculations of marginal effect and elasticity are the same as in NB and ZTNB models.

The Vuong (1989) test can be used to examine the appropriateness of ZINB model compared to NB model. Vuong's statistic for testing the non-nested hypothesis of ZINB model versus NB model is

$$V = \frac{\overline{m}\sqrt{n}}{s_m} \tag{11}$$

where $\overline{m}$ and s_m are the mean and variance of m_i, $m_i = \ln[\hat{P}_1(Trips \mid X_i) / \hat{P}_2(Trips \mid X_i)]$, and $\hat{P}_1(Trips \mid X_i)$ and $\hat{P}_2(Trips \mid X_i)$ are the predicted probabilities of the ZINB and the NB model, respectively. V has an asymptotically normal distribution. If $|V| \leq 1.96$, we cannot reject the null hypothesis that the two models are the same. If $V>1.96$, we reject the null in favor of ZINB being better than NB. If $V<1.96$, we reject the null in favor of NB being better than ZINB.

2.2.3. Data source

Socio-demographic and trip related data on CNR participants are obtained from the 1996 and 2006 NSFHWAR, one of the most important national wildlife recreation databases (USFWS, 2007). In each year, the NSFHWAR collected multistage probability samples covering all fifty states and the District of Columbia. The portion of the NSFHWAR that collected information on fishing and hunting activities was called the ‘sportsmen’ survey in 1996 and ‘sportspersons’ survey in 2006 (USFWS, 1997, 2007). NSFHWAR also collected data on wildlife watching participants in each year. The two types of samples were chosen independently of one another by the NSFHWAR. The interviews were conducted primarily by phone. People unreachable by phone were interviewed in person. Survey questions and methodology used in 1996 and 2006 were similar (USFWS, 2007). Therefore, data collected in the two surveys are comparable. Detailed descriptions of the survey methods can be found in USFWS (1997, 2007).

For each year, NSFHWAR collected data in two phases (USFWS, 1997, 2007). The first phase was a screening interview in order to collect socioeconomic information on households and identify wildlife-related recreation participants. All members 6 years old and older of sample households were surveyed during the screening phase. The second phase collected data on participation and expenditures on hunting, fishing, and nonconsumptive wildlife recreation from selected participants 16 years old and older based on the screening survey. It should be noted that, in each year, the detailed interviewees included both participants and non-participants during the year.

This paper uses two separate samples, CNR 1996 and CNR 2006. CNR 1996 consists of the data from the 1996 ‘sportsmen’ interviews and CNR 2006 sample consists of the data from the 2006 ‘sportspersons’ interviews. The NSFHWAR identified seven types of CNR participation: Great Lakes, other freshwater and saltwater fishing and big game, small game, migratory bird and other animal hunting. The respondents were asked to identify states in which they participated in each type of activity. They were also asked to report annual number of trips, days spent and annual expenditures for each type of activity in each of the states identified by them. Although trip related information, such as days spent in recreation and expenditures, are missing for the non-participants, their socio-economic characteristics are available. The 1996 and 2006 NSFHWAR samples of wildlife-watchers are used to collect wildlife watching expenditure data for each year.

Average annual wage data by state for 1996 and 2006 are obtained from the US Census Bureau (USBOC, 1999, 2009). The US Census Bureau (USBOC, 2009) data are also used to find total land area in each state. Forest cover data for each state are obtained from the US Department of Agriculture, Forest Service (Smith *et al*., 2001, 2009). Data for 1997 and 2007 forest coverage are used for 1996 and 2006, respectively.

2.2.4. Empirical specification and variables

The NSFHWAR does not report the exact location of where people visited. Following Zawacki *et al*. (2000), this paper estimates the single equation TCM by aggregating destinations to state level. Thus the recreational sites are the fifty states of the US. Some of the participants took trips to more than one state. Trips to multiple states by one participant are counted as separate observations. The variables used in this paper are defined in Table 2.1. The following functional relationship is used to estimate CNR trip demand.

$$Trips_i = f\,(Age_i,\ Age_i^2,\ Sex_i,\ Marital_i,\ Race_i,\ School_i,\ Retire_i,\ Urban_i,\ Income_i,\ Income_i^2,\ Cost1_{ij},\ Cost2_{ij},\ Cost3_{ij},\ Natural_j) \tag{12}$$

A quadratic function of age of individuals has been used in TCM studies to capture variable marginal effects of age (Acharya *et al*., 2003; Bilgic and Florkowski, 2007; Rockel and Kealy, 1991; Zawacki *et al*., 2000). The marginal effect of age is usually found to be increasing at a decreasing rate. Marital and racial status and sex of participants are often used to explain nature-based recreation demand behavior (Bilgic and Florkowski, 2007; Chakraborty and Keith, 2000; Englin and Shonkwiler, 1995;

Table 2.1. Variable definitions

Variable	Description
Trips	Number of CNR trips taken during a particular year
Age	Age in years
Sex	=1 if male, =0 otherwise
Marital	=1 if married, =0 otherwise
Race	=1 white, =0 otherwise
School	Years of education
Retire	=1 if retired, =0 otherwise
Urban	=1 if urban resident, =0 otherwise
Income	Annual household income in thousands of dollars
Cost1	Reported expenditures per CNR trip plus opportunity cost of time per trip
Cost2	Average cost (including cost of time) of NNR trips in the state where CNR trip was taken
Cost3	Average cost (including cost of time) of CNR trips to alternate states
Forest	Forest cover per square mile area in the state where CNR trip was taken

Rockel and Kealy, 1991; Zawacki *et al*., 2000). Usually trip demand is found higher among unmarried male whites. The effect of education level on nature-based recreation demand is contradictory in the literature both in terms of its sign and significance (see, for example, Bilgic and Florkowski, 2007; Chakraborty and Keith, 2000; Rockel and Kealy, 1991). Following Rockel and Kealy (1991), this paper uses a dummy variable on retirement status to capture the influence of leisure time on trip demand. A dummy variable on whether an individual is an urban resident is also used because residence location may influence recreation demand (Zawacki *et al*., 2000).

The original datasets included ten categorical variables on household income groups. The average income of a group, calculated as the mean of the highest and lowest income of the group, is assigned to each individual in the group in this paper. The value of the lower boundary is used as the level of income for the open ended group. Instead of assuming a constant marginal effect of income, this paper uses both income and income squared to capture non-constant marginal changes over the range of the variable.

The trip cost variable, *Cost1*, accounts for both variable monetary cost and opportunity cost of time. There are disagreements in the literature about which monetary costs should be included in trip cost variable (English and Bowker, 1996). According to Parsons (2003), typical trip costs include travel cost, access fees and equipment cost. In this study average variable monetary cost per trip for an individual was calculated by summing up transportation costs, land access fees and equipment expenditures during a year and then dividing by the total number of trips taken during that year.

The valuation of travel time is a much debated issue in the economic literature on recreational demand (Zawacki *et al*., 2000). This paper uses (average trip time)*0.25*(wage rate) to proxy for opportunity cost of travel time (Hynes *et al*., 2009; Martinez-Espineira and Amoako-Tuffour, 2008). The average number of days spent per trip during a year is used as average trip time. Since individual income levels are not provided by the NSFHWAR, wage rate is approximated by the average annual wage of an individual's residence state divided by 2080 hours of work per annum (Bin *et al*., 2005). Opportunity cost of time is added to variable monetary cost to obtain *Cost1*. The stated average trip cost has been used in several recent TCM studies (Bilgic and Florkowski, 2007; Loomis *et al*., 2001; Hesseln *et al*., 2003; Zawacki *et al*., 2000). *Cost1* is expected to have a negative influence on CNR trip demand.

Cost2 measures the cost of activities alternative to CNR. It is the statewide average of NNR costs per trip in the state where the CNR trip was taken or, in the case of nonparticipants, in their state of residence. It is assumed that, if nonusers decide to participate, they would participate in their residence state. If the CNR trip was in the individual's state of residence, then *Cost2* is the average trip cost for a resident of that state. If the CNR trip was outside the individual's residence state, then *Cost2* is the average trip cost of nonresident NNR participants. *Cost3* accounts for the price of accessing potential substitute locations. *Cost3* is constructed as the average cost of a CNR trip from the residence state to all states except the one visited. *Cost2* and *Cost3* include the same cost categories as *Cost1*.

Resource supply information is important in modeling nature-based recreation demand. Rockel and Kealy (1991) used total forested area in each state and Zawacki *et al*. (2000) used per capita forest and rangeland in each state in estimating national NNR demand. To measure resource supply, this paper uses forest cover per acre of land area (*Forest*) in destination state or, in the case of nonparticipants, in their state of residence. There is evidence in the literature that forested areas are important destinations for CNR participants (Krieger, 2001; Rockel and Kealy, 1991; Tay *et al*. 1996). This paper hypothesizes that CNR trip demand would be positively related to *Forest*.

Some observations in the original datasets displayed unusually high values of trips expenditures (C*ost1*). It is assumed that these high values are due to multipurpose trips. One of the assumptions required for travel costs to proxy for price in TCM is that the trips made by individual recreational participants are single purpose (Freeman, 2003, p. 422). Since multipurpose trips are not specifically identified in most survey data, recreation demand studies often remove a certain portion of their data based on high expenditures and/or mileages assuming multipurpose trips (Bowker *et al*., 1996; Hellerstein, 1991; Zawacki *et al*., 2000). The inter-quartile range (IQR), equal to the difference between the third quartile (Q3) and first quartile (Q1), is computed based on *Cost1* for the trip-takers in each of the two datasets. Observations higher than Q3 + (3*IQR) are considered to be problematic extreme outliers (Norman and Streiner, 1994, p. 49) and are removed from each dataset. The deleted observations represent about 5% of the original data for each of the datasets. The final datasets for 1996 and 2006 contain 20,141 and 19,812 observations including 7,454 and 7,340 nonparticipants, respectively. A statistical summary of individual characteristics and trip related variables is presented in Table 2.2.

The functional relationship specified by equation (12) is first estimated by applying the ZTNB model to the data on only the participants. Then it is estimated by applying the NB model using data on both participants and nonparticipants. An ordinary least squares (OLS) regression equation of the following form is estimated using data on participants to predict the missing trip cost (*Cost1*) values for the nonparticipants.

$$\begin{aligned}\log(Cost1_{ij}) = \beta_0 + \beta_1 Age_i + \beta_2 Age_i^2 + \beta_3 Sex_i + \beta_4 Marital_i + \beta_5 Race_i + \beta_6 School_i \\ \beta_7 Retire_i + \beta_8 Urban_i + \beta_9 Resident_{ij} + \beta_{10} Income_i + \beta_{11} Income_i^2 + \nu\end{aligned} \quad (13)$$

Resident is a dummy variable (=1 if individual *i* is a resident of state *j*, =0 otherwise), the β's denote unknown parameters to be estimated and ν denotes independent and identically distributed random error. As mentioned earlier, it is assumed that, if nonparticipants decide to participate, they would participate in their home state. This assumption is implemented here by setting the value of *Resident* equal to 1 when predicting trip costs for the nonparticipants.

The ZINB model is estimated to capture both the decision to participate and the amount of participation. This paper uses only the socioeconomic characteristics of individuals as variables in the first stage of ZINB (logit) to model participation decision

Table 2.2. Statistical summary of variables

Variable[a]	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
	1996					
	Total Sample (*n*=20,141)		No trips taken (*n*=7,454)		Trips taken (*n*=12,687)	
Trips	9.97	21.99	0.00	0.00	15.83	25.98
Age	41.17	15.12	41.39	15.86	41.05	14.66
Sex	0.70	0.46	0.56	0.50	0.79	0.41
Marital	0.67	0.47	0.64	0.48	0.68	0.46
Race	0.90	0.30	0.88	0.33	0.92	0.27
School	13.42	2.57	13.38	2.62	13.45	2.55
Retire	0.11	0.31	0.11	0.32	0.11	0.31
Urban	0.62	0.49	0.67	0.47	0.59	0.49
Income	41.17	31.08	36.88	30.32	43.69	31.25
Cost1	106.39	139.42	0.00	0.00	168.89	142.49
Cost2	188.30	76.37	163.05	30.32	203.13	90.14
Cost3	247.77	51.62	260.69	42.93	240.18	54.70
	2006					
	Total Sample (*n*=19,812)		No trips taken (*n*=7,340)		Trips taken (*n*=12,472)	
Trips	9.32	21.81	0.00	0.00	14.81	25.97
Age	44.57	15.47	43.58	15.86	45.15	15.20
Sex	0.70	0.46	0.56	0.50	0.79	0.41
Marital	0.70	0.46	0.67	0.47	0.72	0.45
Race	0.92	0.27	0.90	0.31	0.94	0.25
School	13.58	2.60	13.60	2.66	13.57	2.55
Retire	0.13	0.34	0.12	0.32	0.14	0.35
Urban	0.57	0.50	0.62	0.49	0.54	0.50
Income	62.43	29.22	61.08	29.93	63.22	28.77
Cost1	112.50	155.74	0.00	0.00	178.70	163.39
Cost2	215.12	86.60	186.71	36.83	231.84	101.79
Cost3	269.33	55.82	284.61	44.54	260.35	59.70

[a] *Income, Cost1*, *Cost2* and *Cost3* are in 2006 US dollars.

process. Following Bilgic and Florkowski (2007), it is assumed here that trip related factors, such as trip costs, cost of substitutes and resource availability at destination, may be difficult to recognize before taking a CNR trip. In the second stage of ZINB (i.e., NB), this paper uses the trip related factors *Cost1*, *Cost2*, *Cost3* and *Forest* along with all the individual socioeconomic characteristics to estimate the functional relationship given by (12).

The appropriateness of the ZTNB, NB and ZINB models over the ZTP, POI and ZIP models, respectively, are tested using the LR tests described earlier. A Chow test (Chow 1960) is used to test if the linear regression function for estimating *Cost1* differs across the two years. The unrestricted full model is estimated using the pooled data from the two years together with all explanatory variables and a dummy variable for year (=1 if 1996, =0 if 2006) and its interactions with other explanatory variables. The restricted model is estimated using the pooled data without the dummy variable and interaction terms. The test statistic is calculated using the following formula.

$$F = (RSS_R – RSS_U)(n_1+n_2–2k)/RSS_U(k) \sim F_{(k),(n_1+n_2-2k)}, \tag{14}$$

where RSS_R is the sum of squared residuals of the restricted model, RSS_U is the sum of squared residuals of the unrestricted model, k is the number of parameters (including the intercept) in the restricted model, N_1 is the number of observations in the 1996 sample and N_2 is the number of observations in the 2006 sample. The null hypothesis for the test is that that the behavior of expenditure for CNR trips in response to the explanatory variables is identical for 1996 and 2006. If the null is rejected we cannot estimate a single equation by pooling the data from the two years together and need to estimate separate regressions for each year.

An LR Chow test is used to test whether regression coefficients are different between 1996 and 2006 in the ZTNB, NB and ZINB models. The procedure of the test is same as the Chow test. The only difference in this case is that the test statistic is calculated as

$$LR = 2(ULLF - RLLF) \sim \chi^2(k), \tag{15}$$

where *ULLF* and *RLLF* are, respectively, unrestricted and restricted log-likelihood functions and k is the number of parameters (including the intercept) in the restricted model. The null hypothesis of the test is that regression coefficients are same for 1996 and 2006. A failure to reject the null hypothesis would suggest that the behavior of demand for CNR trips is not different between the two years. CS per trip per person can be estimated as the negative reciprocal of the coefficient of the trip cost variable from all three models. Thus, only if the null hypothesis of the LR Chow test is rejected, would we conclude that the economic welfare value of CNR is different between the two years.

2.3. Results and Discussion

The Chow test in the OLS model of *COST1* and the LR Chow tests in the ZTNB, NB and ZIP models for testing structural differences between 1996 and 2006 are all found highly statistically significant (Table 2.3). Thus, separate regression equations for 1996 and 2006 are estimated in all cases. Estimation results of the semi-log OLS model for estimating trip costs applied to individual year datasets are shown in Table 2.4. Predicting A when $\log(A)$ is the dependent variable by exponentiating the predicted value for $\log(A)$ systematically underestimates the expected value of A (Wooldridge, 2003, p. 208). A can be predicted in this case with a simple adjustment as:

$$\hat{A} = \hat{\theta} * \exp(\hat{\log}(A)), \qquad (16)$$

Table 2.3. Chow and LR Chow test results.

Model (Dependent Var)	Test (DF)	0.05 critical value	Test statistic
OLS (*Cost1*)	F (12; 25,135)	1.75	42.29
ZTNB (*Trips*)	χ^2 (15)	25.00	89.00
NB (*Trips*)	χ^2 (15)	25.00	374.00
ZINB (*Trips*)	χ^2 (26)	37.65	197.00

Table 2.4. Estimation of trip costs using OLS

Variable [a]	Coefficient	S.E.[b]	Coefficient	S.E.[b]
	1996		2006	
Constant	2.283770	0.135010*	-1.014860	0.173030*
Age	0.054220	0.005590*	0.153900	0.006270*
Age^2	-0.000651	0.000064*	-0.001540	0.000070*
Sex	0.448290	0.034060*	0.790720	0.040240*
Marital	0.031080	0.032360	-0.013640	0.041320
Race	0.138750	0.048190*	0.084480	0.067190
School	0.031250	0.005830*	0.085700	0.007140*
Retire	-1.832390	0.060740*	-1.991010	0.064980*
Urban	0.125460	0.027110*	0.102490	0.033360*
Resident	-0.580400	0.031680*	-0.703890	0.040120*
Income	0.035440	0.001540*	0.028980	0.002840*
Income^2	-0.000223	0.000011*	-0.000199	0.000023*
n		12,687		12,472
R^2		0.30		0.27

[a] *Income* is in 2006 US dollars.
[b] An asterisk (*) indicates statistical significance at 1% level.

where $\hat{\theta}$ is the estimated coefficient of $\exp(\hat{\log g}(A))$ from regressing A on $\exp(\hat{\log g}(A))$ without an intercept. Although this prediction is not unbiased, it is consistent. Cost1 values for nonparticipants are predicted using this procedure and are used in untruncated count models (NB and ZINB).

All LR tests for overdispersion are highly significant and suggest the appropriateness of negative binomial models compared to their Poisson counterparts. The statistical significance of the Vuong statistic confirms the superiority of ZINB over NB. The estimation results of the ZTNB, NB and ZINB models are reported in Table 2.5. The rest of this section first discusses the determinants that influence the probability of never participating in CNR. The variables that influence CNR trip demand are discussed next. This section then compares the estimated welfare values of CNR across sample years and

Table 2.5. Estimation results of count data models

Variable[a]	Coefficient	S.E.[b]	Coefficient	S.E.[b]	Coefficient	S.E.[b]	Coefficient	S.E.[b]
	ZTNB		NB		ZINB (NB)		ZINB (Logit)	
	1996							
Constant	2.459700	0.186500***	0.467300	0.151100***	2.852300	0.130800***	0.833800	0.142700***
Age	0.035290	0.006055***	0.026070	0.005064***	0.026870	0.004256***	-0.030720	0.006077***
Age^2	-0.000450	0.000069***	-0.000400	0.000057***	-0.000350	0.000049***	0.000473	0.000069***
Sex	0.845200	0.036470***	1.083300	0.029040***	0.700400	0.026270***	-1.019200	0.034450***
Marital	-0.110100	0.034790***	-0.013720	0.029590	-0.087780	0.024590***	-0.094470	0.036500***
Race	0.006704	0.052290	0.132300	0.042130***	-0.003620	0.036740	-0.373500	0.050460***
School	-0.054600	0.006511***	-0.043780	0.005495***	-0.043390	0.004580***	0.012570	0.006696*
Retire	-0.297300	0.065420***	0.056080	0.057030	-0.185900	0.046400***	-0.400200	0.071420***
Urban	-0.201600	0.029330***	-0.217300	0.025500***	-0.165900	0.020660***	0.355900	0.032390***
Income	0.008314	0.001656***	0.008175	0.001432***	0.005971	0.001174***	-0.011160	0.001737***
Income^2	-0.000040	0.000012***	-0.000060	0.000011***	-0.000030	0.000009***	0.000068	0.000013***
Cost1	-0.004550	0.000116***	-0.002220	0.000119***	-0.003360	0.000085***		
Cost2	-0.004160	0.000196***	-0.002500	0.000183***	-0.003230	0.000142***		
Cost3	0.002133	0.000324***	0.002330	0.000269***	0.001579	0.000229***		
Forest	0.478900	0.070300***	3.833600	0.065000***	0.394900	0.049700***		
α	2.949600	0.100800***	2.715900	0.032060***	1.137800	0.013840***		
n		12,687		20,141				20,141
Log likelihood		-43,200		-55,226				-58,131
LR statistic	(ZTNB vs. ZTP)	215,989***	(NB vs. POI)	302,178***			(ZINB vs. ZIP)	211,444***
Vuong statistic								35.60***
Price elasticity	-0.768453	0.004568	-0.317557	0.001955			-0.480627	0.002958
Income elasticity	0.210526	0.001061	0.133166	0.000708			0.218023	0.001160

(*Table continues on following page.*)

Table 2.5. Estimation results of count data models (*Continued from previous page*)

Variable[a]	Coefficient	S.E.[b]	Coefficient	S.E.[b]	Coefficient	S.E.[b]	Coefficient	S.E.[b]
	ZTNB		NB		ZINB (NB)		ZINB (Logit)	
	2006							
Constant	1.802400	0.207000***	-2.159200	0.160600***	2.330100	0.140100***	1.441400	0.146700***
Age	0.046160	0.005654***	0.032400	0.004565***	0.037740	0.003850***	-0.042510	0.005681***
Age^2	-0.000490	0.000062***	-0.000380	0.000051***	-0.000410	0.000042***	0.000465	0.000064***
Sex	0.826500	0.036660***	0.995900	0.027510***	0.669900	0.025460***	-1.075700	0.032560***
Marital	-0.141500	0.037010***	-0.032960	0.029890	-0.119600	0.025180***	-0.060400	0.037730
Race	0.045120	0.061090	0.256500	0.045710***	0.040070	0.041600	-0.456400	0.055320***
School	-0.051590	0.006913***	-0.032170	0.005508***	-0.041580	0.004648***	0.017350	0.006556***
Retire	-0.178900	0.059630***	0.121300	0.050280**	-0.088970	0.040430**	-0.334200	0.064430***
Urban	-0.259800	0.030190***	-0.457200	0.024560***	-0.213600	0.020580***	0.309300	0.031460***
Income	0.004474	0.002598*	0.007295	0.002037***	0.003794	0.001752**	-0.010130	0.002558***
Income^2	-0.000040	0.000021*	-0.000070	0.000016***	-0.000030	0.000014**	0.000071	0.000021***
Cost1	-0.003590	0.000107***	-0.001180	0.000107***	-0.002610	0.000076***		
Cost2	-0.003890	0.000189***	-0.001070	0.000171***	-0.002970	0.000134***		
Cost3	0.002526	0.000344***	0.008074	0.000276***	0.001921	0.000236***		
Forest	0.544000	0.084580***	4.832400	0.073520***	0.439300	0.057690***		
α	3.518200	0.140900***	2.588100	0.031000***	1.162400	0.014260***		
n		12,472		19,812				19,812
Log likelihood		-41,409		-52,857				-56,378
LR statistic	(ZTNB vs. ZTP)	211,297***	(NB vs. POI)	291,009***			(ZINB vs. ZIP)	206,370***
Vuong statistic								38.24***
Price elasticity	-0.641540	0.004167	-0.175277	0.001197			-0.387689	0.002649
Income elasticity	-0.036897	0.000119	-0.090224	0.000300			0.028656	0.000095

[a] *Income, Cost1*, *Cost2* and *Cost3* are in 2006 US dollars.
[b] Single, double and triple asterisks (*) indicate statistical significance at 10%, 5% and 1% levels, respectively.

models. Finally, an attempt is made to understand the difference in demand between the sample years using a simple demand-supply theory.

The logit portion of the ZINB model predicts the probability of being in the group that always has zero counts. The estimated coefficients are consistent in signs across years. The likelihood of never participating in CNR decreases at an increasing rate with both age and income. Married white males are less likely not to participate in CNR. High levels of education and urban residence increases the probability of not participating in CNR. Being retired reduces this probability.

The ZTNB, NB and the NB portion of the ZINB model demonstrate the influence of explanatory variables on frequency of taking trips given a positive probability of participation. The estimated coefficients are mostly consistent in terms of their signs and significance across models and years. CNR trip frequency increases with age up to certain point and then starts declining. Based on the coefficients of the ZINB model (logit and NB combined), the turning point of trip demand conditional on the probability of participation is found to be an age of 37 years in 1996 and 46 years in 2006.

Males are found to take more frequent trips than females. Being married leads to less participation. Urban residence also has a negative effect. Although the logit in ZINB suggests that retired individuals are less likely not to participate, they demand less frequent trips. Individuals with higher levels of education also demand less frequent trips. Race is only significant in the NB models and has a positive effect implying whites demand more frequent trips than other racial groups.

Cost2 has a negative and significant effect on trip demand in all models. This suggests a complementary relationship between CNR and NNR. Similar relationship has been previously found by recreation demand studies (Hay and McConnell, 1984; Miller and Hay, 1981; Zawacki *et al*., 2000). This complementary relationship may be caused by some common categories of expenses, such as transportation costs, shared by both CNR and NNR activities (Zawacki *et al*., 2000). Variations in transportation costs are expected to affect both activities in the same direction. Moreover, many CNR participants may participate for the primary purpose of experiencing nature and get relief from everyday life (Miller and Hay, 1981). These objectives may lead CNR participants to take NNR trips. They may also observe, photograph or feed wildlife during CNR trips. The positive and significant coefficients of *Cost3* imply that individuals take more CNR trips to a state as cost of CNR trips to other states increases. The coefficients of *Forest* are highly significant and positive in all models confirming the importance of forested acres in CNR demand.

Estimated income coefficients suggest a positive but diminishing influence of income on CNR trip demand. Income elasticities at sample means provided by the ZTNB and NB models are less than zero for 2006 (Table 2.5). Although theoretically income should have a positive influence on trip demand, a negative or insignificant income coefficient is often found in recreation demand studies (Acharya *et al*., 2003; Creel and Loomis, 1990; Zawacki *et al*., 2000; Bilgic and Florkowski, 2007). This paper, however, uses a quadratic function of household income to capture the variability in the marginal effect of the variable. The estimated coefficients suggest that income elasticity remains positive over a certain range of income and then becomes negative. The ZTNB and NB models suggest that income elasticity turned negative at an income level less than the samle average in 2006. The ZINB model, however, provides positive income elasticity at sample means for both 1996 and 2006. The coefficients of the ZINB model suggest that conditional trip demand was highest at a household income level of $92,000 in 1996 and $67,000 in 2006. Thus, individuals at different income levels respond differently to changes in income. It is possible that recreation demand studies often obtain negative or insignificant income coefficients because they fail to recognize the inverted U-shaped relationship between income and trip demand[1].

Consistent with economic theory, the coefficient of *Cost1* is negative and significant in all models. At sample means, the estimated price elasticities (Table 2.5) of CNR trip demand fall within the range of typical price elasticities from outdoor recreation studies, -0.2 to -2.0 (Loomis and Walsh, 1997). Price elasticity estimated from each type of model specification is found smaller for 2006. And, for both years, price elasticities from the untruncated models are smaller than the elasticity estimated from the truncated model. This is not surprising because demand is expected to be more elastic among a group of users than among a general group of individuals including both users and non-users. The ZINB model recognizes potential users in the group of zero trip-takers. This may explain the higher price elasticities given by the ZINB models compared to the standard NB models.

Per trip per person CS values are estimated as the negative reciprocals of the coefficients of *Cost1* (Table 2.6). These values are found higher for 2006. The difference in CS between the two years is robust across model specifications[2]. Aggregate CS in the US is obtained by multiplying per capita CS by total number of CNR trips taken in the US.

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[1] Dropping the quadratic term for *Income* results in either negative or insignificant coefficients.

[2] Although the results are not reported here, the Poisson counterparts of the negative binomial models are estimated. Per capita CS values estimated from the Poisson models are also higher for 2006 compared to 1996.

Table 2.6. Estimated Consumer Surplus Values (in 2006 US dollars)

	ZTNB	NB	ZINB	ZTNB	NB	ZINB
	1996			2006		
CS/Trip/Person (dollars)[b]	219.78 (208.80, 230.76)	450.45 (403.12, 497.78)	297.62 (282.86, 312.38)	278.55 (262.28, 294.82)	847.46 (696.84, 998.08)	383.14 (361.27, 405.01)
Total trips in US (million)[c]	729.50 (689.18, 769.81)	729.50 (689.18, 769.81)	729.50 (689.18, 769.81)	588.89 (555.17, 622.62)	588.89 (555.17, 622.62)	588.89 (555.17, 622.62)
Aggregate CS in US (billion dollars)	160.33 (148.38, 172.27)	328.60 (289.59, 367.61)	217.11 (200.99, 233.23)	164.04 (150.62, 177.46)	499.06 (405.87, 592.25)	225.63 (207.39, 243.87)

[a] 95% confidence intervals are given in parentheses.
[b] Standard errors are estimated by the delta method (Armitage and Colton, 1998, p. 1409).
[c] *Source*: USFWS (1997, 2007).

There is a considerable overlap between the aggregate CS values of the two sample years estimated by ZTNB and ZINB. Thus, although per capita WTP for CNR trips was higher in 2006, aggregate economic value of CNR was not significantly different between the sample years.

Estimated per capita CS from the ZTNB model is smaller than that provided by the NB model, both for 1996 and 2006. This result conforms to findings of Zawacki *et al*. (2000). The ZINB model, which is a more appropriate untruncated model, also provides higher CS values compared to ZTNB. However, the CS values from the ZINB model are lower than the values from the NB models. The differences in the magnitudes of the CS values between models and years are comparable to the differences in price elasticities discussed earlier. CS is expected to be lower for more elastic demand, which is what this paper finds. Thus the results are consistent and robust across combinations of truncated and untruncated models and across sample years[1].

The analysis so far provides useful insight into the market for CNR. However, no attempt has been made to explain the rather large drop in consumption between the

[1] The differences in the magnitudes of per capita CS values across combinations of truncated and untruncated Poisson counterparts of the reported negative binomial models are similar.

sample periods. The total number of trips in the US between 1996 and 2006 declined from 730 million to 589 million. The decline on a per capita basis is from 3.62 trips to 2.57 trips per year, or 29.09%[1]. What explains this sharp drop in equilibrium quantity?

One possibility is a reduction in supply. However, price elasticity of CNR trips is roughly -0.4 (Table 2.5). Since demand is price inelastic, the price increase associated with the supply shift would have to be larger than the observed reduction in quantity. Based on the data used in this paper, the average price of a trip in real terms increased from US $106 to US $112, or 5.7% between the periods.

Since the price increase is less than the quantity decrease, a supply shift can be ruled out as the principal cause. This leaves a reduction in demand, which begs the question of how large is the reduction. Also, if a decrease in demand is the major reason equilibrium quantity declined, we need to find out why equilibrium price increased. To answer these questions this paper uses a simple demand-supply model as follows.

$$d\ln Q_D = \alpha + \eta\, d\ln P \tag{17}$$

$$d\ln Q_S = \varepsilon\, d\ln P \tag{18}$$

$$d\ln Q_D = d\ln Q_S = d\ln Q \tag{19}$$

Here α indicates the horizontal proportional shift in the demand curve between the sample periods, η is the demand elasticity with respect to price, ε is the long-run supply elasticity, and Q and P are the market clearing quantity and price in long-run competitive equilibrium. Thus, $d\ln Q$ and $d\ln P$ are the changes in quantity and price that clear the market.

[1] Calculated based on the total US population 16 years old and older (USFWS, 1997; USFWS, 2007).

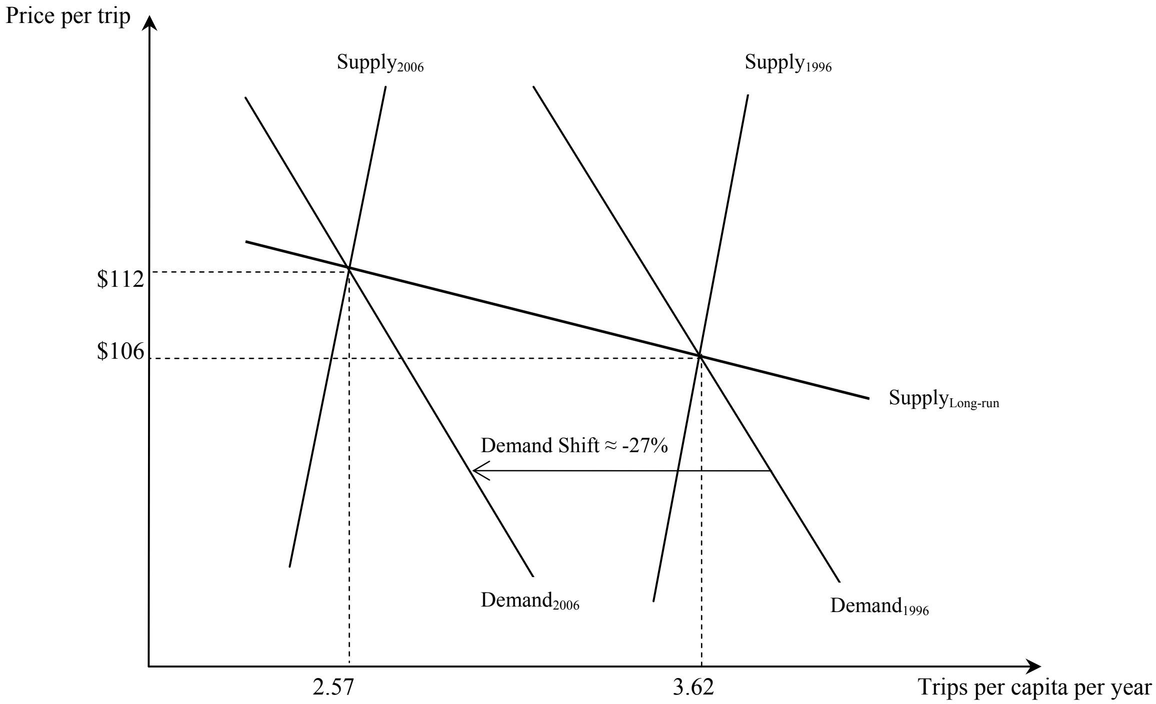

Fig. 2.1. Shift in demand between and the long-run supply curve of CNR.

Solving equations (17) - (19) simultaneously yields the reduced form:

$$d\ln P = \alpha/(\varepsilon - \eta) \tag{20}$$

$$d\ln Q = \alpha\varepsilon/(\varepsilon - \eta) \tag{21}$$

The reduced form yields two equations in two unknowns, α and ε. Inserting the observed changes in equilibrium price (0.057) and quantity (-0.291) between the sample periods, and setting η= -0.4, yields α =-0.268 and ε =-5.11. Thus, one explanation for the 29% decrease in per capita trips and the 5.7% increase in per trip cost between the sample periods is that demand decreased by 27% along a downward sloping long-run supply curve that has an elasticity of approximately -5 (Figure 2.1). A downward sloping supply curve is consistent with a stable market equilibrium provided the supply curve is flatter than the demand curve, i.e., $|\varepsilon| > |\eta|$ (Samuelson, P.A., 1947, p. 263), which is certainly the case here. This suggests that CNR is a decreasing-cost industry, i.e., expansions (contractions) in the size of the industry result in lower (higher) per-unit costs. This result is expected because decreasing cost industries commonly occur in the production of services that require high setup costs but the marginal cost of providing the services to a large number of users is relatively low (Tresch, 1981, p. 178).

2.4. Conclusion

This paper primarily examines the demand for and economic value of consumptive nature-based recreation (CNR) in the US between 1996 and 2006. Results suggest a downward shift in demand for CNR trips along a negatively sloped long-run supply curve between the two study years. This implies that CNR is a decreasing cost industry. Despite the downward shift in the demand for CNR, it is found that per capita willingness to pay (WTP) for CNR was higher in 2006 compared to 1996. The relationship between the WTP estimates for the two sample years conforms to the relatively price inelastic demand in 2006 suggested by all model specifications. The aggregate economic value of CNR was, however, not significantly different between the two sample years resulting from the decline in participation rate from 1996 to 2006.

The results of this paper can be useful in exploring ways to capture the consumer surplus value in CNR. This paper identifies several determinants of CNR demand. The impacts of these determinants on demand are consistent across the models used and the two study years. Although resource availability has a positive influence on CNR demand, participants in higher age and income groups are found to have a declining demand with increasing age and income, respectively. Urban dwellers and retired individuals also take fewer CNR trips. Thus as the population ages, average income level rises and urbanization grows, the surplus value in CNR cannot be captured only by increasing recreational opportunities without changes in tastes and preferences. This paper finds that the people in higher age and income groups and retired persons are less likely not to participate. Thus it might not be very difficult to attract them towards CNR.

Women are found to take fewer trips than men and more likely to never participate in CNR. Although married individuals take fewer trips, they are less likely not to participate in CNR. Family members may accompany married participants during their trips. Thus providing opportunities for alternative activities for nonparticipant family members and facilities convenient for women and children at fishing and hunting sites may increase participation both among married individuals and women. This can also have a similar influence on the aged members of the society by making nature-based recreation a more comfortable experience for them. The complementary relationship found between CNR and nonconsumptive nature-based recreation (NNR) is important from management perspective. Results suggest that trips for these two types of activities are often taken together. Thus, efforts towards improving nature-based recreation should be balanced between CNR and NNR.

This paper addresses an important unresolved issue regarding inconsistencies in welfare measures from truncated and untruncated count data models. Yen and Adamowicz (1993), using a relatively small sample of hunters, found larger welfare estimates from truncated models. Zawacki *et al*. (2000), using national data on NNR found larger welfare estimates from untruncated model. However, both of these studies used standard untruncated count data models which fail to account for participation decision. This paper uses, among other models, the zero-inflated count models which account for the two stage decision process of first deciding whether to participate and then the number of trips to take. It is found that untruncated models give higher welfare estimates. This suggests that welfare estimates from truncated models may not be appropriate for extrapolating to the general population and justifies efforts in collecting additional data on nonparticipants.

CHAPTER 3

State Attributes and Destination Choice by Freshwater Anglers: A Mixed Logit Analysis of the Southeast United States

3.1. Introduction

Recreation demand models help resource managers and policy makers in better understanding future demand and managing recreational resources more efficiently. Studies with a system of recreational destination sites have become increasingly preferred by researchers and managers as compared to single site models (Hunt, 2005). Recreational destination choice models are useful because they can predict the effects of changes to a recreation destination on recreational use at all relevant destinations and on the economic value of the relevant recreational activity. High participation rates for fishing is one important reason that makes it the most studied outdoor activity among researchers. In his review if recreational fishing site choice studies, Hunt (2005) identifies six important factors that influence anglers' choice of destination: costs, fishing quality, environmental quality, facility development, encounter levels with other anglers and regulations. The inclusion of travel costs enables researchers to estimate the economic values of destination attributes.

Recreational fishing has tremendous economic and ecological importance in the United States (US). Fishing has been the financial backbone of the state wildlife

Table 3.1. Economic impact of freshwater fishing, 2006

	Reatil sales [b]	Salaries, wages and business earnings [b]	Jobs	Federal tax revenues [b]	State and local tax revenues [b]
AL	646,200	251,886	9,311	66,981	63,251
AR	536,825	235,795	10,081	52,001	51,426
FL	1,382,934	728,647	23,480	171,543	129,361
GA	990,791	477,569	14,626	112,163	103,713
KY	871,723	411,456	14,842	89,504	79,455
LA	591,584	269,703	10,389	57,971	64,079
MS	231,993	96,506	3,960	20,271	21,621
NC	633,572	300,095	10,588	71,456	62,853
SC	802,727	354,673	13,587	80,754	87,069
TN	700,803	349,320	12,344	76,638	61,558
VA	500,663	249,416	9,213	59,401	46,241
WV	347,752	86,635	4,529	21,034	21,976
US	31,182,649	26,468,324	709,508	6,260,962	5,234,790

[a] Source: American Sportfishing Association (ASA) (2008)
[b] In 1,000 dollars

management agencies for a long time (Floyd and Lee, 2002). In the US, freshwater fishing is the more popular type of fishing in terms of participation and expenditures (US Fish and Wildlife Service (USFWS), 2007). Economic significance of freshwater fishing to state economies in 2006 is depicted in Table 3.1 for twelve southeast states: Alabama (AL), Arkansas (AR), Georgia (GA), Florida (FL), Kentucky (KY), Louisiana (LA), Mississippi (MS), North Carolina (NC), South Carolina (SC), Tennessee (TN), Virginia (VA) and West Virginia (WV). In the rest of this paper the southeast is defined as these twelve states. The number of jobs supported by freshwater fishing industries and businesses in these states ranged from about 4 thousand in MS to about 23 thousand in FL in 2006. The amount of tax revenues generated by freshwater angler spending in 2006 ranged from $42 million in MS to $301 million in FL. Nearly 9 million anglers participated in freshwater fishing in the southeast in 2006, which was more than 35% of total freshwater (except Great Lakes) anglers in the country (USFWS, 2007).

Anglers either travel within their residence states or to other states for recreational fishing. Anglers' choices of destination state, and thus the economic benefits from recreational fishing to the states, are influenced by several locational characteristics. In spite of many recreational fishing destination choice studies done, there is room left for exploring the impacts of state attributes on anglers' choice of destination states. State attributes, such as environmental and aesthetic quality, natural resource supply, and quality and availability of facilities, are potential determinants of fishing state choice. It is important for the state resource managers to understand how the characteristics of a state influence anglers' choice of state for fishing. From policy point of view, it is equally crucial to know the economic impacts of changes to the quality of the state attributes.

Recreational destination choice models have traditionally been specified as conditional logit or nested logit models (Haab and Hicks, 1999). However, these models suffer from several limitations (Haan, 2006; Train, 1998). First, the coefficients of the explanatory variables are assumed constant over all individuals. This implies that individuals with the same observed characteristics impose same values on each of the destination attributes. Second, a common property of both models is independence from irrelevant alternatives (IIA). In recreational destination choice analysis, the IIA property implies that the relative odds between two alternative destinations are the same regardless of the other available alternatives and their attributes. Thus, in these models, a change in the characteristics of one destination results in proportionate changes in the probabilities of all alternative destinations. Third, although in reality the unobserved factors that influence a decision maker can persist over time, conditional and nested logit models assume independence of those factors over time in repeated choice situations. The limitations of the conditional and nested logit models have led researchers to use the mixed logit, also called the random parameters logit, model in recent tourism and recreational destination choice studies (see for example, Choi *et al*., 2010; Murdock, 2006; Train, 1998). The mixed logit model is a generalization of logit and avoids the drawbacks of conditional logit and nested logit by allowing for random taste variation over people, unrestricted substitution patterns and correlated unobserved factors over time (Train, 1998; Train, 2003, p. 138).

The purpose of this paper is to examine the influence of state attributes on choice of destination states by anglers participating in recreational freshwater fishing in the US southeast. This paper quantifies the values that anglers place on several social, infrastructural and environmental attributes of the twelve southeast states and examines how these values vary by angler characteristics. Mixed logit models of destination choice decisions are estimated by Bayesian procedures using revealed preference data on anglers. The rest of the paper is organized as follows. The next section describes study methodologies including statistical models, data sources and empirical specifications. The following section discusses the results. The paper ends with a brief conclusion section.

3.2. Methods

3.2.1. The mixed logit model

In the mixed logit random utility framework, the utility of the i^{th} angler from destination state j in choice situation t is

$$U_{ijt} = \beta_i' x_{ijt} + \varepsilon_{ijt}, \tag{1}$$

where x_{ijt} is a vector of observed destination attributes, β_i is a vector of unobserved coefficients that varies randomly over anglers and represents each angler's tastes, and ε_{ijt}, the unobserved component of utility, is an identically and independently distributed (IID) extreme value. Correlation in utility over sites and trips is induced by the variance of β_i. The probability that angler *i* chooses destination *g* in choice situation *t* is $P[(U_{igt} > U_{iht}) \forall h \neq g]$. The probability of angler *i*'s sequence of choices on all choice situations is the product of standard logit formulas

$$L(y_i \mid \beta_i) = \prod_t \frac{\exp(\beta_i' x_{iy_{it}t})}{\sum_j \exp(\beta_i' x_{ijt})}, \tag{2}$$

where y_{it} is the i^{th} angler's chosen alternative in choice situation *t* and $y_i = \langle y_{i1}, ..., y_{iT} \rangle$ is her sequence of choices over *T* choice situations. The mixed logit probability, unconditional on β_i, is the integral of $L(y_i \mid \beta_i)$ over all possible values of β_i:

$$L(y_i \mid b, \Omega) = \int L(y_i \mid \beta_i) \varphi(\beta_i \mid b, \Omega)\, d\beta_i, \tag{3}$$

where $\varphi(\beta_i \mid b, \Omega)$ is the density of β_i with mean b and variance Ω.

Prior notions about *b* and Ω is needed for Bayesian estimation of mixed logit. The prior on *b* is specified as normal with a very large variance. The prior on Ω is the inverted Wishart. The joint posterior on $\beta_i \forall i, b$ and Ω is:

$$K(\beta_i \forall i, b, \Omega \mid Y) \propto \prod_i L(y_i \mid \beta_i) \varphi(\beta_i \mid b, \Omega) k(b, \Omega) \tag{4}$$

where *Y* is the set of $y_i \forall i$ and $k(b, \Omega)$ is the prior on *b* and Ω. Gibbs sampling is used to take sequential draws from the posterior of each parameter given the previous draws of other parameters (see Train, 2003 for more details). Thus, a draw of *b* is taken first conditional on Ω and $\beta_i \forall i,$ then a draw of Ω is taken given the values of *b* and $\beta_i \forall i$ and finally a draw of $\beta_i \forall i$ conditional on values of *b* and Ω. The Metropolis-Hasting (M-H) algorithm is used in drawing $\beta_i \forall i$ as this part is computationally very intensive (Train and Sonnier, 2005). The resulting conditional posteriors are $K(\beta_i \mid b, \Omega, y_i),\ K(b \mid \Omega, \beta_i \forall i)$ and $K(\Omega \mid \beta_i \forall i, b).$

Some of the utility coefficients (β_i) can be specified to be fixed. If all coefficients are specified fixed, the model becomes a standard logit model. If some of the coefficients are fixed, the utility function is specified as

$$U_{ijt} = \alpha' z_{ijt} + \beta_i' x_{ijt} + \varepsilon_{ijt}, \tag{5}$$

where α is a vector of fixed coefficients and β_i is random with mean b and variance Ω. The probability of angler *i*'s choice sequence given β_i is

$$L(y_i \mid \alpha, \beta_i) = \prod_t \frac{\exp(\alpha' z_{iy_{it}t} + \beta_i' x_{iy_{it}t})}{\sum_j \exp(\alpha' z_{ijt} + \beta_i' x_{ijt})}. \tag{6}$$

Transformations of unbounded normal distribution, such as lognormal, truncated normal and triangular distributions, can be used as well. In such cases, normally distributed β_i's are drawn and then transformed as intended when they enter the utility function (Train and Sonnier, 2005). The utility function can be rewritten as

$$U_{ijt} = C(\beta_i)' x_{ijt} + \varepsilon_{ijt}, \tag{7}$$

where *C* is a transformation that depends only on β_i and is weakly monotonic. The probability of angler *i*'s choices on all choice situations is

$$L(y_i \mid \beta_i) = \prod_t \frac{\exp(C(\beta_i)_i' x_{iy_{it}t})}{\sum_j \exp(C(\beta_i)_i' x_{ijt})}, \tag{8}$$

The estimation procedure does not change much for including fixed or nonnormal utility coefficients. The only difference is that the probabilities in (6) and (8) are in the M-H algorithm instead of the probability in (2).

MATLAB codes for estimating the mixed logit using Bayesian procedures written by Dr. Kenneth Train, University of California, Berkeley (available online at http://elsa.berkeley.edu/~train/software.html) are used in this paper. Twenty thousand draws are generated with Gibbs sampling, 10,000 for burn-in and 10,000 after convergence. Every tenth draw is retained from the later 10,000 draws, for a total of 1,000 draws to conduct inference. To create draws of utility coefficients, 2,000 draws are used from the posterior distributions (Train and Sonnier, 2005).

3.2.2. Data

Socio-demographic and trip related data on anglers are obtained from the 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (NSFHWAR), one of the most important national wildlife recreation databases (USFWS, 2007). The NSFHWAR collected multistage probability samples covering all fifty states and the District of Columbia. The portion of the NSFHWAR that collected information on fishing and hunting activities was called the 'sportspersons' survey. The interviews were conducted primarily by phone. People unreachable by phone were interviewed in person. Detailed description of the survey methods can be found in USFWS (2007).

NSFHWAR collected data in two phases (USFWS, 2007). The first phase was a screening interview in order to collect socioeconomic information on households and identify wildlife-related recreation participants. All members 6 years old and older of sample households were surveyed during the screening phase. Based on the screening survey, the second phase collected data on participation and expenditures on nature-based recreation from selected participants 16 years old and older.

Three types of fishing participation were identified by the NSFHWAR: Great Lakes, other freshwater and saltwater fishing. The respondents were asked to identify states in which they participated in each type of activity. They were also asked to report annual number of trips, days spent and annual expenditures for each type of activity in each of the states identified by them. This paper uses data on 2,154 anglers, from all over the country, who participated in recreational freshwater fishing in the twelve southeastern states in 2006.

Data on average annual wage, crime rate, recreational acreage, land area and water area in each of the twelve states are obtained from the US Bureau of the Census (USBOC, 2009). Data on toxic release to air and surface water in each state in 2006 are extracted from the Right-to-Know Network's (RTKNET) Toxic Release Inventory (TRI) database. The TRI provides information on releases and transfers of toxic chemicals from facilities in certain industrial sectors, including manufacturing, waste handling, mining, and electricity generation (RTKNET, 2009). Releases to water are discharges to streams, rivers, lakes, oceans, and other bodies of water and includes both releases from confined sources, such as industrial process outflow pipes, and releases due to runoff, including stormwater runoff. Fugitive air emissions are all releases to air that are not released through a confined air stream. These include equipment leaks, evaporation from spills, and releases from building ventilation systems. Point source air emissions occur through confined air streams such as smokestacks, vents, ducts, or pipes.

Forest cover data for 2007 for each state are obtained from the US Department of Agriculture (USDA), Forest Service (Smith *et al*., 2009). Smith *et al*. (2009) defined land at least 120 feet wide and 1 acre in size with at least 10 percent cover (or equivalent stocking) by live trees as forest land. This included land that formerly had such forest cover and natural or artificial regeneration was expected. Transition zones, such as areas between forest and nonforest lands that had similar cover with live trees and forest areas adjacent to urban and built-up lands were also included in the definition of forest land. Roadside, streamside, and windbreak strips of trees with a crown width of at least 120 feet and continuous length of at least 363 feet qualified as forest land. Unimproved roads and trails, streams, and clearings in forest areas less than 120 feet wide or an acre in size were classifies as forest. Tree-covered areas in agricultural production settings or in urban settings were not considered forest land.

Data on developed land acreage in each state in 2007 comes from the USDA (2009). USDA defines developed land category as large tracts of urban and built-up land, small tracts of built-up land of less than 10 acres, and land outside of these built-up areas in a rural transportation corridor. Data on long-term averages of annual sunshine for various sites in each state are obtained from the National Oceanic and Atmospheric Administration (NOAA, 2010). Based on the NOAA data, the average possible annual sunshine in each state is calculated as the ratio of the total time that sunshine reaches the earth surface to the maximum amount possible from sunrise to sunset with clear sky conditions.

3.2.3. Empirical specification and variables

This paper examines anglers' site choice decisions for freshwater fishing by aggregating destinations to state level. The recreational sites are the twelve states of the southeast. Some of the participants took trips to more than one state. Trips to multiple states by one participant are treated as separate choice situations. The dataset used in this paper consists of 2,319 total choice situations for 2,154 anglers. Decision of angler *i* to fish in state *j* in choice situation *t* is modeled as a function of travel cost and state attributes. Revealed preference data often provide little or no information on alternatives other than that chosen (Cameron and Trivedi, 2002). For example, we do not know the anglers' costs of traveling to the states not chosen by them for freshwater fishing. This situation necessitates the estimation of a cost function based on angler characteristics in order to be able to estimate values for the states not visited by anglers. The variables used in this paper are defined in Table 3.2.

Difficulties in directly measuring fishing quality of a destination site have led researchers to use proxies, such as waters that hold certain fish species, the presence of stocked water bodies, expected catch rate and fish size, and size of water body (Hunt, 2005). Size of inland water area (*Water_Area*) in each state is used as an explanatory variable. It is expected that larger water areas may hold fishes of wider variety and larger size and may provide anglers with more fishing opportunities (Hunt, 2005). Previous recreational freshwater fishing demand and destination choice studies have emphasized a positive relationship between the size of the water bodies and destination choices made by anglers (see, for example, Feather, Hellerstein and Tomasi 1995; MacNair and Cox 1999; Parsons and Kealy 1992; Tay, McCarthy, and Fletcher 1996). Train (1998) used

Table 3.2. Variable definitions

Variable	Description
$Toxic\_Water_j$	Toxic release to surface water (1,000 pounds/square mile of water area)
$Ammonia_j$	Ammonia released to surface water (10 pounds/square mile of water area)
$Mercury_j$	Mercury released to surface water (10 pounds/square mile of water area)
$Lead_j$	Lead released to surface water (10 pounds/square mile of water area)
$Phenol_j$	Phenol released to surface water (10 pounds/square mile of water area)
$Toxic\_Air_j$	Toxic air emissions (10,000 pounds/square mile of total area)
$Crime_j$	Number of crimes (violent and property) per 1,000 people
$Developed_j$	Developed land per square mile of land area
Rec_Area_j	Recreational acreage per 100 square miles of land area
$Forest_j$	Forest cover per square mile of land area
$Sunshine_j$	Average annual sunshine
$Water\_Area_j$	Inland water area (1,000 square miles)
$Cost_{ij}$	Reported expenditures plus opportunity cost of time per trip ($)
$Distance_{ij}$	Distance between the centroids of the residence state and the destination state
Age_i	Age in years
$Gender_i$	=1 if female, =0 if male
$School_i$	Years of education
$Rural_i$	=1 if rural resident, =0 if urban resident
$Retired_i$	=1 if retired, =0 otherwise
$Income_i$	Annual household income ($)
$Income1_i$	=1 if annual household income<$32,500, =0 otherwise
$Income2_i$	=1 if $32,500 ≤ annual household income<$87,500, =0 otherwise
$Income3_i$	=1 if annual household income ≥ $87,500, =0 otherwise
VA_i	=1 if destination state is VA, =0 otherwise
WV_i	=1 if destination state is WV, =0 otherwise
KY_i	=1 if destination state is KY, =0 otherwise
TN_i	=1 if destination state is TN, =0 otherwise
AR_i	=1 if destination state is AR, =0 otherwise
LA_i	=1 if destination state is LA, =0 otherwise
MS_i	=1 if destination state is MS, =0 otherwise
AL_i	=1 if destination state is AL, =0 otherwise
GA_i	=1 if destination state is GA, =0 otherwise
FL_i	=1 if destination state is FL, =0 otherwise
SC_i	=1 if destination state is SC, =0 otherwise
NC_i	=1 if destination state is NC, =0 otherwise

Note: The subscript *i* and *j* denote the i^{th} individual and j^{th} state, respectively.

the logarithm of size of each site as an explanatory variable to capture the fact that each angler has the option of many locations within a site, and the number of locations is higher at larger sites. At the state level, urbanization puts pressure on the size of nature-based recreational areas. Moreover, since some anglers may like more quiet and rural settings, urbanization can also have an impact on terrestrial aesthetics for recreational fishing discussed in next paragraph. *Developed* is used to examine the impact of urbanization on anglers' destination choices.

Toxic contamination is a special case of water pollution problem (Montgomery and Needleman, 1997). Toxic releases to water bodies may influence anglers' fishing experiences through effects on aesthetics and/or on the health of fish. Effects on the health of fish reduce catch rate and thus works as a disincentive to attracting anglers. Moreover, toxic contaminants in fish are dangerous to human beings eating fish even when they are not harmful to the fish. Previous studies have generally found that anglers prefer sites with better water quality (Hunt, 2005). In addition to the total toxic release to water in a state, the effects of several individual chemical releases on anglers' state choice for fishing are tested. Toxic release to air is another proxy for environmental quality and is expected to have a negative influence on anglers' choices. Environmental quality is also applied in fishing site choice models as terrestrial aesthetics (Hunt, 2005). Forest coverage is often used as a measure of terrestrial aesthetics (Chen and Coslett, 1998; Jones and Lupi, 1999; Tay, McCarthy, and Fletcher, 1996). A nice sunny day is also expected to enhance terrestrial aesthetics and attract anglers to go fishing. Forest land acreage (*Forest*) and average annual sunshine (*Sunshine*) in the twelve states are used to measure terrestrial aesthetics.

Commonly used measures of facility development in recreational fishing site choice studies include the presence or number of boat launches and campgrounds (Hunt, 2005). Both measures have generally been found to have a positive influence on destination choice. Recreational acreage in each state is used to capture the effect of facility development at the state level. *Rec_Area* includes both state parks and recreational areas and National Park Service acreage.

A social attribute that, to the authors' knowledge, has not been examined by previous empirical recreational destination choice studies is crime rate. Criminal activities discourage potential participants from enjoying available outdoor recreational resources (Schroeder and Anderson, 1984). Crime in leisure settings is a growing problem that represents a danger to recreational participants in the U.S. (Chavez and Tynon, 2000; Manning *et al*., 2001; Pendleton 1996; Tynon and Chavez, 2006). Pendleton reports increasing problems of robbery, drugs, gang violence, and murder in public recreational areas. *Crime*, the sum of both violent and property crimes, is used to capture the influence of crime rate on destination choice decisions. Violent crime includes murder, rape, robbery and aggravated assault. Property crime includes burglary, motor vehicle theft and other theft. High crime rate is expected negatively affect anglers' choice of a destination state.

The travel cost variable, *Cost*, accounts for both variable monetary cost and opportunity cost of time. Typical monetary trip costs include travel cost, access fees and equipment cost (Parsons, 2003). In this paper average variable monetary cost per trip for an angler is calculated by summing up transportation costs, land access fees and equipment expenditures during a year and then dividing by the total number of trips taken during that year. This paper uses (average trip time)*0.25*(wage rate) to proxy for opportunity cost of time (Hynes *et al*., 2009; Martinez-Espineira and Amoako-Tuffour, 2008). Average trip time is the average number of days spent per trip during a year. Wage rate is approximated by the average annual wage of an individual's residence state divided by 2080 hours of work per annum (Bin *et al*., 2005). Opportunity cost of time is added to variable monetary cost to obtain *Cost*. *Cost* is expected to have a negative influence on anglers' destination choice decisions.

To predict price values for the sites not visited by anglers, *Cost* is regressed on individual characteristics, distance travelled and locational dummies. There is evidence in the literature (Bilgic and Florkowski, 2009; Heien and Wessells, 1990) of estimating missing price values in this manner. An ordinary least squares (OLS) regression equation of the following form is estimated.

$$\begin{aligned} COST_{ij} = {} & \beta_0 + \beta_1 Distance_{ij} + \beta_2 Age_i + \beta_3 Age_i^2 + \beta_4 Gender_i + \beta_5 School_i + \\ & \beta_6 Rural_i + \beta_7 Retired_i + \beta_8 Income_i + \beta_9 Income_i^2 + \beta_{10} VA_i + \beta_{11} WV_i + \\ & \beta_{12} KY_i + \beta_{13} TN_i + \beta_{14} AR_i + \beta_{15} LA_i + \beta_{16} AL_i + \beta_{17} GA_i + \beta_{18} FL_i + \beta_{19} SC_i + \\ & \beta_{20} NC_i + v. \end{aligned} \tag{9}$$

The β's denote unknown parameters to be estimated and v denotes independent and identically distributed random error. *Distance* is estimated using the geographic information system (GIS) software ArcGIS. It should be noted that *Distance* is zero for resident anglers. The original datasets included ten categorical variables on household income groups. The average income of a group, calculated as the mean of the highest and lowest income of the group, is assigned to each individual in the group. The value of the lower boundary is used as the level of income for the open ended group. Instead of assuming constant marginal effects of age and income, the squared terms are used to capture non-constant marginal changes over the range of the two variables.

Random distributions are specified for the state attribute coefficients to examine differences in tastes among anglers. Normal distributions for attribute coefficients can be implausible because they can imply, for example, that some anglers prefer better environmental qualities whereas others dislike them. The lognormal distribution, on the other hand, would imply that all anglers either like or dislike an attribute. However, it is assumed that there are anglers who are indifferent towards any or all of the attributes. To allow for preference indifference normal distribution truncated from below at zero is specified for all state attribute coefficients but *Water_Area*. Thus for these state attributes, a share of the anglers is not concerned while the other share has a positive preference which varies over anglers (Train and Sonnier, 2005). Since the variables related to toxic releases, crime and land development are expected to negatively influence anglers' destination choices and since the truncated normal distribution does not allow for negative coefficients, the negatives of these variables are entered in empirical estimation. The coefficient of *Water_Area* is specified as fixed. It would not make much sense to assume that the probability of being attracted to a state with greater water resources varies among anglers.

There are at least three reasons for specifying a fixed cost coefficient (Revelt and Train, 2000; Train, 2003). First, if the cost coefficient is fixed, the distribution of willingness to pay (WTP) for an attribute, which is the ratio of the attribute's coefficient to the cost coefficient, is the same as the attribute's distribution. This facilitates interpreting the model. Second, If all coefficients are given random distributions, mixed logit model tends to be unstable and becomes nearly unidentified (Rudd, 1996). Third, it is difficult to find the appropriate distribution for price. Normal and other distributions allow for positive cost coefficients. Lognormal distribution gives cost coefficient values close to zero and thus extremely high WTP values. Although there is another fixed coefficient (*Water_Area*), the coefficient of *COST* is specified fixed for the other two reasons.

A mixed logit model (Model 1) is first estimated with all the state characteristics variables as independent variables except the individual toxic releases to water (*Ammonia*, *Mercury*, *Lead* and *Phenol*). In a second model (Model 2), *Toxic_Water* is excluded and the four individual chemical releases to water are included. This enables this paper to examine if there are differences between the overall toxic release and the individual chemical releases in terms of the nature of their influence on anglers' choices. Practically it is not possible to include every single chemical release in the model. This paper thus considers chemicals that have a significant impact on the health of freshwater fishes (Svobodova *et al*., 1993). Other metals, including aluminum, zinc and arsenic, were initially considered. The best specification is chosen based on improvements in the simulated log likelihood and significance of variables. To examine the influence of the anglers' personal characteristics on the variation of the random parameters, a third model (Model 3) is estimated including interactions of several angler socioeconomic characteristics with the cost variable as independent variables.

3.3. Results and Discussion

Estimation results of the OLS model for estimating travel costs are shown in Table 3.3. White's robust standard errors are estimated to correct for heteroscedasticity found in preliminary analysis. Values of *Cost* for the states not visited by anglers are predicted using this estimated equation. Expenditure in freshwater fishing is found to be

Table 3.3. Estimation of cost

Variable	Coefficient	Robust S.E. [a]
Intercept	-120.9298	15.6958**
Distance	0.1066	0.0133**
Age	5.3259	0.5946**
Age^2	-0.0515	0.0066**
Gender	-33.0275	4.2014**
School	1.8374	0.7227*
Rural	-15.3428	4.0573**
Retired	-91.1646	6.5198**
Income	0.0013	0.0003**
Income^2	-6.59E-09	2.48E-09**
VA	44.8901	9.6381**
WV	17.9928	9.2184*
KY	26.1654	7.8725**
TN	19.7210	7.6070**
AR	27.0879	9.0719**
LA	28.6990	9.1761**
AL	17.6965	6.7484**
GA	28.4923	8.6440**
FL	29.9181	8.4618**
SC	37.7888	8.4322**
NC	22.7225	7.6639**
N	2319	
R^2	0.27	

[a] Single and double asterisks (*) indicate statistical significance at 5% and 1% levels, respectively.

increasing with years of education and increasing at a decreasing rate with both age and income of anglers. Retired rural females spend less per freshwater fishing trip than their studying/working urban male counterpart. Anglers spend more for distant trips. Per trip freshwater fishing expenditure is lowest in the reference state Mississippi and highest in Virginia.

The estimated variances of coefficients in the mixed logit models (Model 1 and Model 2) are significant (Table 3.4). This indicates that the random state attribute parameters indeed vary in the population. The estimated utility coefficients measure the

Table 3.4. Mixed logit models of destination state choice for freshwater fishing

	Model 1				Model 2			
	Coefficient [a b]		Utility Coefficient		Coefficient [a b]		Utility Coefficient	
	Mean	Variance	Mean	Variance	Mean	Variance	Mean	Variance
Toxic_Water (negative)	-2.1578	0.6903	0.0006	0.0002				
	(0.3551)***	(0.1657)***						
Ammonia (negative)					-3.1153	1.2696	0.0007	0.0003
					(0.2348)***	(0.2515)***		
Mercury (negative)					-1.1849	3.8169	0.3524	0.6265
					(0.7159)*	(1.5281)**		
Lead (negative)					-1.6652	0.9445	0.0178	0.0142
					(0.1487)***	(0.1749)***		
Phenol (negative)					-2.8992	6.0217	0.1360	0.2483
					(1.4591)**	(3.6311)*		
Toxic_Air (negative)	-0.7512	1.3830	0.1937	0.1955	-0.8442	2.1697	0.2578	0.3266
	(0.3731)**	(0.6820)**			(0.5440)	(0.8875)**		
Crime (negative)	-2.0917	0.5566	0.0013	0.0008	-2.5236	0.7760	0.0005	0.0003
	(0.2246)***	(0.1576)***			(0.1771)***	(0.1612)***		
Developed (negative)	-0.9599	1.9769	0.1914	0.2200	-1.4333	2.2667	0.1249	0.1516
	(0.2977)***	(0.5518)***			(0.2688)***	(0.8157)***		
Rec_Area	-6.6711	13.0366	0.0454	0.1006	-4.8253	7.5023	0.0408	0.0736
	(0.4551)***	(1.7662)***			(1.2649)***	(3.7871)**		
Forest	-1.7312	2.1797	0.0784	0.0869	-2.5971	2.3507	0.0293	0.0309
	(0.5270)***	(1.0728)***			(0.3813)***	(1.0930)**		
Sunshine	1.1899	4.6253	1.5366	2.3330	1.5542	2.0031	1.6795	1.5648
	(0.3725)***	(2.7725)*			(0.4438)***	(0.8669)**		
Water_Area	0.0609				0.0637			
	(0.0101)***				(0.0134)***			
Cost	-0.0282				-0.0284			
	(0.0005)***				(0.0006)***			
	SLL at convergence		-4518.20		SLL at convergence		-4522.20	

[a] Single, double and triple asterisks (*) indicate statistical significance at 10%, 5% and 1% levels, respectively.
[b] Standard errors are given in parentheses.

marginal utilities of state attributes. Since the negatives of *Toxic_Water*, *Ammonia*, *Mercury*, *Lead, Phenol*, *Toxic_Air*, *Crime* and *Developed* are entered in regression, their utility coefficients are positive. However, the actual direction of their influence on utility should be interpreted as negative[1]. Since USDA (2009) identifies developed lands as lands permanently removed from the rural land base, the coefficient of *Developed* implies anglers' preference for more rural settings for fishing. The absolute values of the utility coefficients directly imply the relative importance of the corresponding state attributes in angler choice decisions[2]. The significant and positive fixed coefficient of *Water_Area* implies that anglers prefer states with larger water areas. Consistent with economic theory, the *Cost* coefficient is negative and significant. The simulated log likelihoods (SLL) are estimated at the means of the draws of b and Ω (Train and Sonnier, 2005)[3].

Benefits from changes in state attributes are estimated as compensating variation. If the cost coefficient is fixed, WTP for an attribute follows the same distribution as the attribute with mean and variance equal to the mean and variance of the attribute scaled by the cost coefficient. Table 3.5 reports the welfare effects estimated from Models 1 and 2. The variances of the WTP values are high implying that WTP varies widely in the population of anglers. Average WTP for reducing the individual releases to water are much higher than that for the total release. This may be the result of information lost when using an aggregate measure of toxic release to water (*Toxic_Water*). Among the individual toxic releases to water, anglers are willing to pay the most for reducing mercury release.

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[1] For example, on an average, a 10 pounds increase in mercury release per square mile of inland water area reduces the utility of an angler by 0.35.

[2] It should, however, be noted that the comparison between coefficients depends on the scaling of the variables.

[3] These statistics show that Bayesian results can be classically interpreted (Train and Sonnier, 2005).

Table 3.5. Welfare impacts of state attributes (in US dollars)

	Model 1		Model 2	
WTP for	Mean	Variance	Mean	Variance
Reducing 1,000 lbs of toxic release to surface water per sq mile of water area	0.02	0.01		
Reducing 10 lbs of ammonia release per sq mile of water area			0.02	0.01
Reducing 10 lbs of mercury release per sq mile of water area			12.41	22.06
Reducing 10 lbs of lead release per sq mile of water area			0.63	0.50
Reducing 10 lbs of phenol release per sq mile of water area			4.79	8.74
Reducing 1,000 lbs of toxic release to air per sq mile area	0.69	0.69	0.91	1.15
Reducing 1 crime per 100 people	0.46	0.29	0.18	0.10
Reducing developed land acreage per sq mile of land area by 1%	0.07	0.08	0.04	0.05
Increasing recreational acreage per sq mile of land area by 1%	1.61	3.57	1.44	2.59
Increasing forest cover per sq mile of land area by 1%	0.03	0.03	0.01	0.01
1% more annual sunshine	0.54	0.83	0.59	0.55

Variations in the state attribute parameters can be related to the observed characteristics of the anglers. To examine if the variations in parameters can be captured by angler characteristics, the approach taken by Revelt and Train (2000) is followed. A model including interactions between demographic characteristics of the anglers and travel cost is estimated (Table 3.6). These interactions allow the WTP for each state attribute to vary with angler characteristics. Significance of the estimated interaction coefficients imply that WTP varies by the included demographic characteristics of anglers. However, the variances of the random state attribute parameters remain large and significant. This implies that variations in WTP are not fully explained by the included demographic characteristics of the anglers. Previous studies (Hynes *et al*., 2008; Revelt and Train, 2000) have also found the existence of significant unobserved heterogeneity even after allowing individual characteristics to interact with choice attributes. This result confirms that variations in preferences are significantly higher than what is explained by observed characteristics of anglers (Hynes *et al*., 2008).

Table 3.6. Mixed logit model with demographic variables

	Coefficient [a b]		Utility Coefficient	
	Mean	Variance	Mean	Variance
Toxic_Water (negative)	-2.4307	0.7966	0.0003	0.0001
	(0.3234)***	(0.2692)**		
Toxic_Air (negative)	-1.9738	4.2911	0.1953	0.3372
	(0.6958)***	(1.0547)***		
Crime (negative)	-2.5400	0.6996	0.0008	0.0004
	(0.2363)***	(0.2098)***		
Developed (negative)	-0.7935	3.1425	0.3689	0.5528
	(0.3994)**	(1.4027)**		
Rec_Area	-8.1489	20.1696	0.0569	0.1581
	(2.1107)***	(9.9471)**		
Forest	-1.3620	1.4734	0.0716	0.0666
	(0.6634)**	(0.4609)***		
Sunshine	2.4826	2.8340	2.5361	2.5892
	(0.6321)***	(1.0137)***		
Water_Area	0.0323			
	(0.0045)***			
Cost	-0.0058			
	(0.0016)***			
*Cost*Gender*	-0.0279			
	(0.0051)***			
*Cost*Rural*	-0.0215			
	(0.0026)***			
*Cost*Income1*	-0.0199			
	(0.0056)***			
*Cost*Income2*	-0.0187			
	(0.0103)*			
	SLL at convergence		-4,735.20	

[a] Single, double and triple asterisks (*) indicate statistical significance at 10%, 5% and 1% levels, respectively.
[b] Standard errors are given in parentheses.

Estimation results for the mixed logit with angler characteristics (Table 3.6) suggest that WTP for state attributes is higher among males than their female counterparts. Urban residents are willing to pay more for favorable fishing conditions than anglers who are rural residents. WTP is also higher among anglers with higher income. The dummy variables on income are constructed based on the lower and upper quartiles of *Income*. Alternative specifications were run in preliminary analysis, including: (i) interacting categorical variables on age, race and years of education with

Cost; and (ii) defining more categories for income. Interactions of dummy variables on age, race and education with *Cost* were either not significant or resulted in unexpected signs of other variables. Similar results were found in stepwise inclusion or exclusion of these interactions. Other definitions of income categories resulted in one or more insignificant categories (interacted with *Cost*). The variances of the random state attribute parameters were large and significant for any specification of angler demographics interacting with cost.

Sensitivity of WTP for state attributes to angler characteristics is shown in Table 3.7. WTP values vary by angler demographics. There is a huge difference in WTP between the highest income group and the bottom two income groups. This difference also varies by gender and residence location of anglers. For example, WTP for recreational acreage by urban males with annual household income between $32,500 and $87,500 is only 5% higher than that by their counterparts with annual household income lower than $32,500. WTP for the same attribute by urban males in the highest income group is about 344% higher than urban males in the lowest income group. In contrast, WTP for recreational acreage by rural females in the highest income group is about 36% higher than their counterparts in the lowest income group. Estimated variances of the WTP values imply that the variability in WTP is not fully explained by personal characteristics of the anglers.

3.4. Conclusion

This paper examines the influence of state characteristics on freshwater anglers' destination state choice using revealed preference data on anglers. This paper also estimates welfare impacts of changes in state attributes and examines the variability of

Table 3.7. Sensitivity of willingness to pay for state attributes to angler characteristics

	Urban				Rural			
	Male		Female		Male		Female	
	Mean	Variance	Mean	Variance	Mean	Variance	Mean	Variance
WTP for reducing 1,000 lbs of toxic release to surface water per sq mile of water area								
Income<32,500	0.01	0.00	0.01	0.00	0.01	0.00	0.00	0.00
Income= [32,500, 87,500)	0.01	0.00	0.01	0.00	0.01	0.00	0.00	0.00
Income≥ 87,500	0.05	0.01	0.01	0.00	0.01	0.00	0.01	0.00
WTP for reducing 1,000 lbs of toxic release to air per sq mile of state area								
Income<32,500	0.76	1.31	0.36	0.63	0.41	0.71	0.26	0.45
Income= [32,500, 87,500)	0.80	1.38	0.37	0.64	0.42	0.73	0.26	0.46
Income≥ 87,500	3.37	5.81	0.58	1.00	0.72	1.24	0.35	0.61
WTP for reducing 1 crime per 100 people								
Income<32,500	0.31	0.15	0.15	0.07	0.17	0.08	0.11	0.05
Income= [32,500, 87,500)	0.33	0.16	0.15	0.07	0.17	0.08	0.11	0.05
Income≥ 87,500	1.38	0.66	0.24	0.11	0.29	0.14	0.14	0.07
WTP for reducing developed land acreage per sq mile of land area by 1%								
Income<32,500	0.14	0.22	0.07	0.10	0.08	0.12	0.05	0.07
Income= [32,500, 87,500)	0.15	0.23	0.07	0.11	0.08	0.12	0.05	0.07
Income≥ 87,500	0.64	0.95	0.11	0.16	0.14	0.20	0.07	0.10
WTP for increasing recreational acreage per sq mile of land area by 1%								
Income<32,500	2.21	6.15	1.06	2.95	1.21	3.35	0.76	2.11
Income= [32,500, 87,500)	2.32	6.45	1.09	3.02	1.24	3.44	0.77	2.14
Income≥ 87,500	9.81	27.26	1.69	4.69	2.08	5.79	1.03	2.86
WTP for increasing forest cover per sq mile of land area by 1%								
Income<32,500	0.03	0.03	0.01	0.01	0.02	0.01	0.01	0.01
Income= [32,500, 87,500)	0.03	0.03	0.01	0.01	0.02	0.01	0.01	0.01
Income≥ 87,500	0.12	0.11	0.02	0.02	0.03	0.02	0.01	0.01
WTP for 1% more annual sunshine								
Income<32,500	0.99	1.01	0.47	0.48	0.54	0.55	0.34	0.34
Income= [32,500, 87,500)	1.04	1.06	0.48	0.49	0.55	0.56	0.34	0.35
Income≥ 87,500	4.37	4.46	0.75	0.77	0.93	0.95	0.46	0.47

[a] All numbers are in US dollars.

these welfare values by demographic characteristics of anglers. Our mixed logit models of freshwater fishing behavior suggest that anglers are less likely to participate in freshwater fishing in states where toxic releases to inland surface water and air, crime rate, and the extent of urbanization are high. On the other hand, anglers prefer states with higher recreational and forest acreages and more sunny days.

Willingness to pay for sunshine and reduced crime rate emphasizes the economic values of weather forecasting and law enforcement. Freshwater anglers value state forest resources positively and land development negatively. Land development causes loss of rural and natural settings available of nature-based recreational participants. Moreover, both forest coverage and available rural settings contribute to the terrestrial aesthetics of a state. Anglers place an even higher value on public recreational acreages. This has positive implications for continued maintenance and feasible growth of state and national parks and wildlife management areas. Freshwater anglers place positive value on reducing toxic release to air and water. Their willingness to pay for individual chemical releases to water, such as mercury, is found significantly higher than that for the total release. Using an aggregate measure of toxic release may provide misleading results because of the information lost in aggregation. Examining individual chemical releases can be more useful in understanding the degree of their influences on angler decisions.

This paper not only estimates the economic value placed by freshwater anglers on state attributes, but also provides information on the characteristics of the target population for capturing the value. Willingness to pay for state attributes varies significantly by the demographic characteristics of anglers. Urbanites place higher values on state attributes than their rural counterparts. Male anglers are also willing to pay more for improved fishing conditions than females. Willingness to pay for state attributes is higher among anglers with higher incomes. Although the variations in willingness to pay are not fully explained by the demographic characteristics of the anglers, it is important to recognize the difference in value placed on state attributes by different groups of individuals in the society.

CHAPTER 4

Using Contingent Valuation to Determine Tourists' Value for Urban Forests: A Study in Savannah, Georgia

4.1. Introduction

Today most of the United States (US) cities embrace and encourage tourism as an important economic sector (Judd, 1995). Many cities, such as Las Vegas, Los Angeles, Orlando, New York City, Washington DC and San Francisco, are visited by millions of international and domestic tourists annually (Law, 2002). Urban recreation resources play a significant role in satisfying recreational demands of both urban residents and tourists. Although tourism in urban areas is frequently considered as "gray tourism" because of the highly developed nature of the typical recreational resources of cities (Deng et al., 2010), such tourism often includes some elements of the 'green' (Ashworth, 2004). Urban green spaces have been identified as an important source of recreational opportunities in previous research (Smardon, 1988; Botkin and Beveridge, 1997; Tyrväinen and Väänänen, 1998; Lorenzo et al., 2000; Jim and Chen, 2006).

Urban forests are defined as "the sum of all woody and associated vegetation in and around dense human settlements, ranging from small communities in rural settings to metropolitan regions" (Miller, 1988, p. 24). Urban forests include natural and planted trees in streets, domestic yards, recreational areas, parks and gardens, unused public and private lands, transportation and utility corridors, and watershed lands around urban areas. Deng et al. (2010) also claim that urban forests have the ability to significantly add to the beauty of urban areas and ameliorate the experience of urban tourists. Urban forests work both as a major factor in attracting tourists and as a complement of other urban tourism magnets.

Local government agencies in urban areas often manage undeveloped areas in an attempt to balance between developed and natural areas (Betz et al., 1999). However, urban forest managers and planners are confronted by the challenge of equilibrating the benefits and costs associated with those resources (Dwyer et al., 1992). In the city of Savannah, Georgia, for example, urban forests are one of the top tourism attractions (Deng et al., 2010). But new development and urban renewal resulting from population growth in Georgia are continuous threats to the city's trees (Savannah Park and Tree Department (SPTD), 2010). Information about the extent and magnitude of the benefits from urban forests can significantly help land-use planning and forest resource management in urban areas (Dwyer et al., 1992).

Several empirical studies have examined and estimated the monetary value of non-priced benefits from urban forests. Tyrväinen and Väänänen (1998), for example, used the Contingent valuation method (CVM) to estimate the values of urban forest recreation areas and residents' willingness to pay (WTP) for small forest parks in Joensuu, Finland. Another study by Lorenzo et al. (2000) examined residents' WTP for community urban forest preservation in Mandeville, US. Jim and Chen (2006) estimated the value of urban green spaces to the residents of Guangzhou, China using the CVM. The above studies found that majority of their survey respondents were willing to pay for the use, protection and preservation of urban forest resources. All these studies, however, focused on estimating value of urban green spaces solely to urban residents. Recently, Notaro and Salvo (2010) estimated tourists' value for ornamental cypress trees on the Trentino region's shore of Lake Garda, Italy using the CVM. While their study was important in terms of policy regarding the maintenance of a specific species in a region, it would be more useful to understand tourists' value for urban forest resources at city levels for efficient management of those resources by local governments and agencies.

The importance of linking urban forests and tourism is gaining national recognition in the US (Neamtzu, 2003). However, in spite of their crucial contribution to enhance urban tourism, research on urban forests as the basis of urban tourism is lacking (Deng et al., 2010). In particular, to our knowledge, no study has estimated the value of the non-priced benefits of urban forests in a city to tourists. According to Buhyoff et al. (1984, p. 71), "perhaps because it is so well accepted that people like trees, very little research has been conducted regarding the visual aesthetic values of urban trees and forests."

The primary objective of this study was to assess the monetary value of non-priced urban forest benefits to tourists. We used the CVM to estimate tourists' value for urban forests in Savannah, Georgia. The influences of tourists' demographic characteristics, perceptions of tourism attribute importance and quality, and destination loyalty on their valuation of urban forests were examined. A maximum likelihood technique was used for econometric estimation. The next section describes study methodologies including study area, data collection procedures, econometric approach and model specifications. The following section discusses the findings. The paper ends with a brief conclusion section.

4.2. Methods

4.2.1. Study area and data collection

This study focused on urban tourism in the city of Savannah, Georgia. Established in 1733, Savannah is located at $32^{0}3'3''$ N, $81^{0}6'14''$ W with a total area of 78.1 square miles (Deng et al., 2010). It is the fourth largest city in Georgia and the largest city in Chatham county (Fig. 4.3) with an estimated population of 135 thousand in 2009 (United States Bureau of the Census (USBOC), 2010).

Savannah's rich historical and cultural amenities and natural beauty attracted more than 50 million visitors during the 1990s (New Georgia Encyclopedia (NGE), 2010). Presently about 7 million tourists visit the city each year (Savannah Convention and Visitors Bureau (SCVB), 2010). Components of urban forests in Savannah, such as botanical gardens, city parks and gardens, tree-lined streets and public squares, are popular nature-based attractions to visitors (Deng *et al*., 2010). These resources are an important part of the character, charm, and beauty of Savannah (SPTD, 2010). The urban

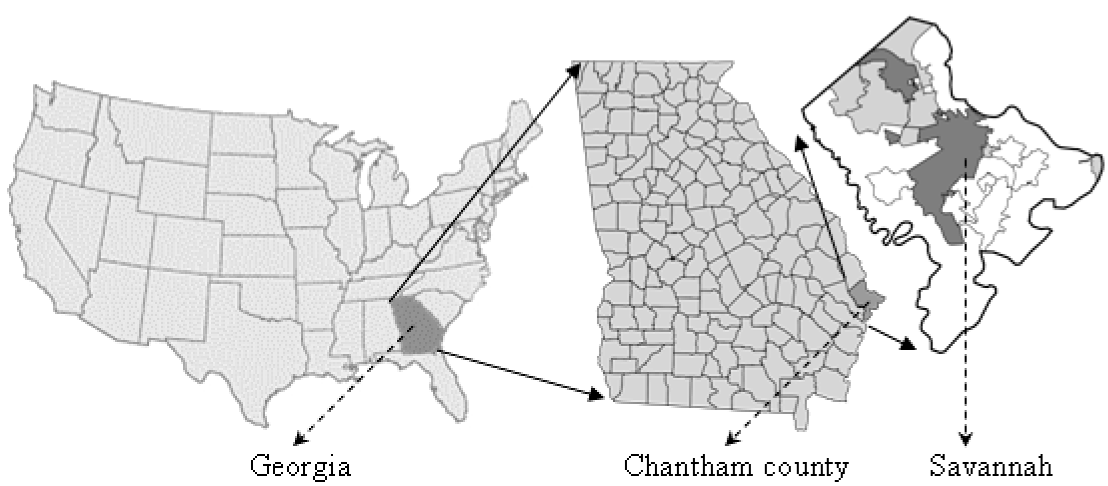

Fig. 4.3. Location of Savannah, Georgia.

forest resources of the city are a result of continuous efforts in planning, planting and maintenance of trees for more than a century. Savannah has been recognized by the National Arbor Day Foundation as a Tree City USA since 1985 and has received Tree City USA Growth Awards eight times for its advancements in urban forest programs. The City also received the Outstanding Community Award from the Georgia Urban Forest Council in 2007.

The data used in this study were from a survey of visitors to Savannah conducted in July 2008 and January, July and August 2009. The questionnaire used in the survey was designed to extract information on visitors' perceptions of tourism attribute importance and performance, destination loyalty, expenditures, willingness to pay for urban forest resources in Savannah, trip characteristics and background information. The questionnaire was reviewed by staff from the SPTD and other project collaborators. Face-to-face onsite self-administered survey was conducted at the River Street, one of the most popular outdoor relaxing and sightseeing places in the city.

Tourists were approached by a surveyor who introduced himself/herself and the study first and then asked them if they were willing to participate in the survey. If a visitor was not willing to participate, the surveyor then approached the next available visitor. If a visitor was willing to participate in the survey, the questionnaire on a clip board was given to him or her to fill out. The questionnaire was collected by the surveyor once it was done onsite. Similar onsite survey method has been used by recent contingent valuation studies (Goffe, 1995; Lee, 1997; Lee and Han, 2002; Togridou et al., 2006).

A payment card technique was used for CVM elicitation. In the payment card method, the respondents are asked to go through a range of values and to circle the amount which is the most they would be willing to pay. This method gets around the problem of starting point in a sequential bidding method (Mitchell and Carson, 1989, p. 100). Payment cards also provide the respondents with more of a context for their bids than what open-ended questions provide. However, the WTP responses obtained by this method can be influenced by the range of values presented (Mitchell and Carson, 1989, p. 242).

In this study, respondents were first asked if they were willing to pay for their experience with urban forest resources, such as trees, squares, gardens and parks, in Savannah. Respondents with a “yes” answer were asked to pursue a range of values and to circle the amount they would be willing to pay per trip. The listed values were \$1, \$5, \$10, \$15, \$20, \$25, \$30, \$35, \$40, \$45 and \$50. The respondents were also given an option to specify any other amount of their choice. To avoid range bias, the range of values were designed based on the responses received in a previous survey done in February 2008 (Deng et al., 2010) wherein most participants provided an integer amount in response to an open-ended direct question about their WTP for urban forest resources in Savannah. In Savannah, visitors do not need to pay a fee to access any of the urban forest resources. It was explained to the respondents that they were asked to provide the amount they would be willing to pay as a fee per trip if they had to pay for viewing or enjoying urban forests, for the purpose of proper maintenance of those resources, in a way that they were paying for hotels, foods and other marketed goods. Potential bias due to scenario misspecification was reduced by face-to-face onsite survey aided by explanations when necessary (Jim and Chen, 2006).

4.2.2. Econometric model

Use of payment cards as CVM elicitation method assumes that a respondent's true valuation lies in between the circled value and the next highest option (Cameron and Huppert, 1989). Payment cards thus provide intervals and not point valuations. In this study, for example, a tourist circling \$10 on the payment card revealed his/her WTP from \$10 to \$15. Nine of the tourists in the final sample specified a value other than the listed ones. The highest listed value preceding the specified value was assigned as the chosen value for them. For example, \$5 was assigned as the chosen value of a respondent who specified a WTP value of \$7. For respondents not willing to pay, a \$0 value was assigned. Thus the data for econometric analysis had 12 WTP intervals.

One simple approach towards econometric analysis of payment card data is to use the interval midpoints as the true unobserved WTP values and to use these values as the dependent variable in an ordinary least squares (OLS) regression model (Cameron and Huppert, 1989). However, ignoring the fact that the midpoints are not necessarily the expected values within the intervals, this method may provide biased regression coefficients. We used a more efficient maximum likelihood estimation method for estimating the parameters of a WTP function described by Cameron and Huppert (1989).

The nonnegative nature and the frequently skewed distribution of valuations have led researchers to assume a lognormal conditional distribution for valuations (Cameron and Huppert, 1989; Legget et al., 2003). The lognormal WTP function for the i^{th} respondent can be written as

$$\log(WTP_i) = X_i'\beta + \varepsilon_i, \qquad (1)$$

where X_i is a vector of explanatory variables and $\varepsilon_i \sim N(0, \sigma^2)$. If the respondent's true valuation, WTP_i, is known to lie within the interval (t_i, t_{i+1}), then log(WTP_i) will lie between log(t_i) and log(t_{i+1}). Each pair of individual thresholds for log(WTP_i) can then be standardized to state the probability that respondent i will select t_i as

$$\begin{aligned}\Pr(t_i) &= \Pr(WTP_i \subseteq (t_i, t_{i+1})) \\ &= \Pr((\log t_i - X_i'\beta)/\sigma < z_i < (\log t_{i+1} - X_i'\beta)/\sigma) \\ &= \Phi((\log t_i - X_i'\beta)/\sigma) - \Phi((\log t_{i+1} - X_i'\beta)/\sigma),\end{aligned} \tag{2}$$

where z_i is the standard normal random variable and Φ is the cumulative standard normal density function. The log likelihood function for a sample of n independent observations can be written as

$$\log L = \sum_{i=1}^{n} \log[\Phi((\log t_i - X_i'\beta)/\sigma] - \Phi[(\log t_{i+1} - X_i'\beta)/\sigma)]. \tag{3}$$

The formulas for the gradients and the Hessian matrix associated with the log likelihood function can be found in Cameron and Huppert (1989).

With the assumed lognormal distribution of valuations, the median of an individual's conditional WTP distribution was estimated as the anti-log of that individual's predicted log(WTP) (Cameron and Huppert, 1989). The mean of WTP, for each individual, was obtained by scaling the median by $\exp(\sigma^2/2)$. The median and mean WTP per trip for urban forests in Savannah were estimated by averaging across all tourists in the sample.

4.2.3. Empirical specification and variables

In this study, WTP for urban forests was modeled as a function of demographic characteristics, perceptions of tourism attribute importance and performance, and destination loyalty of the respondents. The following functional relationship was estimated using maximum likelihood technique.

$$\log(WTP_i)=\mathrm{f}(Age2_i, Age3_i, Gender_i, Education2_i, Education3_i, Income_i, Group_i, Loyalty_i, Importance_i, Quality_i), \tag{4}$$

where, as described in the last section, *WTP* was a latent variable. The other variables are defined in Table 4.1.

Age, gender, education and income of tourists were included in the model to control for demographic variables that may influence WTP. The original datasets included six categorical variables on family income groups. The average income of a

Table 4.1. Variable definitions

Variable	Description	Mean
Age1	=1if 18$\leq$respondent's age<26, =0 otherwise	0.17
Age2	=1if 26$\leq$ respondent's age <55, =0 otherwise	0.47
Age3	=1 if respondent's age $\geq$55, =0 otherwise	0.36
Gender	=1 if respondent is male, =0 otherwise	0.45
Education1	=1 if highest education achieved by respondent is high school degree or equivalent, =0 otherwise	0.26
Education2	=1 if highest education achieved by respondent is undergraduate degree or equivalent, =0 otherwise	0.44
Education3	=1 if highest education achieved by respondent is graduate school degree, =0 otherwise	0.31
Income [a]	Annual family income before taxes (1,000 US$)	67.70
Foreign	=1 if respondent is from a foreign country, =0 otherwise	0.02
Group	Number of people accompanying the respondent during the visit	2.77
Loyalty	Number of previous visits to Savannah	4.53
Importance	=1 if urban forest is important to the respondent, =0 if not	0.75
Quality	=1 if urban forest resources in Savannah are aesthetically pleasing to respondent, =0 if not	0.70

[a] Calculation of mean includes estimated values for the missing income values as described in this section.

group, calculated as the mean of the highest and lowest income of the group, is assigned to each individual in the group in this paper. The value of the lower boundary is used as the level of income for the open ended group. Annual family income was not reported by 41 respondents in the final sample used in this study. To compensate for possible item nonresponse bias, income was imputed for missing observations by regressing the logarithm of *Income**1000 on other observed demographic characteristics of the respondents (Mitchell and Carson, 1989, p.273)[1].

The dummy variable *Foreign* was included in the model to account for any difference in WTP between domestic and foreign tourists. The *Group* variable was used as an explanatory variable to capture the possibility that parents and couples considered cost increase for the whole group in selecting the WTP value (Legget et al., 2003). The coefficient of *Group* was expected to be negative if this was true. This would also imply that tourists with families were willing to pay less for urban forests.

Destination loyalty (*Loyalty*) was measured as the number of previous visits. Repeat visitation is often considered desirable in the tourism literature (Oppermann, 2000). Lower marketing costs are needed to attract repeat visitors and repeated visits indicate satisfaction. Repeat visitors are also more likely to return (Opperman, 1998). Deng et al. (2010) argued that urban forests positively contributed to the development of destination loyalty among tourists. This study examined the other side of the relationship.

[1] The results are given below, with standard errors in parentheses.

$$\hat{\log}(Income*1000) = \underset{(0.08)}{10.08} + \underset{(0.08)}{0.56}*Age2 + \underset{(0.09)}{0.67}*Age3 + \underset{(0.06)}{0.03}*Gender + \underset{(0.07)}{0.42}*Education2 + \underset{(0.08)}{0.56}*Education3$$

N=437; R^2=0.26; F-statistics=31.05 (p-value<0.0001).

Annual family income was predicted for respondents with missing income values as $\hat{\theta}*\exp(\hat{\log}(Income*1000))$, where $\hat{\theta}$ is the estimated coefficient of $\exp(\hat{\log}(Income*1000))$ from regressing *Income**1000 on $\exp(\hat{\log}(Income*1000))$ without an intercept (Wooldridge, 2003, p. 208).

The coefficient of Loyalty would determine whether or not destination loyalty paid for urban forests.

In constructing variables on visitors' perceptions of tourism attribute importance and performance, public squares were used as a proxy for all urban forest resources in Savannah. The green public squares of Savannah are the major urban forest attractions in the city and have national and even international uniqueness (Deng et al., 2010). *Importance* was originally rated on a 7 point likert scale, with 1 being "the least important" and 7 being "the most important," in response to a question asking the respondents to indicate the importance of the beauty of public squares in Savannah. These categories were aggregated into "important" (6-7) and "not important" (1-5). *Quality* was also constructed in a similar way from the ratings on a 7 point likert scale, with 1 being "strongly disagree" and 7 being "strongly agree," in response to a question asking the respondents if the public squares in Savannah were aesthetically pleasing. Both *Importance* and *Quality* were expected to positively influence WTP for urban forests. The inclusion of their interaction in the model, allowed examining their effects on WTP with respect to the reference category of tourists for whom urban forests in Savannah were not important and not aesthetically pleasing.

The design of payment cards might cause biased WTP amounts in the following ways (Mitchell and Carson, 1989, p. 242): (1) the payment card may artificially constrain a respondent's WTP if the maximum amount listed in the card is lower than the respondent's maximum WTP; (2) a respondent may choose a value higher than the actual WTP if he or she considers the maximum amount listed as a reasonable upper bound; and (3) a respondent may choose a value either higher or lower than his or her actual WTP because the payment card may not include the preferred WTP value. This third type of bias is comparatively more subtle and not easy to minimize. Although the payment card used in this study was constructed based on a previous survey to avoid possible range bias, we conducted a counterfactual experiment by combining pairs of existing intervals together. The counterfactual intervals were represented by the values $0, $5, $15, $25, $35 and $45. A respondent, for example, could have chosen $10 when his or her actual WTP was $8. We captured these possibilities, at least partially, by estimating a model using the coarser intervals. We then examined the difference in the estimated WTP between the models using original and coarser intervals.

4.3. Results and Discussion

4.3.1. Response rate and data validation

A total of 1219 visitors were approached during the four survey periods. The number of visitors who participated in the survey was 640, resulting in a response rate of 52.5%. Questionnaires took about 5-6 minutes for each respondent to fill in. Usable information for contingent valuation analysis was provided by 478 visitors.

A random sampling technique could not be used in the survey as information about the size and location of the target tourist population were not available (Togridou et al., 2006). WTP estimates can be extrapolated to the population of tourists based on the sample if the demographic characteristics of the sample are not significantly different from the population (Jim and Chen, 2006). As 98% of the respondents in the final sample were from the United States (US), the demographic characteristics of the sample were compared to the USBOC (2010) data (Table 4.2). Association between demographic characteristics and origin (domestic or foreign) of tourists in the sample was examined

Table 4.2. Comparison of tourists' demographic characteristics

	Comparing sample domestic and foreign tourists			Comparing sample tourists with US Census data				
							Pearson's χ^2 statistic [a]	
Tourist characteristics	Domestic (%)	Foreign (%)	Freeman-Halton test (p-value)	Sample with only domestic tourists (%)	Total sample (%)	USBOC (%)	Only domestic	Total sample
<u>Age</u>			0.48				1.79	1.55
18-25	16.53	0.21		16.88	16.74	14.78		
26-54	46.03	1.46		47.01	47.49	53.69		
>54	35.36	0.42		36.11	35.77	31.53		
<u>Gender</u>			0.35				0.95	0.82
Feamle	54.39	0.84		55.56	55.23	50.69		
Male	43.51	1.26		44.44	44.77	49.31		
<u>Education</u>			0.92				71.75*	71.47*
High School or less	24.9	0.63		25.43	25.52	61.80		
Undergraduate	42.68	0.84		43.59	43.51	27.90		
Graduate school	30.33	0.63		30.98	30.96	10.30		
<u>Income</u>			0.71				7.91	7.78
≤ \$20,000	8.16	0.21		8.33	8.37	12.12		
\$20,001-\$40,000	11.51	0.42		11.75	11.92	19.19		
\$40,001-\$60,000	19.87	0.42		20.3	20.29	17.32		
\$60,001-\$80,000	14.64	0.42		14.96	15.06	14.56		
\$80,001-\$100,000	16.53	0.42		16.88	16.95	10.99		
≥ \$100,001	27.20	0.21		27.78	27.41	25.82		

[a] Single asterisk (*) indicates statistical significance at 5% level.

using Freeman-Halton test (Freeman and Halton, 1951). Results did not suggest any such association. Pearson's χ^2 test (Agresti, 2007, p. 35) showed that only education of both the sample of domestic tourists and the total sample was significantly different from that of the total US population. Since age, gender and annual family income of the sample were not found to be significantly different from those of the general US population, the sample was considered an acceptable representation of the population of tourists[1].

4.3.2. WTP for urban forests in Savannah

Before turning to the WTP estimation results, we examined the distribution of WTP responses by respondent characteristics and presented the results Table 4.3. Percentage of respondents willing to pay less than \$1 was slightly lower in higher age and education groups. Percentage of respondents willing to pay more than \$40 was, however, much higher among respondents aged more than 54 years and among respondents with graduate school degree. Although about 56% of both males and females were willing to pay less than \$1, greater percentages of women placed the higher valuations above \$35. Distributions of WTP responses were not consistent among income groups. For example, percentage of respondents willing to pay less than \$1 was lower in the income group less than \$20,000 than the next two higher income groups. The highest income group, however, had the lowest percentage of respondents willing to pay less than \$1 and the highest percentage of respondents willing to pay more than \$50.

Higher percentages of both repeat visitors and visitors traveling alone were willing to pay higher amounts (see Table 4.3). The similar trend was found among both

[1] The percentage of foreign tourists was assumed to be very low in the population of tourists as it was in the sample. Note that the ratio of total foreign visitors in the US for pleasure to total domestic travel by US residents in 2006 was about 0.01 (USBOC, 2010).

Table 4.3. Distribution of responses to contingent valuation question

Tourist characteristics		Percentage of respondents											
		<$1	$1-$5	$5-$10	$10-$15	$15-$20	$20-$25	$25-$30	$30-$35	$35-$40	$40-$45	$45-$50	≥ $50
Age	18-25	58.75	1.25	11.25	6.25	3.75	3.75	6.25	5.00	0.00	2.50	0.00	1.25
	26-54	57.27	1.32	4.41	8.37	3.52	5.29	4.41	1.32	1.76	2.64	3.96	5.73
	>54	55.56	0.58	1.17	5.26	2.92	6.43	2.34	4.09	1.75	7.02	4.68	8.19
Gender	Female	57.58	0.76	4.17	5.68	4.55	5.68	2.65	2.65	1.52	4.55	3.79	6.44
	Male	56.07	1.40	4.67	8.41	1.87	5.14	5.61	3.27	1.40	3.74	3.27	5.14
Education	High School or less	63.11	0.82	9.02	8.20	4.92	4.92	1.64	2.46	0.00	0.82	0.82	3.28
	Undergraduate	58.17	0.48	4.33	6.73	1.44	6.25	5.29	2.40	0.96	4.81	3.85	5.29
	Graduate school	50.00	2.03	0.68	6.08	4.73	4.73	4.05	4.05	3.38	6.08	5.41	8.78
Income	≤ $20,000	55.00	2.50	15.00	0.00	2.50	5.00	2.50	7.50	0.00	7.50	0.00	2.50
	$20,001-$40,000	68.42	1.75	10.53	10.53	3.51	1.75	1.75	0.00	0.00	0.00	0.00	1.75
	$40,001-$60,000	62.89	1.03	1.03	12.37	8.25	5.15	2.06	1.03	0.00	0.00	1.03	5.15
	$60,001-$80,000	54.17	0.00	4.17	6.94	4.17	5.56	8.33	4.17	1.39	2.78	2.78	5.56
	$80,001-$100,000	59.26	1.23	3.70	3.70	0.00	11.11	0.00	2.47	2.47	6.17	6.17	3.70
	≥ $100,001	48.09	0.76	1.53	5.34	1.53	3.82	6.87	3.82	3.05	7.63	6.87	10.69
Loyalty	Repeat visitor	44.59	1.69	4.73	8.45	4.39	7.43	4.39	3.72	2.03	5.74	5.07	7.77
	First time visitor	76.92	0.00	3.85	4.40	1.65	2.20	3.30	1.65	0.55	1.65	1.10	2.75
Group	With group	61.58	1.13	3.67	7.34	2.82	4.52	3.95	2.54	1.69	3.67	1.98	5.08
	Alone	43.55	0.81	6.45	5.65	4.84	8.06	4.03	4.03	0.81	5.65	8.06	8.06
Importance	Not important	68.31	1.41	2.11	7.75	2.82	6.34	4.93	0.70	0.00	2.11	2.11	1.41
	Important	52.08	0.89	5.36	6.55	3.57	5.06	3.57	3.87	2.08	5.06	4.17	7.74
Quality	Not pleasing	67.50	2.50	2.50	5.83	1.67	7.50	2.50	0.83	0.00	2.50	2.50	4.17
	Pleasing	53.35	0.56	5.03	7.26	3.91	4.75	4.47	3.63	1.96	4.75	3.91	6.42
Foreign	Domestic	57.05	1.07	4.27	6.84	3.21	5.34	4.06	2.99	1.28	4.27	3.63	5.98
	Foreigner	50.00	0.00	10.00	10.00	10.00	10.00	0.00	0.00	10.00	0.00	0.00	0.00
Total sample		56.90	1.05	4.39	6.90	3.35	5.44	3.97	2.93	1.46	4.18	3.56	5.86

[a] In this table *Loyalty* and *Group* are presented in categories.

the respondents who considered urban forests in Savannah were important to them and the respondents who found them aesthetically pleasing. Compared to the foreign respondents, a higher percentage of domestic respondents were willing to pay < $1. However, the percentage willing to pay > $40 was higher among the domestic respondents. Overall, more than half of the respondent tourists in the sample were willing to pay less than $1, about 7% were willing to pay $10-$15, about 4% were willing to pay $40-$45, and about 6% were willing to pay more than $50 for urban forests.

WTP estimation results of the two models are given in Table 4.4. Although the coefficients of the model with coarser intervals were damped compared to the model with original intervals, the slope parameter estimates were consistent in their signs and significance across the two models. In the rest of this section we discuss the estimated coefficients of the model with original intervals unless mentioned otherwise.

Coefficients of age and gender of tourists were not significant (see Table 4.4). Coefficient of *Education3* was higher in value than the coefficient of *Education2*. However, only *Education3* was significant, suggesting that tourists with graduate school degree were willing to pay more than tourists with high school education or less. Family income of tourists had a small but positive and significant influence on WTP. For every $1,000 increase in family income tourists were willing to pay $0.02 more for urban forests. No significant difference in WTP was found between domestic and foreign tourists.

The coefficient of *Group* was negative and significant (see Table 4.4). This coefficient implied that, on average, one additional member in a group reduced WTP by 57%. Thus, tourists considered the cost increase to the entire group or family when

Table 4.4. Maximum likelihood estimation of WTP

	Original intervals		Coarser intervals	
Variable	Coefficient	S.E. [a]	Coefficient	S.E. [a]
Intercept	-2.7778	0.8587***	-0.4926	0.5175
Age2	-0.0024	0.5591	0.0020	0.3278
Age3	-0.0416	0.5932	0.0348	0.3462
Gender	0.2630	0.3692	0.1088	0.2162
Education2	0.4769	0.4887	0.3212	0.2863
Education3	1.1453	0.5552**	0.6789	0.3249**
Income	0.0156	0.0073**	0.0122	0.0043***
Foreign	0.3657	1.2245	0.1629	0.7115
Group	-0.5524	0.1249***	-0.3233	0.0738***
Loyalty	0.0468	0.0163***	0.0320	0.0098***
Importance	2.3833	0.7871***	1.3710	0.4685***
Quality	2.0100	0.7195***	1.2105	0.4286***
*Importance*Quality*	-1.9333	0.9560**	-1.0606	0.5649*
σ	1.8414	0.0034***	1.3935	0.0022***
Median WTP	2.35	0.37	5.63	0.35
Mean WTP	12.76	2.00	14.85	0.94
N	478		478	
Log likelihood	-912.36		-625.39	

[a] Single, double and triple asterisks (*) indicate statistical significance at 10%, 5% and 1% levels, respectively.

placing valuations of urban forests. The negative coefficient of Group could also be a result of lower disposable income for tourism among larger households (Legget et al., 2003).

The coefficient of *Loyalty* was positive and significant (Table 4.4). On an average, an extra trip made in the past contributed about 5% more in WTP for urban forests. This implied that perceived satisfaction with urban forests in Savannah increased with number of trips. This result has important implications for economic sustainability of Savannah's urban forestry because of the greater likelihood of coming back among repeat visitors and the reduced cost of attracting them.

Both *Importance* and *Quality* had significant positive coefficients (see Table 4.4). The coefficient of their interaction term was negative and significant. These results suggested that the tourists with perceived importance of Savannah's urban forests in tourism were willing to pay 238% more than the reference category tourists without positive perceptions about both importance and quality. Tourists who thought that Savannah's urban forests were aesthetically pleasing were willing to pay 201% more than the reference category tourists. Finally, WTP by tourists with positive perceptions about both importance and quality of Savannah' urban forests was 246% higher than that by tourists in the reference category. Cities in the US often use large amount of funds in competing for tourists (Judd, 1995). Although perceived quality varies by individuals, the average level can be controlled by resource suppliers and managers. The influence of perceived quality on WTP found in this study suggests that efforts in improving the quality of urban forest resources can result in tremendous economic benefits in a city.

The median and mean WTP for urban forests per trip to Savannah shown in Table 4.4 were estimated as the sample averages of estimated individual median and mean WTP values, respectively. Both median and mean WTP values provided by the model with coarser intervals were higher compared to the values estimated from the model with original intervals. A paired t test revealed that median WTP was significantly different between the two models at 5% level of significance. Mean WTP was, however, not found significantly different between the two models. Assuming a constant annual number of visits of about 7 million (SCVB, 2010), the total annual value of Savannah's urban forests in terms of tourism range from a minimum of US $62 million to a maximum of US $117 million depending on the model used.

4.4. Conclusions

Tourism is one of the major drivers of urban economies. Urban forest resources have played an increasingly important role in attracting tourists to urban areas by enhancing the beauty of cities and working as a complement of other urban attractions. It is thus important for city government and agencies to better understand the relationship between urban forests and tourism. However, little is known about the value of the urban forests from the perspective of tourism. This study filled this gap in the literature of urban forestry and tourism by examining tourists' behavior towards urban forests and by providing monetary value estimates of urban forests' non-price benefits to them.

WTP for urban forests by tourists in Savannah, Georgia was estimated using the contingent valuation method (CVM). The function of tourists' demographic characteristics, destination loyalty and perceptions of urban forests' importance and quality in Savannah were examined. The results indicate that WTP would be higher among tourists with graduate school education. It also seems that WTP would increase with higher income. The results suggest that tourists traveling in groups were willing to pay less likely because of lower disposable income available for tourism in larger households.

An important finding of this study is that loyal tourists would be willing to pay more for urban forests. Both first time and repeat visitors are important for a city's tourism industry. However, a marketing strategy towards retaining the repeat visitors would be beneficial in terms of the value generated for urban forests. The influence of perceived quality on WTP found in this study suggests an immense value in proper maintenance and improvement of urban forest quality relative to competing cities.

Land use in urban areas is highly competitive (Deng et al., 2010). Georgia is one of the fastest growing states in the US. Population growth and urban development puts continuous pressure on open and green spaces in Georgia cities. Conversion of green spaces to other land uses not only deteriorates urban environment and quality of life, but also causes loss of non-market benefits, which in fact generate market value by attracting more tourists. The results of this study would be useful for urban resource managers and planners in making efficient land use and management decisions. Economic efficiency in maintaining urban forests can be achieved by capturing the tourism benefits in the form of fees for enjoying urban forest resources in Savannah. The magnitude of the estimated aggregate value of urban forests from tourism perspective gives the policymakers valuable information on the contribution of urban forest resources to the quality of Savannah’s landscape.

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