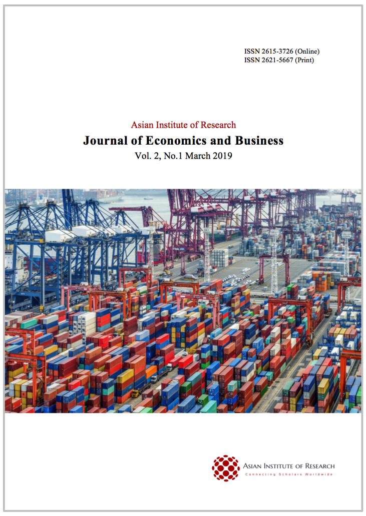

Journal of Economics and Business

Chi, Yeong Nain. (2019), A Triple Hurdle Expenditure Analysis of U.S. Saltwater Recreational Fishing. In: *Journal of Economics and Business*, Vol.2, No.1, 73-84.

ISSN 2615-3726

DOI: 10.31014/aior.1992.02.01.68

Published by:
The Asian Institute of Research

The Asian Institute of Research
Journal of Economics and Business
Vol.2, No.1, 2019: 73-84
ISSN 2615-3726

DOI: 10.31014/aior.1992.02.01.68

A Triple Hurdle Expenditure Analysis of U.S. Saltwater Recreational Fishing

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Abstract
This study used cross-sectional data extracted from the 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation to analyze individual trip-related expenditures associated with saltwater recreational fishing in the United States. Based on the utility maximization framework in the triple hurdle model, all observations can be used to estimate a participant's final decision for saltwater recreational fishing. Positive observations that are simultaneously passed down the participation and consumption decisions can be used for estimation based on a censored and truncated sample, allowing for richer interpretation of saltwater recreational angler behavior. Empirical results (income, age, gender, ethnicity, urban setting, fishing license, fishing on a boat, fish types) showed significant effects on U.S. saltwater recreational fishing trip-related expenditures. The results of this study can provide insight into the determinants of U.S. saltwater recreational fishing trip-related expenditures, which can be used for saltwater recreational fisheries management and policy.

Keywords: Saltwater Recreational Fishing, Participation, Expenditures, Tobit Model, Triple Hurdle Model

1. Introduction

Saltwater recreational fishing has become a common practice across the United States which provides excitement, reduces stress and also serves as a means to improve unity among family members. It's also a source of revenue to the community, promotes tourism and contributes billions of dollars to the American economy. In 2015, NOAA Fisheries released the National Saltwater Recreational Fisheries Policy (U.S. Department of Commerce, 2015) to provide guidance in pertaining to development and maintenance of enduring and sustainable high quality saltwater recreational fisheries, which recognized the importance of saltwater recreational fishing to the nation.

According to the report from the 2011 National Survey of Fishing, Hunting and Wildlife-Associate Recreation, saltwater recreational fishing attracted 8.9 million anglers who took 86.2 million trips in 99 million days. A staggering amount of $10.3 billion was spent on saltwater recreational fishing trips and equipment during that year. Expenditure on trip-related cost totaling $7.3 billion was the highest, Accommodation and food cost $2.4 billion, and transportation cost was $1.5 billion. Other miscellaneous cost such as guide fees, licenses, permits, bait, membership dues and equipment rental were $3.4 billion (U.S. Fish and Wildlife Service, 2014).

Saltwater recreational fishing is usually done with equipment such as rod, reel, bait, hook and line. It was estimated by the 2011 National Survey of Fishing, Hunting and Wildlife-Associate Recreation that a total of $2.9 billion was spent by anglers on equipment for saltwater recreational fishing. A detailed breakdown of this cost comprised of \$1.4 billion on main fishing equipment (rod, reel, hook and line), \$1.3 billion for special equipment (boats, travel vans etc.) and \$217 million for auxiliary equipment (binoculars, camping equipment etc.) (U.S. Fish and Wildlife Service, 2014).

In 2011, saltwater recreational anglers spent an average of 11 days fishing and enjoyed an average of 10 trips. Saltwater recreational anglers spent an average of \$824 per angler on trip related costs which was the highest average expenditure cost compared to average expenditure of freshwater recreational anglers and great lake recreational anglers, an average of \$74 per day (U.S. Fish and Wildlife Service, 2014).

The most commonly sought fish among saltwater recreational anglers are striped bass, flatfish, redfish, sea trout, bluefish, salmon and mackerel. According to the 2011 National Survey of Fishing, Hunting and Wildlife-Associate Recreation, 2.1 million saltwater recreational anglers fished for striped bass for 18 million days, 2 million anglers fished for flatfish for 22 million days. 1.5 million Anglers fished for redfish for 21 million days and 1.1 million saltwater recreational anglers fished for 15 million days (U.S. Fish and Wildlife Service, 2014).

According to the reports from the 2001, 2006, and 2011 National Surveys of Fishing, Hunting, and Wildlife-Associated Recreation, the number of all anglers in the United States decreased from 34.1 million in 2001 to 30.0 million in 2006 then increased to 33.1 million from 2006 to 2011. The total fishing expenditures increased from \$45.3 billion in 2001 to \$47.0 billion in 2006, and decreased to \$41.8 billion from 2006 to 2011. A comparison of the 2001, 2006 and 2011 National Survey of Fishing, Hunting and Wildlife-Associate Recreation indicated that the total number of saltwater recreational anglers decreased significantly from 9.5 million in 2001 to 7.7 million in 2006 and then increased to 8.9 million in 2011. Total expenditures on saltwater recreational fishing trip-related costs and equipment increased slightly from \$8.4 billion in 2001 to \$8.9 billion in 2006, and also increased to \$10.3 billion from 2006 to 2011 (U.S. Fish and Wildlife Service, 2002, 2007, 2014).

The purpose of this study is to analyze the determinants of saltwater recreational fishing trip-related expenditures in the United States, based on the utility maximization framework in the triple hurdle model, all observations can be used to estimate a participant's final decision for saltwater recreational fishing. Positive observations that are simultaneously passed down the participation and consumption decisions can be used for estimation based on a censored and truncated sample, allowing for richer interpretation of saltwater recreational angler behavior. This improves our understanding of the trade-offs made in this process.

However, expenditure analysis not only provides information about how different socio-economic groups allocate their resources toward saltwater recreational fishing activities, but it may also contribute to a better understanding of current and future angler behavior of U.S. saltwater recreational fishing participation and consumption. The results of this study can provide insight into the determinants of U.S. saltwater recreational fishing trip-related expenditures, which can be used for saltwater recreational fisheries management and policy.

2. Econometric Method

An analysis of saltwater recreational fishing trip-related expenditures can be beneficial from the use of appropriate econometric analysis and measurement to comprehend the full value of this type of saltwater recreational fishing activities within the framework of saltwater recreational fisheries management and policy. In particular, analyzing saltwater recreational fishing trip-related expenditures in the framework of an angler who allocate a constrained budget to maximize utility improves a better understanding of the tradeoffs made in this process.

According to consumer choice theory, angler attempts to maximize his/her utility from saltwater recreational fishing activities subject to his/her budget constraint. Thus, the maximization of the utility function for saltwater recreational fishing activities can be stated as follows:

$$\mathrm{Max}_{y,\,z} \quad u = u(y, z \mid a, s) \quad \text{subject to} \qquad py + qz = I$$

where u(.) represents the utility function which is assumed to be continuous, increasing, and quasi-concave, y is quantity demanded of saltwater recreational fishing activities, i.e. the number of saltwater recreational fishing trips to the fishing site, z represents the quantity of all other goods consumed, a is the vector of exogenous attributes of the activity or site, s is the vector of socioeconomic characteristics, p is trip-related expenditures of saltwater recreational fishing activities, q is the vector of prices of other goods and services, and I is income.

Then the angler's demand function for saltwater recreational fishing activities can be expressed in terms of saltwater recreational fishing trip-related expenditures as follows:

$$Y = f(X, \beta, \varepsilon)$$

where Y is the vector of the dependent variable representing saltwater recreational fishing trip-related expenditures, X is the matrix of independent variables such as socioeconomic factors and trip characteristics, β is a vector of parameters including, but not limited to, the estimated coefficients of the independent variables, and ε is the vector of the random error term assumed to be independent and identically distributed.

In general, the demand function gives the quantity of a market good that the individual will purchase as a function of market prices and the individual's income. This relationship is referred to as the Engel curve. The Engel curve can be used to estimate the relationship between expenditures and income, holding price constant. Typically, price is assumed to be constant with the cross-sectional data that is usually used to estimate the Engel function. Hence, given the individual's income and prices of goods, the quantities demanded by the individual can be determined from the individual's demand function (Deaton & Muellbauer, 1980; Henderson & Quandt, 1980; Varian, 2010).

In order to develop the relationship between trip-related expenditures associated with saltwater recreational fishing activities, anglers' income and their socio-economic characteristics, sample recognition and data related issues (censored and truncated samples), which are common to expenditure model, improve measurement reliability. A better understanding of the nature of this data helps select an appropriate econometric model for this expenditure analysis. Modeling consumer behavior with cross-sectional data is complicated by a significant proportion of zero expenditures in the sample. In practice, the sample containing observations with reported zero expenditure presents a unique problem with cross-sectional survey data. Using traditional econometric techniques, the parameter estimates are biased and inconsistent (Maddala, 1983; Judge, et al. 1988; Greene, 2008). For example, regression analysis based on nonzero observations of the dependent variable can lead to biased parameter estimates.

Empirically, researchers have often used the Tobit model, first represented by Tobin (1958), to consider the fact that the expenditures, the limited dependent variable of the regression model, cannot be negative when analyzing household expenditures on durable goods. Thus, the Tobit model can be used to analyze the demand for any specific goods when household expenditures can be observed only in a limited value, usually zero. Under the Tobit specification, zero expenditure implies zero consumption. Hence, it represents a true corner solution (Gould, 1992). Statistically, the Tobit model can be expressed as:

$$\begin{aligned} y_i &= y_i^* && \text{if } y_i^* = x_i'\beta + e_i > 0 && i = 1, \ldots, n \\ y_i &= 0 && \text{otherwise} \end{aligned}$$

where y_i is a vector of individual observed expenditures, y_i^* is a vector of the corresponding desired expenditures, x_i is a vector of regressor that influence expenditures, β is a vector of unknown parameters, and e_i is an independently distributed error term with distribution $N(0, \sigma^2)$. For the observations y_i that are zero,

$$\text{Prob}(y_i = 0) = 1 - \text{Prob}(y_i > 0) = 1 - \Phi(x_i'\beta/\sigma)$$

For the observations y_i that are greater than zero,

$$\text{Prob}(y_i > 0)f(y_i|y_i > 0) = (1/\sigma)\phi[(y_i - x_i'\beta)/\sigma]$$

where $\phi(.)$ and $\Phi(.)$ are the standard normal density and cumulative distribution functions, respectively. Using 0 to denote zero observations and + denote positive observations, the likelihood function for the Tobit model can be specified as:

$$L = \Pi_0[1 - \Phi(x_i'\beta/\sigma)]\ \Pi_+[(1/\sigma)\phi[(y_i - x_i'\beta)/\sigma]]$$

Then the log-likelihood function for the Tobit model is:

$$\ln L = \Sigma_0 \ln[1 - \Phi(x_i'\beta/\sigma)] + \Sigma_+ \ln\{[(1/\sigma)\phi[(y_i - x_i'\beta)/\sigma]\}$$

The maximum likelihood estimation technique can be used to estimate the unknown parameters.

Recently, the triple hurdle model has been drawn attention to the importance in empirical applications in agricultural economics and agribusiness. Burke, et al. (2015) applied the triple hurdle model to evaluate production and market participation in Kenya's dairy sector, and to examine the factors associated with the decision to produce or not produce; the decision of producers whether to participate or not participate in the market; and the decision of market participating producers on how much to buy or sell.

Jensen, et al. (2015) employed the triple hurdle model to estimate cattle farmer willingness to adopt or expand prescribed grazing on pasture in response to a hypothetical incentive program. Interest in adoption/expansion was estimated first, then willingness to participate in the program, followed by intensity of participation measured as additional acres enrolled.

The triple hurdle model may provide a better interpretation of consumer choice behavior that takes into account the probability of consumption and the level of consumption simultaneously. Statistically, the triple hurdle model is established as a useful extension of the univariate Tobit model. It allows three separate stochastic processes for participation in and consumption for saltwater recreational fishing. The triple hurdle model in this study can be expressed as:

$$y_i = y_i^* \quad \text{if } g_i = z_i'\alpha + u_i = 1,\ h_i = w_i'\gamma + v_i = 1,\ y_i^* = x_i'\beta + e_i > 0 \quad i = 1, \ldots, n$$
$$y_i = 0 \quad \text{otherwise}$$

where g_i characterizes the decision of whether to participate in any recreational fishing (the first stage of participation), z_i is a vector of regressor that influence participation in any recreational fishing; α is a vector of unknown parameters; and u_i is an independently distributed error term with distribution N(0, 1); h_i characterizes the decision of whether to participate in saltwater recreational fishing (the second stage of participation), w_i is a vector of regressor that influence participation in saltwater recreational fishing; γ is a vector of unknown parameters; and v_i is an independently distributed error term with distribution N(0, 1). For the observations y_i that are zero,

$$\text{Prob}(y_i = 0) = 1 - \text{Prob}(g_i = 1)\text{Prob}(h_i = 1)\text{Prob}(y_i > 0) = 1 - \Phi(z_i'\alpha)\Phi(w_i'\gamma)\Phi(x_i'\beta/\sigma)$$

For the observations y_i that are greater than zero,

$$\text{Prob}(y_i > 0)f(y_i|y_i > 0) = \Phi(z_i'\alpha)\Phi(w_i'\gamma)(1/\sigma)\phi[(y_i - x_i'\beta)/\sigma]$$

The likelihood function for the triple hurdle model can be specified as:

$$L = \Pi_0[1 - \Phi(z_i'\alpha)\Phi(w_i'\gamma)\Phi(x_i'\beta/\sigma)]\ \Pi_+\{\Phi(z_i'\alpha)\Phi(w_i'\gamma)(1/\sigma)\phi[(y_i - x_i'\beta)/\sigma]\}$$

And the log-likelihood function for the triple hurdle model is:

$$\ln L = \Sigma_0 \ln[1 - \Phi(w_i'\gamma)\Phi(z_i'\alpha)\Phi(x_i'\beta/\sigma)] + \Sigma_+ \ln\{\Phi(w_i'\gamma)\Phi(z_i'\alpha)(1/\sigma)\phi[(y_i - x_i'\beta)/\sigma]\}$$

The maximum likelihood estimation technique can be used to estimate the unknown parameters. Based on the assumptions of normality and independence of the error term, the probability of non-zero consumption can be expressed as:

$$\text{Prob}(y_i > 0) = \Phi(z_i'\alpha)\Phi(w_i'\gamma)\Phi(x_i'\beta/\sigma)$$

Because the dependent variable y_i is truncated at zero, the expected value of conditional consumption is simply $x_i'\beta$ plus the expected value of the truncated normal error term, which can be expressed as:

$$E(y_i|y_i > 0) = x_i'\beta + \sigma[\phi(x_i'\beta/\sigma)/\Phi(x_i'\beta/\sigma)]$$

Thus, the expected value of total consumption is directly related to the expected value of conditional consumption via the probability of non-zero consumption. The expected value of total consumption can be expressed as:

$$E(y_i) = \text{Prob}(y_i > 0)E(y_i|y_i > 0) = \Phi(z_i'\alpha)\Phi(w_i'\gamma)\Phi(x_i'\beta/\sigma)\{x_i'\beta + \sigma[\phi(x_i'\beta/\sigma)/\Phi(x_i'\beta/\sigma)]\}$$

The probability of non-zero consumption in the triple hurdle model considered here requires consideration of the probability from the participations and consumption equations simultaneously. Otherwise, the maximum likelihood estimates of the expected value of total consumption with respect to the explanatory variable would be biased.

In practical applications, the likelihood ratio (LR) test seems to be a popular selection in empirical expenditure analysis between the Tobit model and the triple hurdle model, which is based on the principle of maximum likelihood estimation. It can be used to test the hypotheses that the Tobit model performs as well as the triple hurdle model by comparing the values of the maximized likelihood functions under the restricted (H_0) and unrestricted (H_1) models. Systematically, the LR test is based on the statistic:

$$\lambda_{LR} = -2[L(H_1) - L(H_0)]$$

where (H_0) and (H_1) are the maximized values of the log-likelihood function under the restricted and unrestricted models, respectively. The null hypothesis (H_0) is rejected when $\lambda_{LR} > \chi^2_c$, where χ^2_c is a chosen critical value from the $\chi^2_{(j)}$ distribution, and j is the number of the restrictions under the null hypothesis (Judge, et al. 1988; Greene, 2008).

3. Data

The source of data for this study was extracted from the 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (U.S. Fish and Wildlife Service, 2014), which is developed by the U.S. Fish and Wildlife Service every five years. This type of survey started in 1955 and the 2011 survey is the 12th of its kind. It is one of the comprehensive and most reliable recreation surveys in the United States. Basically, the survey aims to collect information on the frequency of participation and expenditure on fishing activities in the United States as well as the number of anglers, hunters and wildlife watchers.

Data was collected for the survey by the U.S Census Bureau in two phases namely the screening phase and three detailed wave process. According to the 2011 National Survey of Fishing, Hunting and Wildlife-Associated Recreation, the U.S. Census Bureau interviewed a sample of 48,600 households in the United States to determine who in the household participated in fishing, hunting or watched wildlife in 2010 and those planning on engaging in those activities in 2011. Mostly, one adult household member provided information for all members.

The second phase of the survey consisted of three detailed interviews. Interviews were conducted with people who were at least 16 years who were chosen from the screening phase. According to the report from the 2011 National Survey of Fishing, Hunting and Wildlife-Associated Recreation, most of the respondents were interviewed by phone whiles in-person interviews was used for those who couldn't be reached on phones.

From this initial phase, 11,016 recreational anglers were selected for a detailed interview about their participation and expenditures associated with saltwater recreational fishing activities in the United States in 2011, based on the question (1) "Did you do any recreational fishing, including shell fishing, in the United States, from January 1, 2011 to December 31, 2011?" (the first stage of participation), (2) followed up "Respondent fished in saltwater in the United States in 2011?" (the second stage of participation) and (3) then "When you were fishing in the U.S. chiefly in saltwater during 2011, how much was spend for your share of (…)?" (consumption).

Trip-related expenditures on saltwater recreational fishing activities include: (1) food, drink, and refreshments; (2) lodging of motels, cabins, lodges, campgrounds, etc.; (3) public transportation, including airplanes, trains, buses, and car rentals; (4) the round trip cost for transportation by private vehicle; (5) guide fees, pack trip or package fees; (6) public land use or access fees; (7) private land use or access fees (not including leases); (8) equipment rental as boats, camping equipment, etc.; (9) boat fuel; (10) other boat costs (such as launching, mooring, storing, maintenance, pump out fees, insurance); (11) heating and cooking fuel; and (12) bait (live, cut, prepared) and ice.

4. Empirical Results

The choice of explanatory variables (Table 1) selected for U.S. saltwater recreational fishing trip-related expenditure equation estimated in this study can be expressed as:

Trip-Related Expenditures = f(Age, Male, Household Income, Graduate, White, Minority, Urban, License, Boat, Salmon, Striped Bass, Bluefish, Flatfish, Redfish, Seatrout, Mackerel, Marlin, Tuna, Mahi-Mahi, Shellfish)

Table 1. Parameter Description of U.S. Saltwater Recreational Fishing Expenditures

Parameter	Description
Expenditures	Saltwater recreational fishing trip-related expenditures
AGE	Respondent's age (in year; 16 years old and older)
MALE	Respondent's gender; 1 if male; 0 otherwise
HOUINC	1 if respondent's household income greater than $50,000; 0 otherwise
GRADUATE	Respondent's education level; 1 if graduate or professional degree; 0 otherwise
WHITE	Respondent's ethnicity; 1 if white; 0 otherwise.
MINOR	Respondent's ethnicity; 1 if minority; 0 otherwise
URBAN	1 if respondent lived in the urban settings; 0 otherwise
LICENSE	1 if respondent bought a fishing license; 0 otherwise.
BOAT	1 if respondent fished on the boat; 0 otherwise.
SALMON	1 if Salmon was one type of targeted fish; 0 otherwise
SBASS	1 if Striped Bass was one type of targeted fish; 0 otherwise
BLUEFISH	1 if Bluefish was one type of targeted fish; 0 otherwise
FLATFISH	1 if Flounder, Flatfish, or Halibut was one type of targeted fish; 0 otherwise
REDFISH	1 if Red Drum (Redfish) was one type of targeted fish; 0 otherwise
SEATROUT	1 if Sea Trout (Weakfish) was one type of targeted fish; 0 otherwise
MACKEREL	1 if Mackerel was one type of targeted fish; 0 otherwise
MARLIN	1 if Marlin was one type of targeted fish; 0 otherwise
TUNA	1 if Tuna was one type of targeted fish; 0 otherwise
MAHI-MAHI	1 if Dolphin (Mahi-Mahi) was one type of targeted fish; 0 otherwise
SHELLFISH	1 if Shellfish was one type of targeted fish; 0 otherwise

Descriptive statistics for the explanatory variables selected in this analysis are presented in Table 2. In 2011, average trip-related expenditures were $136.96 for the total sample (n = 11,106), but average trip-related expenditures were $957.94 for the sample with positive expenditures (n = 1,575) in the United States. About 85 percent of respondents reported zero expenditures in this study. In order to test which variables are collinear with other variables, a collinearity diagnostic test based on condition indexes was performed. In this analysis, the value of the largest condition index, from the principal component analysis, was 22.23. It implied that multicollinearity was not a concern in the estimated model (Belsley, et al. 1980).

Table 2. Descriptive Statistics of U.S. Saltwater Recreational Fishing Expenditures

Parameter	Recreational Fishing Samples (n = 11,016)		Saltwater Fishing Samples (n = 6,052)		Positive Expenditure Samples (n = 1,575)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Expenditures	136.96	796.41	249.30	1061.40	957.94	1910.94
AGE	48.27	16.40	46.60	16.08	48.33	15.25
MALE	0.68		0.74		0.78	
HOUINC	0.55		0.60		0.64	
GRADUATE	0.13		0.12		0.17	
WHITE	0.91		0.91		0.86	
MINOR	0.13		0.13		0.18	
URBAN	0.53		0.52		0.61	
LICENSE	0.37		0.68		0.61	
BOAT	0.10		0.19		0.67	
SALMON	0.01		0.02		0.08	
SBASS	0.04		0.08		0.28	
BLUEFISH	0.02		0.04		0.14	
FLATFISH	0.04		0.06		0.23	
REDFISH	0.02		0.03		0.11	
SEATROUT	0.01		0.03		0.09	
MACKEREL	0.01		0.02		0.06	
MARLIN	0.01		0.01		0.02	
TUNA	0.01		0.02		0.06	
MAHI-MAHI	0.01		0.02		0.05	
SHELLFISH	0.01		0.03		0.09	

Based on the LR test results, $\lambda_{LR} = -2[L(H_1) - L(H_0)] = [(6578.509+1694.991+27983.342) – 30308.87] = 5947.972 > \chi^2_{20} = 36.1909$, the hypothesis that the Tobit model performs as well as the triple hurdle model in modeling saltwater recreational fishing trip-related expenditure analysis was strongly rejected at the 0.01 significance level. Thus, participation and consumption decisions in the saltwater recreational fishing trip-related expenditure analysis were not based on the same decision-making structure, and the triple hurdle model was clearly the preferred specification. As a result, drawing inferences about the effects of the explanatory variables selected on participation and consumption decisions based on the Tobit model for the saltwater recreational fishing trip-related expenditure analysis would lead to erroneous conclusions.

In summary, empirical results of the Tobit model (Table 3) indicated that well-educated mature male, including white and minority, living in the urban area with higher income, who has a fishing license, would spend more to go fishing on the boat for Salmon, Striped Bass, Bluefish, Flatfish, Redfish, Seatrout, Mackerel, Marlin, Tuna, Dolphin (Mahi-Mahi), and Shellfish in U.S. saltwater areas.

Table 3. Tobit Model for U.S. Saltwater Recreational Fishing Expenditures

Parameter	Recreational Fishing (n = 11,016)		
	Estimates	S.E.	p-value
INTERCEPT	-3994.127	248.269	< 0.0001
AGE	5.173	2.278	0.021
MALE	294.051	81.317	< 0.0001
HOUINC	225.037	72.790	0.002
GRADUATE	186.485	97.155	0.055
WHITE	-552.785	179.593	0.002
MINOR	537.235	161.789	0.001
URBAN	256.572	71.746	< 0.0001
LICENSE	553.538	73.115	< 0.0001

BOAT	2950.270	97.340	< 0.0001
SALMON	879.721	173.853	< 0.0001
SBASS	1195.373	111.522	< 0.0001
BLUEFISH	822.939	142.779	< 0.0001
FLATFISH	846.347	113.234	< 0.0001
REDFISH	1135.277	166.055	< 0.0001
SEATROUT	381.860	177.884	0.032
MACKEREL	515.681	196.857	0.009
MARLIN	772.863	339.826	0.023
TUNA	722.428	220.085	0.001
MAHI-MAHI	1209.006	240.548	< 0.0001
SHELLFISH	2007.681	161.421	< 0.0001
σ	1880.031	34.019	
-2 Log-Likelihood	30308.87		

The triple hurdle model for U.S. saltwater recreational fishing trip-related expenditures was estimated by maximizing the logarithm of the likelihood functions. Empirical results of the triple hurdle model are presented in Table 4. All observations can be used in the estimation for two stages of participation decisions, but only positive observations which pass through participation and consumption decisions simultaneously can be used in the estimation based on a censored and truncated sample.

The triple hurdle estimates indicated that the explanatory variables might have different impacts on two stages of participation and consumption decisions in sign or magnitude. There is no strong economic theoretical basis to suggest what explanatory variables should be in each hurdle or for predicting the signs of estimated coefficients in each hurdle.
The variables *AGE*, *MALE*, *HOUINC*, *GRADUATE*, *URBAN*, and *LICENSE*, all had different signs in the two stages of participation and consumption decisions. The variables *AGE*, *MALE*, and *HOUINC* were significant in the recreational fishing participation and saltwater fishing consumption decisions, but not significant in the saltwater fishing participation decision. The variables *GRADUATE* and *WHITE* were significant in the both two stages of participation decisions but not significant in the saltwater recreational fishing consumption decision. Even having different signs, the variable *LICENSE* was significant for both saltwater fishing participation and consumption decisions, not significant in the recreational fishing participation decision. The variable *URBAN* was significant for both saltwater fishing participation and consumption decisions with a positive sign, but also positively significant in the recreational fishing participation decision as well.

Table 4. Triple Hurdle Model for U.S. Saltwater Recreational Fishing Expenditures

Parameter	Recreational Fishing (n = 11,016)		Saltwater Fishing (n = 6,052)		Positive Expenditures (n = 1,575)	
	Estimates	S.E.	Estimates	S.E.	Estimates	S.E.
INTERCEPT	-0.495**	0.209	-2.283***	0.390	-689.485**	330.681
AGE	-0.007***	0.002	-0.002	0.004	6.616**	3.056
MALE	0.311***	0.064	-0.016	0.150	281.707**	112.317
HOUINC	-0.288***	0.063	0.100	0.139	329.554***	97.229
GRADUATE	-0.161*	0.096	0.521***	0.197	-41.733	123.685
WHITE	-0.354**	0.171	-0.580**	0.269	-100.939	241.395
MINOR	0.088	0.149	1.105***	0.253	56.290	218.509
URBAN	-0.344***	0.062	0.619***	0.144	167.085*	94.893
LICENSE	22.058	581.362	-1.294***	0.139	303.818***	97.586
BOAT	19.371	805.542	22.213	852.089	485.004***	105.158
SALMON	17.179	2209.242	21.489	2440.822	162.567	172.398
SBASS	18.121	1173.797	21.857	1280.418	249.760**	110.879
BLUEFISH	18.075	1593.119	20.496	1674.244	190.099	139.709
FLATFISH	18.563	1311.913	21.253	1379.549	234.584**	111.177
REDFISH	17.761	1807.098	21.133	1909.357	322.098**	163.044
SEATROUT	17.029	1952.625	20.928	2117.287	138.722	175.309
MACKEREL	17.655	2369.445	20.637	2554.493	138.166	191.286

MARLIN	-0.009	4042.853	0.400	4611.837	1269.091***	343.722
TUNA	16.762	2358.778	16.052	2366.980	543.221**	214.916
MAHI-MAHI	16.777	2496.663	17.800	2724.994	1122.022***	236.758
SHELLFISH	20.913	2308.085	22.991	2389.008	248.324	162.809
σ	---	---	---	---	1790.461	31.959
-2 Log-Likelihood	6578.509		1694.991		27983.342	

*** denotes statistical significance at the 1% level.
** denotes statistical significance at the 5% level.
* denotes statistical significance at the 10% level.

Previous studies on outdoor recreation expenditures have suggested that income level has a strong influence on outdoor recreation expenditures, as did other socio-economic characteristics including age, gender, ethnicity, and level of education (Arlinghaus, 2006; Dalrymple, et al. 2010; Brida & Scuderi, 2012). The age of respondents appeared to have a positive and significant impact on the saltwater recreational fishing expenditures, but negative effect on participation in recreational fishing significantly and saltwater fishing insignificantly. It revealed that the higher age the anglers had, the more expenditures they spent when they fished in the saltwater areas, implying that demand increases with the older anglers significantly. Results also showed that respondents who had graduate or professional degree did not have a significant effect on U.S. saltwater recreational fishing expenditures.

According to studies of traditional recreational fishing activities, men tended to dominate saltwater recreational fishing activities and spent more on such kinds of recreational fishing activities than women did. Thus, men were hypothesized to have a positive impact on saltwater recreational fishing expenditures due to different life styles and different time constraints (Arlinghaus, 2006; Dalrymple, et al. 2010; Brida & Scuderi 2012). Consistent with the previous studies, males spent more when they participated in saltwater recreational fishing activities.

Theoretically, one would expect saltwater recreational fishing expenditures to be positively correlated with income, holding price of saltwater recreational fishing constant. Thus, income was hypothesized to have a positive impact on saltwater recreational fishing expenditures (Arlinghaus, 2006; Dalrymple, et al. 2010; Brida & Scuderi, 2012). As expected, results indicated that household income greater than $50,000 had a positive and significant effect on U.S. saltwater recreational fishing expenditures, but insignificant in the participation decision. It also revealed that saltwater recreational fishing is a normal good for which demand increases with high household income.

In general, non-white individuals have been observed to have a much lower preference for participation in most types of wildlife-based recreation than did white individuals (Arlinghaus, 2006; Dalrymple, et al. 2010; Brida & Scuderi, 2012). The variable *WHITE* was negatively and significantly related to recreational fishing participation and saltwater fishing participation decisions, but not significant in the saltwater fishing consumption decision. The variable *MINOR* was significant in the saltwater fishing participation decision positively, but insignificant in the saltwater fishing consumption decision. It indicated that those who were white had a significantly negative impact, and that those who were minority had a significantly positive impact, on saltwater recreational fishing participation, implying that demand decreases with the white anglers, but increases with the minority anglers significantly.

The variable *URBAN* was positively and significantly related to saltwater recreational fishing for both participation and consumption decisions, but negatively significant in the recreational fishing participation decision. It revealed that those who reside in the urban settings had a positive and significant impact on saltwater recreational fishing participation and consumption, implying that demand increases significantly with the urban residents. The variable *LICENSE* was negatively and significantly related to saltwater recreational fishing participation decision, but significant in consumption decision positively. It revealed that those who purchased the fishing license had a positive and significant impact on saltwater recreational fishing consumption, implying that demand increases significantly with the anglers who purchased the fishing license.

The variables *BOAT* was positively significant in the saltwater fishing consumption decision, but insignificant in the both of two participation decisions. The variable *BOAT* had a significantly positive effect on saltwater recreational fishing expenditures, showing that the demand for saltwater recreational fishing activities increases with the satisfaction of fishing on the boat. The variables *SBASS*, *FLATFISH*, *REDFISH*, *MARLIN*, *TUNA*, and *MAHI-MAHI* were positively significant in the saltwater fishing consumption decision, but insignificant in the both of two participation decisions. As expected, the variables *SBASS*, *FLATFISH*, *REDFISH*, *MARLIN*, *TUNA*, and *MAHI-MAHI* all had a significant and positive impact on saltwater recreational fishing expenditures, indicating that demand increases significantly with the presence of fish categories, including Striped Bass, Flatfish, Redfish, Marlin, Tuna, and Mahi-Mahi, which is the primary purpose of saltwater recreational fishing activities.

Intuitively, saltwater recreational anglers purchasing fishing licenses were less likely to participate in, but tended to consume more for saltwater recreational fishing activities when they fished significantly. Insignificantly, older male anglers were less likely to participate in saltwater recreational fishing, but tended to consume more significantly related to saltwater recreational fishing activities. Similarly, anglers with high household income were more likely to participate in, and tended to consume more significantly related to saltwater recreational fishing activities. Empirically, this study also showed that anglers living in the urban area with a fishing license, would spend more to go fishing on the boat for Striped Bass, Flatfish, Redfish, Marlin, Tuna, and Mahi-Mahi in U.S. saltwater areas.

5. Discussion and Conclusion

This study provided an empirical analysis of individual participation and consumption behavior for saltwater recreational fishing using data extracted from the 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (U.S. Fish and Wildlife Service, 2014). The triple hurdle analysis of U.S. saltwater recreational fishing expenditures, in this case, is a necessary step in understanding relationship between individual participation and consumption behavior, anglers' socioeconomic characteristics, and the attributes of fish species.

Under the Tobit specification, zero expenditure implies zero consumption, hence represents a true corner solution (Gould, 1992). On statistical grounds, the Tobit model is very restrictive in its parameterization which implies that the probability of consumption and the level of consumption are determined by the same sets of variables and parameters. Hence, drawing inferences from the Tobit model would lead to erroneous conclusions (Bockstael, et al. 1990).

To compare the Tobit model and the triple hurdle model, all observations can be used in the estimation, but only positive observations which pass through participation and consumption decisions simultaneously can be used in the estimation for the triple hurdle model based on a censored and truncated sample. The Tobit model is a one-step model, while the triple hurdle model is a three-step process.

The results of this study are multi-dimensional. First, purchasing a fishing license and fishing on the boat are important driving forces for saltwater recreational fishing expenditures. Anglers are more likely to participate in and consume for saltwater recreational fishing activities in order to satisfy their fishing desires. Second, a mature male living in urban settings with higher household income does appear to be a distinguishing factor in saltwater recreational fishing activities. Thus, saltwater recreational fisheries managers have an opportunity to target this specific user group in their management plans, expanding a shrinking constituency. Third, the availability of a diversity of species plays an important role in saltwater recreational fishing activities. Saltwater recreational fisheries managers should educate the public about the availability or location of diverse habitats to generate continued interest and increased participation in saltwater recreational fishing activities.

Saltwater recreational fishing activities has grown in popularity in the United States. The purpose of trip taken for saltwater recreational fishing would be expected to have a positive impact on saltwater recreational fishing expenditures. Many studies have reported that the opportunity for saltwater recreational fishing expenditures should consider species and numbers of fisheries that participants want to participate in, what species actually are caught, and how many visual encounters with fisheries are made, and the quality of the experiences (Arlinghaus, 2006; Cisneros-Montemayor & Sumaila, 2010; Brida & Scuderi, 2012).Thus, fisheries habitats and populations can be viewed as a critical factor. With an increase in ecosystem and biodiversity of fisheries, the more saltwater recreational anglers would participate and consume (Cisneros-Montemayor & Sumaila, 2010).

Most importantly, healthy fisheries habitat are not only essential for a healthy fisheries, but are also an essential part of the fishing experience. Saltwater recreational fishing adds to mixed activity vacation venues attracting anglers and families with multiple interests. In particular, saltwater recreational fishing businesses succeed on the quality basis of fishable resources, ancillary experiences of nature, comfort, and well-directed marketing strategies that match specific venues to the needs of various types of anglers (Cisneros-Montemayor & Sumaila, 2010). In order to continue high quality saltwater recreational fishing experiences for anglers, a healthy environment for fish must be properly provided through well-defined planning and management strategies and decision-making processes.

The empirical results in this study provided insight into the determinants of saltwater recreational fishing expenditures, which can be interpreted in terms of three stochastic processes, recreational fishing participation, saltwater fishing participation and consumption, allowing for richer interpretation of saltwater recreational angler behavior. Also, the results of this study provide insight into the determinants of saltwater recreational fishing expenditures, which can be used in analyzing the social and economic impacts of saltwater recreational fisheries planning and management.

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