

Trip-related Expenditure Analysis of U.S. Saltwater Recreational Fishing:

A Tobit Approach

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Abstract: This study utilized cross-sectional data extracted from the 2011 National Survey of Fishing, Hunting, and Wildlife Associated Recreation to analyze individual trip-related expenditures on saltwater recreational fishing in the United States. Tobit model for U.S. saltwater recreational fishing expenditure analysis was evaluated. Empirical results of this study indicated that income, age, gender, ethnicity, urban residence, license, fishing on the boat, and types of fish such as salmon, striped bass, bluefish, flatfish, redfish, mackerel, marlin, tuna, dolphin, ULUA, and shellfish had 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.

Key words: saltwater; recreational fishing; trip-related; expenditures; Tobit **JEL codes**: C24, Q22

1. Introduction

Wildlife-related recreation such as fishing, hunting, and wildlife watching plays an important role in outdoor recreation in the United States. In 2011, 90 million U.S. residents 16 years old and older participated in wildlife-related recreation activities. More than 33 million American fished. Among anglers, freshwater anglers numbered 27.5 million, while 8.9 million anglers participated in saltwater fishing (U.S. Fish and Wildlife Service 2014).

Anglers spent a total of \$41.8 billion, and sportspersons (including anglers and hunters) spent a total \$14.3 billion on items used for both hunting and fishing in 2011. Of the total fishing expenditures spent by anglers in 2011, anglers spent \$21.8 billion on trip-related costs, \$15.5 billion on fishing equipment, and \$4.5 billion on other fishing expenditures including land leasing and ownership, magazines and books, membership due and contributions, licenses, stamps, tags, and permits (U.S. Fish and Wildlife Service 2014).

Among anglers, freshwater anglers spent more than \$25.7 billion, while saltwater anglers spent \$10.3 billion on their fishing trips and equipment in 2011. Of saltwater angler expenditures in 2011, they spent a total of \$7.3 billion on trip-related costs — \$2.4 billion on food and lodging, \$1.5 billion on transportation costs, and \$3.4 billion on other trip costs such as equipment rental, bait, and guide fees; and a total of \$2.9 billion on fishing

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equipment — \$1.4 billion on equipment (rods, reels, etc.), \$217 million on auxiliary equipment (camping equipment, binoculars, etc.), and 1.3 billion on special equipment such as boats, vans, and so forth (U.S. Fish and Wildlife Service 2014).

According to 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, and increased to 33.1 million from 2006 to 2011. Total fishing expenditures in 2011 dollars increased from 45.3 billion in 2001 to 47.0 billion in 2006, and decreased to 41.8 billion from 2006 to 2011. (U.S. Fish and Wildlife Service 2002, 2007, 2014).

The total number of saltwater anglers decreased from 9.5 million in 2001 to 7.7 million in 2006, but increased to 8.9 million from 2006 to 2011. Total expenditures on saltwater 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 socio-economic characteristics associated with individual behavior of saltwater recreational fishing trip-related expenditures in the United States, based on the utility maximization framework in the Tobit model. Expenditure analysis can provide information about how different socio-economic groups allocate their resources toward saltwater recreational fishing activities. It may also contribute to a better understanding of current and future individual behavior of U.S. saltwater recreational fishing participation and consumption.

2. Conceptual Model

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

A conceptual model of recreational fishing activities is developed by integrating three components: anglers, fish resources, and fisheries habitats. This conceptual model demonstrates the context of the human-fisheries interaction and provides a framework that identifies utility maximization as the ultimate objective for the participants in recreational fishing activities in terms of their consumption decisions. Recreational fishing can be viewed as an intermediate interface between the anglers, fishes and their habitats. Anglers can be treated as the demand sector, and fishes and their habitats can be treated as the supply sector in the conceptual model. Without adequate fishes and their habitats, there would be far fewer or no participants in recreational fishing activities.

Previous studies on outdoor recreation expenditures suggest that income level has a strong influence on outdoor recreation expenditures, as do other socio-economic characteristics including age, gender, ethnicity, level of education and marital status (Bergstrom & Cordell, 1991; Cordell & Bergstrom, 1991; Davis & Mangan, 1992; Walsh et al., 1992; Dardis et al., 1994; Arlinghaus, 2006; Dalrymple et al., 2010; Brida & Scuderi, 2012). The literature from participation in outdoor recreation or related fields is also of interest. Most of these studies have been designed to understand outdoor recreation participation behavior, including characteristics of the individual, characteristics of the resources, and willingness to pay for outdoor recreation experiences (Walsh et al., 1992; Arlinghaus, 2006; Dalrymple et al., 2010; Brida & Scuderi, 2012).

Theoretically, one would expect saltwater recreational fishing expenditures to be positively correlated with income, holding price of saltwater recreational fishing constant. Thus, income is hypothesized to have a positive impact on saltwater recreational fishing expenditures (Blaine & Mohammad, 1991; Walsh et al., 1992; Dardis et al., 1994; Arlinghaus, 2006; Dalrymple et al., 2010; Brida & Scuderi, 2012).

According to studies of traditional recreational fishing activities, men tend to dominate saltwater recreational fishing activities and spend more on such kinds of recreational fishing activities than women do. Thus, male is hypothesized to have a positive impact on saltwater recreational fishing expenditures due to different life styles and different time constraints (Dardis et al., 1994; Arlinghaus, 2006; Dalrymple et al., 2010; Brida & Scuderi, 2012).

In most outdoor recreational activities, the level of education reportedly has a positive effect on the rates of participation (Arlinghaus, 2006; Dalrymple et al., 2010; Brida & Scuderi, 2012). Hence, level of education in graduate school is hypothesized to have a positive impact on saltwater recreational fishing expenditures. In general, non-white individuals have been observed to have a much lower preference for participation in most types of wildlife-based recreation than do white individuals (Walsh et al., 1992; Arlinghaus, 2006; Dalrymple et al., 2010; Brida & Scuderi, 2012). Hence, ethnicity, defined in terms of minority individuals, would be expected to have a negative impact on saltwater recreational fishing expenditures.

Saltwater recreational fishing activities have grown in popularity in the United States. Thus, the purpose of trip taken for saltwater recreational fishing would be expected to have a positive impact on saltwater recreational fishing expenditures. Thus, fisheries habitats and populations can be viewed a critical factor, as with an increase in ecosystem and biodiversity of fisheries, the more saltwater recreational anglers would participate in and consume (Cisneros-Montemayor & Sumaila, 2010).

Quality of fisheries habitat and quantity of fisheries may also appear to play a key role in determining saltwater recreational fishing expenditures. Many studies report that the opportunity for saltwater recreational fishing expenditures should consider species and numbers of fisheries that participants want to participate, what species actually are caught, and how many visual encounters with fisheries are made, and the quality of the experiences (Manfredo & Larson, 1993; Arlinghaus, 2006; Cisneros-Montemayor & Sumaila, 2010; Brida & Scuderi, 2012).

Based on the consumer demand theory, the demand function for saltwater recreational fishing can be expressed in terms of individual trip-related expenditures as follows:

$$EXP = f (INC, SE, WH)$$
(1)

(2)

Where *EXP* is individual trip-related expenditures on saltwater recreational fishing activities, *INC* is individual income, *SE* is individual's socio-economic characteristics, and *WH* is fish resources and their habitats attributes. The choice of explanatory variables selected for empirical analysis is based on the conceptual model as described above. U.S. saltwater recreational fishing trip-related expenditure equation estimated in this study is expressed as:

Where

Trip-related Expenditures = Trip-related expenditures on recreational saltwater fishing activities. High Income (+) = 1 if respondent's household income greater than \$50,000; 0 otherwise. Male (+) = Respondent's gender; 1 if male; 0 otherwise. Age (+/-) = Respondent's age (in year; 16 years old and older). Graduate (+) = Respondent's education level; 1 if graduate or professional degree; 0 otherwise. White (+/-) = Respondent's ethnicity; 1 if white; 0 otherwise. Black (+/-) = Respondent's ethnicity; 1 if black; 0 otherwise Urban (+) = 1 if respondent lived in the urban settings: 0 otherwise. Exemption (+/-) = 1 if respondent exempted from buying a fishing license; 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. Striped Bass (+) = 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. Dolphin (+) = 1 if Dolphin (Mahi-Mahi) was one type of targeted fish; 0 otherwise. ULUA (+) = 1 if ULUA was one type of targeted fish; 0 otherwise. Shellfish (+) = 1 if Shellfish was one type of targeted fish; 0 otherwise.

3. Empirical Model

According to consumer demand 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:

Maximize
$$U = U(Q_i)$$

Subject to $INC = P_i \cdot Q_i$, $i = 1, ..., n$ (3)

Where U(.) represents the utility function which is assumed to be continuous, increasing, and quasi-concave, Q_i is a vector of market goods the individual purchased for saltwater recreational fishing activities in the marketplace, P_i is a vector of corresponding market prices for market goods, and *INC* is the individual's income. The individual's ordinary demand function can be expressed as:

$$Q_i = V(P_i, INC) \qquad i = 1, \dots, n \tag{4}$$

Generally, 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 an Engel curve. The Engel curve can be used to estimate the relationship between expenditures and income, holding price constant. Hence, given the individual's income and prices of goods, the quantities demanded by the individual can be determined from the individual's demand functions (Deaton & Muellbauer, 1980; Henderson & Quandt, 1980; Silberberg, 1990; Varian, 1992). Prices are typically assumed constant with the cross-sectional data that are usually used to estimate the Engel functions.

In order to develop the relationship between trip-related expenditures on saltwater recreational fishing activities and anglers' income and their socio-economic characteristics, recognition of sample and data related issues (censored, truncated samples) common to expenditure models can improve measurement reliability. In practice, the sample containing observations with reported zero expenditure presents a unique problem with cross-sectional survey data.

Typically, researchers have often used the Tobit model to estimate demand relationships with limited dependent variables. The Tobit model, was first represented by Tobin (1958), took account of the fact that the expenditure, the dependent variable of the regression model, cannot be negative when analyzed 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 and hence represents a true corner solution (Gould, 1992). Using standard econometric techniques, the parameter estimates are biased and inconsistent (Maddala, 1983). For example, regression analysis based on nonzero observations of the dependent variable can lead to biased parameter estimates.

The Tobit model, a commonly used econometric technique, can be used for estimating the consumption pattern for saltwater recreational fishing activities with a unique problem of zero expenditures. Statistically, the Tobit model can be defined as followings: for i = 1, ..., n,

$$y_i = \begin{cases} y_i^*, & \text{if } y_i^* > 0, \\ 0, & \text{otherwise,} \end{cases}$$
(5)

Where $y_i^* = \mathbf{x}_i' \mathbf{\beta} + \varepsilon_i$, y_i is an individual observed expenditure, y_i^* is the corresponding desired expenditures for some commodities, β is a vector of unknown parameters, x_i is a vector of individual characteristics that influence expenditures, and ε_i is the random and normally distributed error term with mean zero and standard deviation σ^2 .

Let Y_i be the random variable representing the individual expenditures with probability density function f(.). For the observations y_i 's that are zero,

$$f(y_i) = P(Y_i = 0) = 1 - P(Y_i > 0) = 1 - \Phi(\mathbf{x}_i \boldsymbol{\beta} / \sigma)$$
 (6)

For the observations y_i 's that are greater than zero,

$$f(y_i) = P(Y_i > 0) \cdot f(y_i \mid Y_i > 0) = (1/\sigma) \cdot \phi[(y_i - \mathbf{x}_i'\boldsymbol{\beta})/\sigma]$$
(7)

Where $\phi(.)$ and $\Phi(.)$ are the standard normal density and distribution functions, respectively. Using 0 to denote zero observations, that is, $i \in \{y_i = 0\}$, and + denote positive observations, that is, $i \in \{y_i > 0\}$, the likelihood function for the Tobit model can be specified as follows:

$$L = \Pi_0 \left[1 - \Phi(\mathbf{x}_i \boldsymbol{\beta} / \sigma) \right] \cdot \Pi_+ \left[\phi[(y_i - \mathbf{x}_i \boldsymbol{\beta}) / \sigma] / \sigma$$
(8)

The maximum likelihood estimation technique can be used to estimate the unknown parameters (Maddala, 1983; Amemiya, 1984; Judge et al., 1988; Greene, 1997).

4. Data

Data used in this study were 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 and collected by the U.S. Census Bureau every five years.

This national survey was composed of two phases, the first screening phase and the second detailed phase. In the screening phase, the U.S. Census Bureau interviewed 48,600 households in the United States to identify respondents who had participated in wildlife-related activities in the year of 2011 to gather information on fishing, hunting, and wildlife watching participation, expenditures, and socioeconomic characteristics of respondents. From this initial phase, 6,052 saltwater 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.

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.

5. Empirical Results

Descriptive statistics for all variables used in this analysis are presented in Table 1. In order to test which variables are collinear with other variables, collinearity diagnostic test based on condition indexes was performed. The value of the largest condition index in this analysis resulting from the principal component analysis performed was 17.85. Thus, suggesting that the explanatory variables selected to explain U.S. saltwater recreational fishing expenditures were not correlated in this case (Belsley et al., 1980). The Tobit model for the U.S. saltwater recreational fishing trip-related expenditure analysis was estimated by maximizing the logarithm of the likelihood functions.

In 2011, average trip-related expenditures were \$249.30 for the total sample, but average trip-related expenditures were \$957.94 for the sample with positive expenditures in the United States. About 74 percent of respondents reported zero expenditure in this study. Empirical results of the Tobit model for U.S. saltwater recreational fishing expenditure analysis are presented in Table 2.

Results indicated that high household income has a positive and significant effect on U.S. saltwater recreational fishing expenditures, as expected. It also revealed that saltwater recreational fishing is a normal good for which demand increase with high household income.

Consistent with the findings of previous studies, males spent more when they participated in saltwater recreational fishing activities. The age of respondent appeared to have a positive and significant impact on the saltwater recreational fishing expenditures. Results pointed out that respondents who had graduate or professional degree didn't have significant effect on U.S. saltwater recreational fishing expenditures. The negative signs on the variable *White* and *Black* suggested that those anglers who participated would spend less in saltwater recreational fishing activities.

The positive sign on the variable *Urban* suggested that those who resided in urban settings have a higher demand for saltwater recreational fishing. But the negative sign on the variable *License* suggests that those who comply with licensing requirements less likely to consume saltwater recreational fishing activities than those who do not. The variable *Boat* had a positive and significant effect on saltwater recreational fishing expenditures. It showed that the demand for saltwater recreational fishing activities increased with the satisfaction to go fishing on boat.

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Variables	Total	Sample (N = 6,052)	Sample	of Expenditure > 0 (N = 1,575)	Sample of	f Expenditure = $0 (N = 4,477)$
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Expenditure	249.30	1061.40	957.94	1910.94		
Age	46.60	16.08	48.33	15.25	45.98	16.33
High Income	0.60		0.64		0.53	
Male	0.74		0.78		0.73	
Graduate	0.12		0.17		0.10	
White	0.91		0.86		0.92	
Black	0.04		0.05		0.03	
Urban	0.52		0.61		0.49	
Exemption	0.19		0.20		0.19	
License	0.68		0.61		0.70	
Boat	0.19		0.67		0.02	
Salmon	0.02		0.08		0.00	
Striped Bass	0.08		0.28		0.01	
Bluefish	0.04		0.14		0.00	
Flatfish	0.06		0.23		0.01	
Redfish	0.03		0.11		0.00	
Seatrout	0.03		0.09		0.00	
Mackerel	0.02		0.06		0.00	
Marlin	0.01		0.02		0.00	
Tuna	0.02		0.06		0.00	
Dolphin	0.02		0.05		0.00	
ULUA	0.01		0.04		0.00	
Shellfish	0.03		0.09		0.00	

Table 1	Descri	ntive Statist	ics of US	Saltwater	• Recreationa	l Fiching	Trin_I	Related Evi	venditure	Analy	cie
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 Table 2
 Empirical Results of U.S. Saltwater Recreational Fishing Trip-related Expenditure Analysis

Variable	Parameter Estimate	Standard Error	
Constant	-2651.0138***	204.5868	
High Income	271.1144***	78.2829	
Male	238.6717***	89.5543	
Age	7.6467***	2.4510	
Graduate	170.1040	106.2300	
White	-1034.0122***	140.3529	
Black	-380.3893*	215.9288	
Urban	303.1713***	76.4287	
Exemption	-121.1688	102.2488	
License	-148.9354*	85.2445	
Boat	2575.2840***	95.7935	
Salmon	914.1708***	174.1149	
Striped Bass	1096.9848***	111.5717	
Bluefish	708.8241***	142.9842	
Flatfish	777.9182***	113.2939	
Redfish	1093.8197***	166.2676	
Seatrout	366.3038**	178.2382	
Mackerel	454.8394**	197.2250	
Marlin	710.1523**	340.4220	
Tuna	607.7170***	220.5043	
Dolphin	976.2347***	242.6568	
ULUA	909.8186***	266.6055	
Shellfish	1637.9040***	161.1297	

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

In this study, we found that targeting one or more of several specific species have positive and significant impacts on U.S. saltwater recreational fishing expenditure, indicating that demand increases significantly with the presence of fish categories including Salmon, Striped Bass, Bluefish, Flatfish, Redfish, Seatrout, Mackerel, Marlin, Tuna, Dolphin (Mahi-Mahi), ULUA, and Shellfish.

In summary, empirical results of this study indicated that mature male 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), ULUA, and Shellfish in U.S. saltwater areas.

6. Conclusions

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 consumption, and attracts anglers 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 income does appear to be a distinguishing factor in saltwater recreational fishing activities. Thus, recreational fishery managers have an opportunity to target this 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. Resource managers should educate the public about the availability or location of diverse habitats to generate continued interest and increased participation in saltwater recreational fishing.

More importantly, fisheries habitat health needs to be at the core of any effort to develop recreational fisheries. Without a healthy fishery based on healthy fisheries habitats the effort will fail. Healthy fisheries habitat is not only essential for a healthy fishery, but is also an essential part of the fishing experience. Saltwater recreational fishing adds to mixed activity vacation venues attracting anglers and families with multiple interests. Particularly, saltwater recreational fishing business succeed on the basis of the quality of the fishable resource, the quality of the ancillary experience of nature, comfort and well-directed marketing that matches the venue to the needs of various types of anglers (Cisneros-Montemayor & Sumaila, 2010).

The findings of this study point out that a healthy natural environment supports a diverse array of processes that provide both goods and services to human beings. Also, the empirical 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 fishery planning and management.

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