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ABSTRACT

THE DEMAND FOR RECREATIONAL BOAT MOORAGE

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This paper presents the results of an econometric investigation of the demand for recreational boat moorage. The demand model assumes that individuals minimize the cost of producing the services derived from recreational boating. This minimization presents the boat owner with a cost function that is incorporated into the budget constraint. The resultant demand functions show that the demand for moorage depends on variables which affect the cost of boating (e.g., the price of moorage, the cost of travel between the owner's residence and the moorage site), variables which affect owner preferences for boating (e.g., fishing activity), and variables which affect cost and preferences (e.g., location of residence).

The binary-choice logit model is the specific model used in the study. This model measures the effect of each independent variable on the log of the odds of a boat owner expresssing a desire to moor and boat primarily near one site over wanting to moor at some other site, or trailer and boat on the same and/or other waters. The maximum likelihood method is used to estimate the coefficients of the model, and several measures of success are calculated to evaluate each set of parameter estimates. The econometric analysis is based on data obtained from a mail questionaire survey of western Oregon pleasure boat owners. All coefficients of the estimated model have their expected signs and are statistically significant at the ten percent or better level.

The most important findings of the study are (a) the demand for moorage is price-elastic, (b) the demands for moorage at specific locations are more elastic than the aggregate demand along the entire Oregon coast, and (c) the absolute responsiveness of demand to unit changes in moorage rates is about the same at alternative locations. The study also found that as net travel cost increases, the odds of boaters wanting moorage also increase. The implication is that increases in fuel prices and/or travel time (either from traffic congestion or reduced speed limits) can be expected to increase the demand for moorage.

EXHIBIT A

Dear Boater,

Concern has been expressed lately about what Oregon boaters think is right or wrong about boating in the state and how boating can be improved. In order to provide information that is important to all Oregon boaters, we are asking you to take a few minutes to complete the questionnaire in this booklet.

There are not enough funds to contact all boaters so only a few have been selected. Your name was chosen by scientific methods and your response is a vital part of our cross-section. There is no way we can substitute for the answers only you, yourself, can give us.

We would like to receive your questionnaire as soon as possible. Just drop it in the mail after you have answered the questions. No stamp is necessary.

A final note. You will see that your questionnaire is numbered. This serves as a way by which reminders may be sent, if necessary, without further imposing on those who have completed and returned their questionnaire. I assure you that the information we gather will be used only for statistical summaries of all Oregon boaters and in no way will your responses be linked to your name. The Survey Research Center at the University will process the questionnaires and help in tabulating the results.

Thank you for your courtesy and help.

Very truly yours,

R. Charles Vars

R. Charles Vars
Professor of Economics

13. How many people usually went with you on your boating trips this year?
.... Number of persons per trip

14. How many hours did you spend on the water for a typical boating trip this year?
.... Hours

15. What is the shortest length of time you would consider worth your while to spend on the water for a one-day boating trip?
.... Hours

15a. And, how many miles would you travel one way by land for this one-day trip?
.... Miles

16. Please list your expenses associated with owning and using your boat during the past year—making it ready last spring, using it during the boating season, and hauling and storing for the fall and winter. Include expenses you had during the past year even if they do not occur every year.

	ITEM	*AMOUNT*
a.	Fitting out, paints, replacements	$........
b.	New things for the boat	$........
c.	Dockage or mooring costs	$........
d.	Repairs and paid maintenance	$........
e.	Fuel and oil	$........
f.	Other supplies (ice, cleaners, etc.)	$........
g.	Miscellaneous	$........
h.	Winter storage	$........
i.	Decommissioning and winterizing	$........
j.	Insurance	$........
k.	Other (Describe ....)	$........

17. About how much do you think you could get for your boat and gear if you were to sell them within a couple of months of advertising them this winter?
$........

18. Please indicate the location and distance from home for moorage and storage sites for your boat that would be ideal for you.

	IDEAL LOCATION	Distance from home of ideal location (Miles)
Moorage	....	....
Storage	....	....

18a. What do you especially like about the ideal moorage location you listed above?

18b. And, what do you especially like about the ideal storage location you listed above?

19. What is the most you would be willing to pay to moor or store your boat at the ideal locations you listed above in question 18?

Maximum moorage rate for ideal site $........ per boat-foot per month

Maximum storage rate for ideal site $........ per month

20. How many years, altogether, have you owned a boat?
.... Years

21. Please indicate whether or not you have ever taken a boating course from any of the organizations listed below. (Check all that apply.)

	Organization	*Yes*	*No*
a.	The Power Squadron	....	....
b.	The Coast Guard Auxiliary	....	....
c.	The Red Cross	....	....
d.	Other (Specify)	....	....

THE DEMAND FOR RECREATIONAL BOAT MOORAGE

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This paper provides a summary of a recreational boat moorage demand study undertaken during 1977-78 for the Oregon State University Sea Grant College Program. This research effort produced econometric estimates of the demand for coastal moorage by western Oregon recreational boat owners, the principal component of the total demand for recreational boat moorage along the Oregon coast.

The paper is organized as follows. The first section presents the problem and objectives of the study. The second section discusses the demand model developed for the study, while the third and fourth sections describe the estimation method and data employed. The final section reports the major results of the study.

Problem

During the past two decades old and new coastal boat basin managements in Oregon have made substantial capital investments to provide recreational boat moorage facilities. Most managements contemplate even larger investments to satisfy the increasing demands for their facilities in the next decade. In fact, they assume moorage demands will be sufficiently large, rapidly growing and price-inelastic to justify 50 to 100 per cent increases in capacities and moorage rates. Although such expectations may be correct, there have been no thorough empirical studies of the demands for boat moorage along the Oregon coast. Previous studies have been descriptive, focused on recent trends and reported informed judgments of probable developments. They have not provided the conceptual framework, data base or estimated demand equations needed to predict the impact of additional facilities at alternative locations and higher moorage rates.

This study has investigated the determinants of the demand by western Oregonians for recreational boat moorage along the Oregon coast. The sensitivity of these demands to changes in moorage rates, travel costs, and other factors have been investigated. The results of this research will provide some useful data to guide public and private investment and pricing decisions at Oregon coastal boat basins and harbors. The results, however, must be interpreted as what they are, estimates of the demand for coastal moorage by western Oregon boat owners in 1977-78, not estimates of the total demand for moorage along the Oregon coast in 1977-78.

Demand Model

Two observations guided the development and specification of the model used in the study. First, the demand for recreational boat moorage at coastal locations is the result of aggregation over the boat-owning population, each member of which is making an individual decision about the mode of his or her boat use. These decisions are discrete, complex, and reflect the preferences, assets, and constraints operative for each boat owner. The usual specifications of aggregate demand, however, are not appropriately applied to moorage demand where individual boat owners choose between discrete alternatives; McFadden (1973 and 1974) has shown that in such situations the appropriate specifications differ substantially from conventional demand specifications.

The second observation is that moorage is not normally the end objective of the boat owner, but rather a concomitant of the recreational activities engaged in by the owner and his or her companions near where the boat is moored. Thus, it is natural to analyze moorage demand within the framework of the consumption activity/household production models of Court-Griliches-Becker-Lancaster, as extended by Domencich and McFadden (1975) to encompass discrete choice.

The general form of the moorage demand model is derived from the now-conventional consumption activity/household production function models. This theory assumes that individuals minimize the cost of producing the services derived from recreational boating. This minimization presents the boat owner with a cost function that is incorporated into his or her budget constraint. The resultant demand functions show that the demand for moorage depends on variables which affect the cost of boating (e.g., the price of moorage, the cost of travel between the owner's residence and the moorage site), variables which affect owner preferences for boating (e.g., fishing activity), and variables which affect cost and preferences (e.g., location of residence).

Following completion of this study I discovered that Deyak and Smith (1978), McConnell and Ramsey (1978), and Caswell and McConnell (1978) have independently developed versions of consumption activity/household production function models for application to recreational choices. These models focus on simultaneous relationships affecting participation decisions, congestion, and the role of stock variables. My selection of the binary-choice logit model for the analysis of moorage reflected many of the considerations that motivated these studies. The models developed by McConnell and his coauthor are fundamentally the same as the one presented here.

The binary-choice logit model was the specific model used in this study. This model measures the effect of each independent variable on the log of the odds of a boat owner expressing a desire to moor and boat primarily near some coastal site over wanting to moor at some other site, or trailer and boat on the same and/or other waters. The model is of the form:

$$\log Q_i = \sum_k B_k Z_{ki}$$

where

$Q_i = P_i/(1-P_i)$ = odds that owner i will express a desire for moorage, and P_i is the probability of owner i expressing a desire for moorage;

and the independent variables Z are defined as follows:

Price = net willingness to pay for moorage, equals the maximum amount that owner i is willing to pay for moorage minus the actual or predicted moorage rate in the relevant coastal area (in dollars per boat-foot per month);

Travel Cost = proxy variable for net travel cost, equals distance to the desired moorage site minus the distance to the the current moorage site, or 1.5 times the distance to current usual boating site;

Coastal Resident = 1 if owner resides in coastal county, 0 if owner resides in non-coastal county;

Days Fishing = total number of days the boat owner fished in 1977; and

Income = boat owner household income before taxes.

Exploratory analysis with linear probability models provided the basis for selecting the independent variables listed above, the equation used to predict moorage rates for calculation of the "Price" variable, and the selection of the weight of 1.5 used to calculate the "Travel Cost" proxy variable.

Domencich and McFadden (1975, chapter 4) establish the link between the theory of individual behavior and aggregate demand data obtained by sampling a population. They also discuss (chapter 5) the statistical estimation methods appropriate for particular models. Their work guided the design and execution of this study.

Estimation

The maximum likelihood method was used to estimate the coefficients of the model. The parameter estimates are asymptotically efficient and normally distributed under general conditions (Domencich and McFadden, 1975). Since the observed choices if individuals, y_i, are binomially distributed, the log of the probability of observing a given sample can be written as

$$L = \sum_i [y_i \log P_i + (1-y_i) \log (1-P_i)]$$

$$= \sum_i \log \left(1+\exp(B'Z_i)\right) + \sum_i y_i B'Z_i$$

This is referred to as the log likelihood function, and the method of maximum likelihood asserts that the calculated probability of observing a given sample will be highest when the unknown vector of parameters B is near its true value. Therefore, the method searches for and accepts parameter estimates that maximize L.

Several measures of success were calculated to evaluate each set of parameter estimates. Percentages of correct predictions were found by computing the probability that individuals either want or do not want moorage and comparing these results with their expressed preferences. Predictions are correct if $P_i > 0.5$ and $y_i = 1$, or $P_i < 0.5$ and $y_i = 0$, and incorrect if vice versa. In addition, Type I and II error statistics were calculated. The Type I error statistic reports the percentage of incorrect predictions that occur by predicting individuals do not want moorage when in fact they expressed a desire for moorage. The Type II error statistic is the percentage of error caused by predicting individuals want moorage when in fact they did not want moorage.

Data

The econometric analysis was conducted on data obtained from a mail questionaire survey of western Oregon pleasure boat owners after the close of the 1977 boating season (Vars, 1977). A six-percent systematic sample was drawn in September 1977 from the list of recreational (pleasure) boats registered by owners with western Oregon mailing addresses. The survey instrument was mailed to 6,668 boat owners on November 30, 1977 and again to non-respondents on January 5, 1978. Altogether 2,395 boat owners responded by returning partially or completely answered questionaires. This represented a response rate of 35.9 percent. Reasons for non-response were not evaluated.

Responses to the questionaire provided information concerning the characteristics of boat owners and their boats, as well as the location, extent, and expenses of their boat use. Boat owners were also asked to describe the importance of and the satisfaction they derive from various boating services they receive in Oregon, including the maximum amount they would be willing to pay for moorage at the location which they consider ideal. A description of the survey findings is given in Vars (1979).

Data for the empirical analysis were developed from the responses of western Oregon boat owners who used coastal waters or who resided in an Oregon coastal county in 1977. Boat owners who neither used coastal waters nor resided in coastal counties were excluded from the data set used to estimate the demand models. This was done to assure that estimates would not be biased because they were based on data sets that included ill-informed potential purchasers of moorage.

The most interesting variable, or course, is price, or the net willingness of a boat owner to pay for moorage. The distribution of values for this variable for all owners who expressed a desire for coastal moorage is as follows:

Price	Number
Less than $0.50	38
$0.50-0.99	22
1.00-1.49	24
1.50-1.99	12
More than $2.00	11
Total	107

Individuals may have responded untruthfully, but on the whole this distribution provides no substantive support for the hypothesis that respondents grossly over-stated their willingness to pay for coastal moorage. The distribution shows boaters willing to pay more than the going Oregon coastal rates for moorage, but not substantially more than the top rates charged along the coast of northern California and Washington.

Since the cover letter to the questionaire (see Exhibit A) did not suggest that responses would be used to estimate demands for new facilities or to evaluate rate schedules, the probability would appear low that respondents as a whole were attempting to influence study findings.

The responses to the willingness to pay questions may also be regarded as somewhat realistic because they were asked on the page immediately opposite from the question where boating expenses were to be listed (see questions 16 and 19, Exhibit A). None of this, of course, guarantees that the information underlying the distribution is truly accurate, but it does suggest that responses cannot be dismissed as obviously biased or unrealistic.

Table 1 reports the sizes of the four samples used to estimate moorage demand equations for the entire Oregon coast, as well as the Astoria, Tillamook, and Newport areas. The table also reports the number of western Oregon boat owners in the sample that want, or do not want, moorage in different coastal areas.

TABLE 1

Coastal area	Sample size	Expressed preference for moorage	
		Want moorage	Do not want moorage
Entire cost	503	107	396
Astoria and vicinity	112	10	102
Tillamook and vicinity	111	14	97
Newport and vicinity	198	34	164

Results

The results of the maximum likelihood estimation procedure are presented in Table 2. All coefficients of the models have their expected signs and are statistically significant at the ten percent or better level. When the model was estimated for Astoria, Tillamook, and Newport with the full set of independent variables, all coefficients but income had the expected signs. (The same results were obtained when a linear probability model was estimated by ordinary least squares regression techniques; these models, however, had less predictive success and larger Type I and II errors than the binary-choice logit models reported here.)

TABLE 2

Variable	Coefficients, t-statistics, and price-elasticities, by coastal area			
	Entire coast	Astoria and vicinity	Tillamook and vicinity	Newport and vicinity
Price	3.416 (8.265)	5.760 (3.374)	5.041 (3.683)	5.208 (5.150)
Price-elasticity	-1.22	-3.20	-1.42	-1.90
Travel cost	0.015 (4.122)			0.008 (1.338)
Coastal resident	1.122 (2.745)	2.471 (1.859)	3.178 (2.845)	2.293 (2.977)
Days fishing	0.020 (4.010)	0.022 (1.435)	0.038 (2.189)	0.032 (3.088)
Income	0.028 (1.652)			
Constant	-3.388	-6.214	-5.943	-5.063

The coefficient on the price variable appears to have the wrong sign, but it does not. Recall that price in the model equals the net willingness to pay for moorage and, therefore, varies inversely with changes in actual or predicted moorage rates. As a consequence, the price-elasticities of demand for coastal moorage reported in Table 2 have their expected negative signs. (These elasticities were calculated using the formula given by Domencich and McFadden (1975, p. 181).)

Unquestionably the most important findings of the study are that (a) the demand for coastal moorage is price-elastic, (b) the demands for moorage at specific locations are more elastic than the aggregate demand for moorage along the entire Oregon coast (a result consistent with the theory of consumer demand for differentiated products), and (c) the absolute responsiveness of demand to unit changes in moorage rates is approximately the same at Astoria, Tillamook, and Newport. The investment and policy implications of these findings require careful consideration.

The parameter for net travel cost measures the effect of an increase in travel cost to the ideal moorage site, or a decrease in travel costs to the usual site for boat use, on the odds of wanting moorage over not wanting moorage. Its positive signs indicate, as expected, that as net travel cost increases, the odds of wanting moorage increase. (Net travel cost was also found to be positively signed in models where it was not a statistically significant independent variable.) The implication of this finding, of course, is that increases in fuel prices and/or travel time (either from traffic congestion or reduced speed limits) can be expected to generate modest increases in moorage demand.

The coefficient for coastal resident is positive and statistically significant, undoubtedly reflecting jointly the ease of access to boat use by coastal residents (a production function phenomenon) and the choice of a coastal residential location to engage intensely in boating (a preference phenomenon). The positive parameter for days fishing, of course, directly reflects the primary activity in which coastal boaters engage (Vars, 1979). Again, the positive parameter reflects both a desire to fish (a preference phenomenon) and the fact that moored boats typically requires less time to get underway, and hence allow more time to fish, than trailered boats (a production function phenomenon).

Alternative measures of goodness of fit were calculated for each model. The upper half of Table 3 reports the predictive success of the model for each area; and the lower half shows the sizes of the Type I and II errors, as well as the overall error, the each model. Table 3 reveals that the models are quite successful in predicting actual choices, as well as achieving tolerably low levels of Type I errors. Not surprisingly, the predictive success is larger, and Type I, II, and overall errors are smaller, when the basic model is estimated for a specific area (e.g., Astoria, Tillamook, Newport) rather than for the entire Oregon coast.

TABLE 3

Alternative measures of goodness of fit	Percent, by coastal area			
	Entire coast	Astoria and vicinity	Tillamook and vicinity	Newport and vicinity
Predictive success				
Want moorage	84	88	92	83
Do not want moorage	91	97	97	95
Overall	90	96	96	93
Errors				
Type I	36	30	21	26
Type II	3	1	1	3
Overall	10	4	4	7

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