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AN ECONOMIC ANALYSIS OF THE CISCO FISHERIES OF BEAR LAKE, UTAH AND IDAHO

by

John E. Keith

A thesis submitted in partial fulfillment
of the requirements for the degree

of

MASTER OF SCIENCE

in

Range Economics

Approved:

UTAH STATE UNIVERSITY
Logan, Utah

1971

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To my mother, who has encouraged me throughout my academic career, and to my wife Linda, who spent many hours helping me with this paper, go my most sincere thanks.

John E. Keith

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ABSTRACT

An Economic Analysis of the Cisco Fisheries

Of Bear Lake, Utah and Idaho

by

John E. Keith, Master of Science

Utah State University, 1971

Major Professor: Dr. John P. Workman
Department: Range Economics

The willingness to pay of participants in cisco fishing was studied for 1970. Opportunity cost of time, calculated from foregone income, was examined as part of the total costs of fishing. The opportunity cost of time was found to be a significant factor in the consumers' decision to participate, and therefore effected the valuation of the recreation considerably.

Additionally, the coefficients of income and opportunity costs of time were compared and found to be of different sign for rural counties indicating a difference between the two variables.

(69 pages)

INTRODUCTION

Developing "demand" functions for non-market priced goods and services, such as recreation, has been a problem for resource managers and economists for some time (Senate Document No. 97, 1963). Increasing pressure for natural resource allocation between conventional goods and recreation goods makes imperative the development of demand functions for non-market priced goods which are both reliable and comparable to market demand curves. In order to arrive at a demand curve for a good, it is necessary to identify both the quantity bought and its price. While such identifications in the market place are easily accomplished, recreation goods may not be so obvious in nature, and their prices may be quite elusive to the measurer. Moreover, identical recreation experiences may exist at various sites, which may affect attempts to establish a proxy variable for price. When identical goods (perfect substitutes) are offered at different prices (or travel costs) all sales of the substitute must be taken into account.

The Cisco fisheries at Bear Lake, Utah, are unique to the Intermountain West. No other body of water in the area contains the Cisco fish nor is adapted to provide a run of spawning fish which may be netted from the shore. The Cisco run takes place in mid-January each year when the water temperature reaches 34° Fahrenheit, at the surface. At this time, many of the fish spawn on the gravel shores on the southeastern end of Bear Lake, where they may be netted with hand nets of a limited opening by fishermen standing in water less than four feet deep. The Utah and Idaho Departments of Fish and Game have established catch

limits which insure perpetuation of the fish population as a result of fishing pressure. Cisco fishing lends itself well to a demand analysis using site visitation as a measure of demand.

THE THEORETICAL MODEL

The recreation "good" has been defined in two ways. The most traditional definition of a "unit" of purchased recreation good has been based on visits to the recreation area. Each visit is measured on the basis of an average length of stay per recreation experience.[1] Clawson (1963) indicates that the recreation experience may be broken down into five distinct categories: 1) anticipation, 2) travel to the site, 3) the actual participation in the recreation, 4) return travel, and 5) recall. While the visit to a site may in fact be the result of benefits derived from all five categories, a strong case may be made for attributing all benefits to the visit as a whole (Clawson, 1959). In fact, Wennergren (1964) has stated that the various aesthetic values generated, presumably in each of the five "experiences," are not unique to the recreation experience, but are inherent in any market-purchased good. Thus, demand measures have been based on the "visit" to the site and calculated from average lengths of stay at the site. These measures of "purchase" of the non-market priced recreation goods have also been widely used by both researchers and most federal agencies.

The crucial and most debated issue in constructing demand curves for recreation is determination of value of the recreation to the consumer. In the past, measures of gross expenditures by recreationists, contributions to GNP of recreation expenditures, and other indicators

---

[1]Clawson, Wennergren, and most other researchers have used demand calculations based upon "visits" per unit of time per capita, or some variant thereof.

of some social welfare level changes on local, regional and national levels have been used to indicate value. Objections to these sorts of measures have been forceful and convincing (Clawson, 1959). A more logical approach based upon the consumers' willingness-to-pay has been used by Clawson (1959), Wennergren (1964, 1967), and others (for example, Dyer, 1967). The logic behind the willingness-to-pay framework has been discussed often in the literature (e.g., Wennergren, 1964). For the purposes of this study, it will be assumed that the necessary conditions for the use of willingness-to-pay measures are met. Those assumptions are: 1) consumers attempt to maximize their satisfaction, given their constraints; 2) consumers have, or act as if they have, perfect knowledge; 3) commodities generate a total utility function which at some point exhibits diminishing returns; and, 4) utility generated by the consumption of the commodity is the basis for the consumers' decision to participate (Dyer, 1967). It is further assumed the relevant cost to the consumer is the variable cost of the marginal trip. Previous studies have used the cost of travel and on-site expenditures as that variable cost. (Wennergren, 1964, and 1967; Dyer, 1967) To assume that on-site and travel costs compose the entire price which the recreation consumer faces is, at best, questionable. A reasonably precise definition of price is necessary in order to arrive at a proxy variable which is in any way comparable to the market price.

A price which is paid for a good in the market is a measure of worth to the consumer. This "worth" has been discussed from two standpoints: The value in use and the value in exchange (Stigler, 1966). The former concept is grounded in the ability of a commodity to satisfy wants, or produce utility. A total utility function, assuming dimin-

ishing marginal utility of goods, should resemble a normally conceived production function relating total utility and the quantity of a given good controlled by the consumer. Becker (1965) has defined purchases of a given good by a household as equivalent to a production input to the output of utility. An unconstrained consumer (that is, a consumer with the ability to purchase any amount of all goods) will purchase a given good only until the price of that good equals the utility derived from the last unit purchased. The consumer's net marginal utility is zero. If, in fact, all consumers were unconstrained in their ability to purchase goods, the prevailing equilibrium prices in perfect competition would reflect the value in use of each good, at the margin. The constrained consumer, in equilibrium, will not be able to equate marginal utility to price, but will equate the marginal utilities per unit expenditure as among the various goods purchased (Little, 1957), with a net positive marginal utility. The constrained utility optimum is analagous to a constrained production optimum.

In the real world, an unconstrained consuming population does not exist. Therefore, market price is a relative (per unit expenditure) measure of utility.

Value in exchange is the rate at which units of a commodity may be traded for units of other goods. At equilibrium in the perfectly competitive market, price measures the trade off between goods and, therefore, value in exchange. In the (constrained) real world both value in exchange and value in use are equal to price and measure the relative marginal utility production.

If opportunity cost of utility is defined as the utility foregone from one commodity as a result of a decision to purchase another commodity, then the market price is one opportunity cost of utility in equilibrium. Price alone, however, may not measure the full opportunity cost of a given purchase. If it is assumed that time itself produces utility for a consumer (that is, if time may be used in alternative ways to produce utility of one sort or another), then there is an implicit loss of utility associated with the time required for a given purchase. Only if the time cost of utility (relative to price) is exactly the same for each consumer purchasing every good will the price system behave as if the opportunity cost of time were included. Such is obviously not the case in the real or the theoretical economic world.

It has been argued that time in purchase or in participation produces positive increments of utility to consumers (Linder, 1970). Theoretically, positive utility derived from time reduces the total opportunity cost of time to the consumer. If the time involved can be separated into segments producing benefits and those producing costs, then the time which produces cost may be considered as part of the "price" of the time which produces benefits. Many recreation commodities offer the opportunity to delineate these segments. However, at least some of the time associated with the purchase of commodities produces a loss of utility.

If a utility function is constructed to include the utility cost of time which is related to the time taken for a given purchase, then total utility at a given amount of purchase is diminished by the utility cost of time at that amount. Moreover, since the utility cost of time is functionally related to the quantity purchased, the marginal

utility of purchases of goods will also be decreased (Figure 1.).

Mathematically, if total utility is assumed to be a decreasing function of X (purchased good), then a typical function would be:

$TU = a_o + a_1X + a_2X^2$, where TU is total utility and a_2 is negative.

If $UF = b_o + b_1X$, where UF is utility of time foregone, total net utility, then would be TU - UF, or:

$TNU = (a_o - b_o) + (a_1 - b_1)X + a_2X^2$, where NU is net utility.

Marginal utility (associated with total utility is):

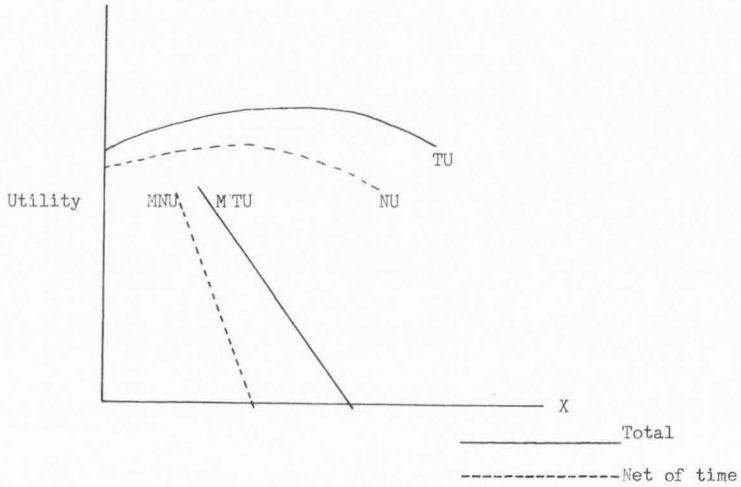

Figure 1. Total and marginal utility

$\frac{dTU}{d\ X} = a_1 + 2a_2X$, where a_2 is negative.

Marginal net utility (associated with total net utility is):

$\frac{dNU}{d\ X} = (a_1 - b_1) + 2a_2X$, where a_2 is negative and b_1 is greater than zero. The marginal net utility, therefore, is less than the marginal total utility.

It can easily be seen (Figure 2.) that at any given amount of purchase, the utility derived from that purchase at the margin is less when the cost of time is included. Therefore, the market price which would be paid by a consumer for a given quantity of X would be less than if time were not involved in the purchase in both the constrained and unconstrained cases. For example, if the quantity X_0 were pur-

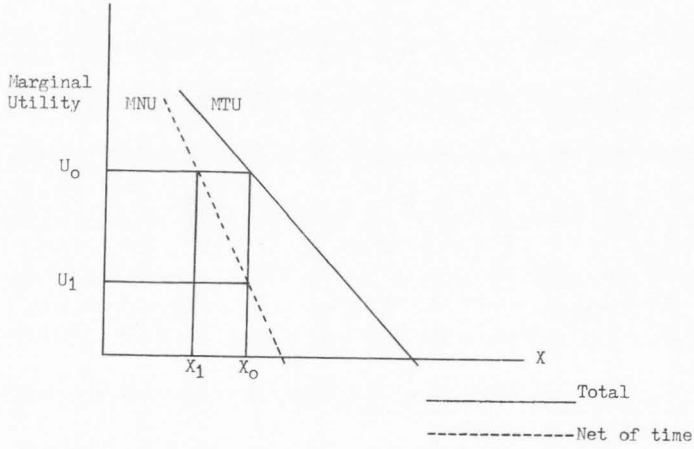

Figure 2. Marginal utility at given quantity

chased, the marginal utility derived would be U_0 if no time were taken for purchase, and U_1, which is less than U_0, if time cost of utility

is taken into account. The price which would be paid in this example is less for U_1 than for U_0 marginal utility for both the constrained and unconstrained cases as a result of the equilibrium condition that $\frac{MU_1}{P_1} = \frac{MU_2}{P_2} = \ldots = \frac{MU_n}{P_n}$ (= 1 in the unconstrained case), as stated by Stigler (1966).

Conversely, it may be stated that at given market price, less of the good will be purchased if the time cost of utility is considered. Moreover, it can logically be concluded that as the time involved in purchasing a unit of a given good increases, or increases relative to the time required to purchase other goods, less of the good will be purchased at a given price. Figure 2 clearly indicates the difference in amounts of the goods purchased. At a given price (absolute or relative marginal utility) less X is purchased if the time cost of utility is considered than if time is not considered (the MNU intersection with U_0 at X_1 units which is less than the MTU intersection with U_0 at X_0 units). As indicated above, the inclusion of time cost of utility results in precisely the same market phenomena as an increase in price. The total opportunity cost of purchase is, then, the sum of the opportunity cost of alternative commodities (the market price) and the opportunity cost of time. Mathematically:

TP (Total Price) = MP (Market Price) + TC (Time Cost).

Since demand for a commodity is logically assumed to be a function of, among other things, the price paid for that commodity, then any attempt to construct functional demand statements must include all prices whether explicit or implicit. Thus, demand is a function of both market price and the cost of time.

The most logical measure of the opportunity cost of time, from both a theoretical and a practical consideration, is the foregone opportunity to earn on the part of the consumer (Scott, 1965). From a theoretical standpoint, the efficiency conditions necessary in a perfectly competitive equilibrium indicate that the marginal hour of labor should produce the ability to purchase commodities which are marginally valued equal to the input wage (Little, 1957).[2] Further, the marginal rate of substitution between leisure and any consumption good must be equal to the labor required to produce wages sufficient to purchase that good (Little, 1957). The logical conclusion is that the price of leisure is the foregone consumption which may be purchased by wages paid to inputs, at the margin. The extent of the departure from the assumption of perfect competition in the real world is, of course, open to debate. When dealing with a public good, the assumption of atomistic production (i.e., there is no monopoly or monopsony) and consumption is probably warranted. The assumption of perfect knowledge, perfect homogeniety of product, and perfect divisibility of product may not be violated to a debilitating extent.

If benefits accruing from time are significant, at least for some part of the time taken for consumption, then equating time cost to foregone income may not be logically sound. The additional benefits derived from time are offset in equilibrium by part of the price or costs incurred. The time cost must be separable from time benefits in order to determine the total cost. If utility-producing time is not separable and is instead included as a cost, the total paid and there-

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[2] Mathematically, the Marginal Value Product of a unit of labor must equal the wage paid to that labor, or $MPP_a \times P_x$ = Wage of input a, for all goods and all inputs.

fore the willingness-to-pay is overestimated. However, Becker (1965) indicates that the inclusion of time as a cost variable in demand functions results in a significant increase in statistical explanatory power. Most econometric studies ignore the cost of time and (implicitly) assume the time cost is insignificant relative to the market price of commodities. This assumption about the market pricing is, in a Friedmanian sense,[3] a reasonable approximation of reality. These models predict sufficiently well to be considered a tested theory and the addition of time affects predictive power very little. The implicit assumption that the marginal utility of time approaches zero for market purchases leads to the conclusion that the market price is equivalent to the total price paid by the consumer. For example, the purchase of one item out of a bundle of items in a supermarket may take almost no time. However insignificant the cost of time may be in market purchases, time involved in the "purchase" of recreation cannot be considered negligible. While market decisions and purchases are often made in minutes or a few hours, recreation activities most frequently involve days or weeks.

Comparability between the recreation price and demand and the market price and demand is possible, assuming that the opportunity cost of time in the market decision is negligible. The departure of the market from perfect competition may adversely affect the comparability, but it will be assumed that the departure of the market from the perfect competition model is minimal.

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[3]Friedman (1953) concludes that the test of a theory rests upon 1) generality, 2) simplicity, and 3) ability to predict.

Given that the demand curve derived from the stated total price model approximates the true willingness-to-pay of the recreationist, the value assigned to the recreation should be the value of the units of the good "taken" at the total market price experienced by the recreationist.

VALUATION METHOD

The valuation procedure most commonly used for non-market priced recreation is the consumers' surplus method. By assuming a pure public good with a marginal cost of production of zero, the value of the recreation is a function of demand only.

Consumers' surplus valuation typically follows Marshall's consumers' surplus rational (Marshall, 1925): a consumer, willing to pay one price (say P_o) but only having to pay a lesser price, (P_c such that P_c P_o) reaps a surplus of value equal to the difference in the prices multiplied by the amount of the good purchased. Given the assumption of a public good, the consumers' surplus is the area under the demand curve, bounded by the X and Y intercepts ($\int f(x)\, dx$). The discussion of consumers' surplus as a technique and as a theory has been thoroughly examined by both Clawson (1959) and Wennergren (1964).

The theoretical problems with the use of the consumers' surplus approach are two-fold. First, lacking a supply curve (a summation of the marginal costs of production) and thereby an indication of market equilibrium, the analysis is insufficient to produce a measure of efficiency for decisions involving allocation of the recreation resource. Second, the value of the consumers' surplus is the total area under the demand curve, given the public good supply price of zero. As a dollar value measure of the worth of a given good, the consumers' surplus cannot be compared with any value other than a consumers' surplus for other goods. Moreover, market valuations are usually based upon a market price (determined in equilibrium) multiplied by the units

purchased. Thus, it must be remembered that consumers' surplus valuations are invalid for comparisons with market valuations. Consequently a consumers' surplus valuation is not a measure of value which can be used as an efficiency criteria for decisions concerning allocations of resources. Consumers' surplus valuations of non-market priced recreation goods can only be compared to consumers' surplus valuations of market priced goods. It should also be pointed out that valuation of a market priced good on a surplus basis should include producers' surplus (since an unlimited supply does not exist) as well as consumers' surplus. Other methods, have been suggested for valuing non-market priced recreation. While some methods of valuation have advantages in that they produce a "price," the consumers' surplus is as theoretically satisfying, since that "price" is not determined from efficiency criteria.

THE STATISTICAL MODEL

The statistical models used include the conventional measure of price used by other recreation valuation schemes (the costs of transportation and on-site expenditures). In addition, the opportunity cost for the time required to participate in the recreation experience is treated in one model and the income effects are treated in another. The functional statements of the models are:

$$U_{ij} = B_1 + B_2 P_{ij} + B_3 O_{ij} + e_{ij}$$

and $$U_{ij} = B_1 + B_2 P_{ij} + B_3 Y_{ij} + e_{ij},$$

where B_k = the regression coefficient associated with the variable,

U_{ij} = Use from a given county,

P_{ij} = Transportation and on-site costs experienced by a user from a given county,

O_{ij} = Opportunity cost of time (foregone income) of a given user from a given county,

Y_{ij} = Yearly income of a given user from a given county,

e_{ij} = The error term associated with a given observation,

j = the county of origin,

i = the state of origin (see Appendix A and B).

Users are defined in three ways: 1) fishermen, 2) total visitors (fishermen and non-fishermen), and 3) households (number of families represented by individual visitors among total participants). Price designations are, respectively, PF_{ij}, PT_{ij}, and PH_{ij}. Opportunity cost designations are OI_{ij} and OH_{ij} for individuals and households, respec-

tively. Each user definition will be tested by both linear and log-linear regressions. Therefore, each county's visitors will be represented by six linear and six log-linear regressions, one regression per "user" definition and model. Each model will be tested for best linear unbiased estimates of parameters significantly different from zero. In addition, linear and log-linear regressions for total visitors are made to determine levels of significance for comparison with county regressions.

If opportunity cost of time is, in fact, a price, the coefficients of opportunity cost would be expected to always be negative. Income, coefficients, however, might not exhibit constancy of coefficient signs. Rural and urban counties might be expected to show differences. As income rises, urban dwellers may prefer "elite" sports such as skiing to traditional sports such as fishing (i.e., fishing may be an inferior recreation good). Rural people, as a result of the cultural milieu, may increase participation in fishing as income rises (i.e., fishing may be a superior good). The coefficients of the variables will be tested for these relationships, as well as significance.

A total demand curve will be constructed by summing the demands for each county, consistant with normal practice of horizontal summation. The problems of aggregation of demand curves have been discussed widely in the literature. The essential condition which must be met in order to aggregate a number of individual demand functions is that variables other than price and quantity must be identical or constant over the individual demands. While it is not the purpose of this paper to discuss in detail the problems of aggregation, the summing of county demand curve does require an acknowledgement of the

problem. Given that demand is a function of price, prices of substitutes and complements, income, and tastes and preferences (functionally $Q_X = f(P_X, P_S, P_C, Y, T)$), an evaluation of the constancy of each variable over the counties is necessary.

FIELD PROCEDURES

Data were taken by personal interview each day of the 1970 Cisco run, from January 14 through January 22. The information collected is illustrated in Appendix G, the survey questionnaire. In cases in which a group consisted of more than one family and/or more than one car, averages for income and visitors per car are used. Cost sharing among families is assumed and the average cost is divided among the adults and fishing children in the family. Travel and opportunity costs are calculated for each fisherman, visitor or household.

Game laws require that only one limit of Cisco may be taken and held in possession. Each day's recreation results in just one experience: that of obtaining a limit of Cisco. Moreover, a very high percentage of fishermen are successful in obtaining the limit. Children old enough to dip a net, approximately four years of age, are allowed half an adult limit and must be counted as fishermen because the entire catch is assumed to be distributed among the visiting group. Many of the children's limits are illegally netted by adults and the number of fish taken by a given party is a function of the number of both adults and children. Therefore, use is measured in terms of a visitor day for each fisherman or visitor. Overnight stays, assuming the limit taken on the first day is eaten, given away, or kept illegally, result in two experiences or visits. Therefore, the cost to overnight recreationists is divided between two days (the price per day is halved). Total use is calculated from sampling percentages. Weekday sampling

includes approximately 14 percent of the visitors: weekend sampling, approximately 10 percent.

Demand is calculated for fishermen, total visitors (including non-fishermen over four years of age), and households for each county. For regressions which pool the data from all counties, the data are adjusted to a per capita basis. After regression results are determined, coefficients are readjusted for total visiting population so that bias of the demand function due to variant population densities is eliminated.

Travel costs and on-site expenditures are lumped in the price variable, P_{ij}. Yearly licenses and re-usable equipment (e.g., nets and camping gear) are considered sunk or fixed costs which do not enter into the decision to participate in the marginal visit. Expenditures for special licenses (2-day and 5-day Utah licenses and 5-day Idaho licenses) and for motels are included in the marginal cost. Meals are considered as being a cost incurred regardless of the decision to participate and are therefore not included, even though differentials between costs of meals eaten in the home and meals eaten during the visit probably do exist to some extent. The major component of "price" is the expenditure for travel. This cost is approximated by using round trip travel distance multiplied by an average cost per mile ($0.05 per mile). Data do not allow for differences in cost per mile for different types of vehicles. Such differences might result in up to a 25 percent difference in vehicle cost. The choice of five cents per mile is based primarily on the fee charged by the General Services Administration for sedans for 1968.

The recreation experience itself, that is the netting of Cisco fish, generally takes much less time than travel. The on-site time is seldom longer than thirty minutes to an hour. Compared with the usually lengthy travel time, benefits from on-site time are assumed to be negligible. Therefore, the amount of income foregone is calculated from the individual's daily income and is used as a proxy for the true opportunity cost of recreationists' time unadjusted for benefits accruing to on-site time. It is assumed that an individual (or household) recreationist could have worked on a week day and earned his normal daily salary (yearly income divided by 251 working days per year), but chose to recreate at the expense of his salary. The data do not include the work status of the recreationist. It is further assumed that even if a recreationist takes paid vacation time, such time is in fact a foregoing of wages earned. The recreationist could have worked and thereby been "paid" an extra day's wages in lieu of vacation. That is, a vacation day not taken is paid by accumulation and eventual remuneration. Casual observation indicated that a larger proportion of weekday fishermen were retired or unemployed persons than would normally be expected from the populations of origin. Since the data do not include the employment status of recreationists, it is assumed that all persons were gainfully employed on a five-day-a-week basis at their indicated salary.

Weekend opportunity cost is approached in two ways. First, it is assumed that weekend participators would not work (whether or not the opportunity was available) and therefore the opportunity cost for time of Cisco fishing on the weekend is zero. Second, it is assumed that the opportunity cost for time on a weekend is not zero but instead is

some fraction of the individual's daily earnings. That fraction is assumed to be one quarter, which is an arbitrary choice. The one quarter fraction is assumed primarily because it is felt that work which recreationists would or could do on the weekend is most likely to be of a domestic nature, rather than productive of real income. There is however, a basis for assuming that time on the weekend is worth more to some workers, depending on their employment category, due to premium wages paid for weekend work. The lack of data concerning the employment categories prevents calculation of individual opportunity costs based on known weekend employment opportunities. The two methods of calculating weekend opportunity cost will at best provide a basis for comparison.

The income variable is calculated on an individual (or household) basis. The income variable also provides a check on the opportunity cost variable. If the opportunity cost variable is equivalent to the income variable, no difference in the sign of the regression coefficient is expected.

REGRESSION RESULTS

Regression results are shown in Appendix A and B. The county regressions exhibit relatively high R^2 values, and relatively significant "t" values. However, the regressions using the total population of visitors adjusted to a per capita basis exhibits low R^2 values and erratic significance levels (see Appendix C and D).

The total demand curves which result from the sum of the county demand functions based on zero opportunity cost on weekends are:
Number of fishermen = 5202.696 - 721.913(PF) - 48.415(OI),
Number of total visitors = 5723.416 - 606.347(PT) - 61.008(OI),
and Number of visiting households = 3613.537 - 302.136(PH) - 44.182(OH).
The total natural log functions (sums of county log functions) are:
Ln number of fishermen = 70.13554 - 9.36924(Ln PF) - 0.98003 (Ln OI),
Ln number of total visitors = 71.97307 - 9.26291 (Ln PT) - 0.55725 (Ln OI), and Ln number of households = 67.26671 - 8.35801 (Ln PH) - 1.05890 (Ln OH).

In all counties, regression coefficients for opportunity costs are negative. Significance levels for opportunity cost coefficients for both linear and log-linear regressions are relatively low for Rich, Bingham, and Franklin counties. The number of observations of fishermen from these counties (indicated in Appendix F) is fewer than ten. The resultant fewer degrees of freedom for each of these regressions lowers significance levels for given "t" and "F" values.

Coefficients for the income variable are both positive (for Box Elder, Rich, Weber, Bear Lake and Bingham counties) and negative. Sig-

nificance levels are generally lower for income than the opportunity costs.

Results of the regressions also indicate that the difference in calculation of opportunity costs for weekends are negligible. (See Appendix A and B.) When coefficients are compared as between regressions using the zero and twenty-five per cent of daily earnings opportunity costs, the latter values are within the standard deviations of the former values, in almost all cases. Significance and R^2 values seldom vary more than ten per cent of the indicated value. The coefficients also exhibit identical positive and negative relationships. Consequently, only the results of the zero weekend opportunity cost calculations are used for valuation. No total curves including the income variable are necessary. The income variable is useless for valuation and serves only to show significance and as a comparison to opportunity costs, as suggested above.

DISCUSSION OF RESULTS

The uniqueness of Cisco fishing has been discussed in the introduction, above. The alternative recreation experiences which exist in the area are primarily skiing and snow-mobiling, neither of which could be considered a direct substitute for fishing. However, some Cisco fishermen also jig-fish for whitefish and lake trout. The number who partake in the jig-fishing is negligible compared to the total population of Cisco fishermen, and the complementarity has been disregarded. There may be some complementarity between Cisco fishing and skiing and snow-mobiling, since the fishing is generally best and fishermen more numerous in the early morning and late evening and the other sports are generally late morning and early afternoon activities. Casual observation indicates that few skiers or snow-mobilers participate in Cisco fishing. Therefore, the costs of complementary and substitutable recreation "goods" are not considered as important variables which differ greatly as among counties or origin.

The income variable (Y_{ij}) has been examined by other investigators in recreation studies (Dyer, 1967, and Beardsley, 1968), for the counties of Utah which are being considered. These studies indicate that there is no significant difference in average incomes between Utah counties. Thus the assumption of constant income over the Utah, Idaho and Wyoming counties is probably valid. Most of these studies have identified origins as either individual counties or groups of counties (zones) around the recreation site. Regression analysis with both methods indicates insignificant differences between the counties and between

groups of counties. Many of the counties used in previous work are also used for the present study.

It can be noted, however, that changes of tastes and preferences between counties might be expected. Some of these counties are primarily urban (Davis, Salt Lake), while others are almost entirely rural (Rich, Bear Lake). However, it is assumed that tastes and preferences are not significantly different as among county populations. Since the Inter-mountain West is a relatively homogenous cultural region, and since the counties from which fishermen visit are very similar in much of the cultural milieu, the assumption of homogenous tastes and preferences may be warranted.[4]

Three problems may exist in the regressions: model misspecification, auto-correlation in the error term, and multi-colinearity. Model misspecification is defined as the exclusion of one or more significant variables. As a result, the parameter estimates (betas) are biased and the regression results are at best questionable (see Appendix E). The listed high R^2 values indicate that much of the variability in the obscured data are explained by the regressions. Misspecification bias is assumed not to exist.

If the excluded variables tend to move in the same direction, the error terms are auto-correlated. As a result, the regression coefficients are unbiased but the estimates of the variances of the parame-

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[4]The results of the regressions indicate that there is a difference in tastes and preferences, since the "good" is superior in two mostly rural counties and inferior in most of the more urban counties. Further examination of the difference in tastes and preferences is indicated, but as yet a sophisticated analysis of the problem from an economic standpoint is unavailable.

ters are biased upward resulting in invalid "t" and "F" values. The significance of the regression coefficients is therefore in doubt (Johnston, 1963). A test for auto-correlation of the first order Markov type has been developed by Durbin and Watson (1950, 1951). Values of the lower and upper bounds of the Durbin-Watson statistic are indicated in Appendix A and Appendix B, as well as the calculated statistic for each regression. If the Durbin-Watson statistic is less than the lower bound value, auto-correlation exists. If the Durbin-Watson statistic is greater than the upper bound, the hypothesis of random disturbance cannot be rejected. If the statistic lies between the upper and lower bound, no conclusion can be reached. Auto-correlation is assumed not to be substantial.

The third problem which might be encountered (multi-colinearity), results in a biased standard error of the estimates, since the determinant used to calculate a given standard deviation tends toward zero with increasing multi-colinearity. An examination of the correlation coefficients of the various independent variables reveals that the correlation between variables used in the various regressions is not sufficiently high (no greater than 0.30) to warrant the conclusion that the problem exists. Income and opportunity costs exhibit a high correlation coefficient since the latter is calculated from the former. The two variables are never used in the same regression, so multi-colinearity is avoided.

VALUATION

As previously stated, the consumers' surplus valuation is no more than the area bounded maximally by the demand curve, given a public good. Since both the travel and on-site costs and opportunity cost for time are part of the "price" which is paid by the recreationist, then the consumers' surplus is the volume bounded by the three-variable function, and by the minimum and maximum prices. Both the straight line and the log-linear equations will be used for valuation in order to compare the values. The total demand functions which will be used are:

$Q = 5723.416 - 606.347(PT) - 61.008(OI)$ and

$LnQ = 71.97307 - 9.26291(Ln\ PT) - 0.57720(Ln\ OI)$.

The consumers' surplus valuation is the double integral of the demand curve evaluated over the intervals of observed "prices."

The rationale for using a double integral approach to consumers' surplus, which is a volume rather than an area, is straightforward. For any given level of opportunity cost, there exists a demand curve relating quantity taken with travel costs, the area under which is a "partial" consumers' surplus and equal to the integral of that demand equation (see Figure 3). Essentially, this partial surplus amounts to a "slice" across the demand curve plane parallel to the travel cost axis at a given level of opportunity cost. Since there exist an infinite number of such "slices" (i.e., an infinite number of fixed values of opportunity cost) the limit of the sum of the "partial" consumers' surplus is the double integral of the total demand function (see Figure 4). That is, the worth of the recreation site is the sum of the worth

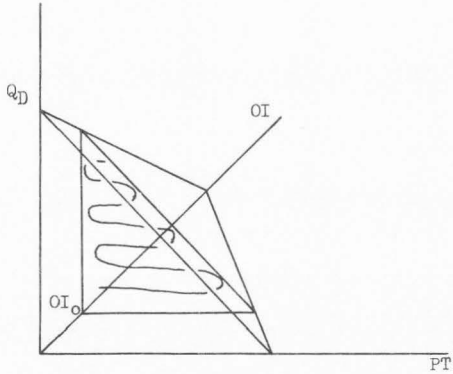

Figure 3. Consumer's surplus given OI_o.

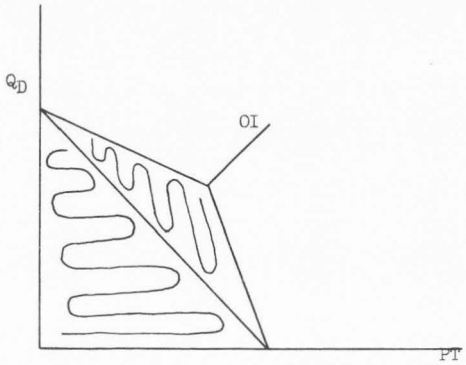

Figure 4. Total consumer's surplus.

of the experience to each recreationist, which is exactly the indicated volume. The observed bounds are ten cents and eleven dollars per person for the travel and on-site costs, and zero cents to 75 dollars per person for the time cost. The consumers' surplus, then, is for the linear demand function.

$$\int_{0}^{75} d(OI) \int_{.10}^{11} Qd(PT)$$

$$= \int_{0}^{75} d(OI) \int_{.10}^{11} 5723.416 - 606.347(PT) - 61.008(OI)\ d\ (PT)$$

$$= \int_{0}^{75} d(OI) \left[5723.416(PT) - \frac{606.347}{2} (PT)^2 - 61.008(OI)(PT) \Big|_{.10}^{11} \right]$$

$$= \int_{0}^{75} 25{,}704.273 - 664.988(OI)\ d(OI)$$

$$= 25{,}704.273(OI) - \frac{664.988}{2} (OI)^2 \Big|_{0}^{75}$$

= \$67,641.725 for 1970. The consumers' surplus for the log-linear demand function is:

$$\int_{0}^{75} d(OI) \int_{.10}^{11} Qd\ (PT)$$

$$= \int_{0}^{75} d(OI) \int_{.10}^{11} 71.97307 - 9.26291\ (\text{Ln } PT) - 0.5772\ (\text{Ln } OI) d\ (PT)$$

---

[5] .001 is used for calculations, since the Ln of zero is undefined.

$$= \int_0^{75} d(OI)\left[71.97307(PT)-9.26291(PT)(Ln\ PT)-(PT)-6.5772(Ln\ OI)(PT)\Big|_{.10}^{11}\right]$$

$$= \int_0^{75} 345.940 - 6.267\ (Ln\ OI)\ d(OI)$$

$$= 345.940(OI) - 6.267\ (Ln\ OI)(OI) - OI\ \Big|_0^{75}$$

$$= \$26,020.52 \text{ for } 1970.$$

It may be noted that the values of the integrals for travel costs only (assuming opportunity cost equals zero) differ by a factor of approximately 100. These values cannot be identified as consumers' surplus using travel cost alone. The interaction terms of the integrals are the factors which cause this discrepancy. The choice of linear or log-linear relationship does effect the final valuation. The choice should be made based upon significance levels and extent of explanatory powers, if no theoretical grounds for the choice exist.

Since 1970 was a subnormal year for visiting population, according to the surveys of the preceding ten years, an adjustment of the consumers' surplus is necessary. The average attendance for the Cisco run has been approximately 8,500 with a high of 12,000 in 1967 and a low of 4,500 in 1958. The attendance in 1970 was approximately 6,000 visitors. The average consumers' surplus, assuming that the proportion of visitors for each origin and each income level has been the same, is increased by giving an average annual value of $84,552.157, for the straight-line, and $32,525.65 for the log-linear equation.

Assuming an interest rate of 5%, the present worth of such a value stream in perpetuity is

$$\frac{\$84,552.156}{.05} = \$1,691,043.12 \text{ and}$$

$$\frac{\$32,525.65}{.05} = \$650,513.00,$$

respectively, for the straight-line and log-linear equations. The 5% interest rate chosen for this study is slightly higher than the government borrowing rate (currently 4 5/8%) which is used by the Bureau of the Budget. Many other studies of this type have used 5% for determining present value (e.g., Dyer, 1967). It is not the purpose of this paper to delve into the controversy surrounding the selection of interest rates for capitalization purposes. The choice is arbitrary and open to debate.

CONCLUSIONS

The opportunity cost for time appears to be a very significant variable in the decision to participate in Cisco fishing. The differences in sign between the income variable and the opportunity cost variable in Box Elder, Rich and Weber counties in Utah and Bear Lake and Bingham counties in Idaho implies that income and opportunity cost are in fact different variables and that opportunity cost is a part of the price variable.

Given the somewhat questionable assumption of zero opportunity cost of time on weekends used in the calculations, the quantitative values of the opportunity cost of time relative to the travel costs may not be definitive. Instead, the results are only indicative of the potential significance of the opportunity cost of time, or income foregone. Therefore, using travel and on-site costs alone as the price determinants in recreation demand curve construction is open to much criticism. Studies which have ignored the time cost of recreation, or included those costs as hours traveled alone, have seriously underestimated the worth of recreation to the consumer.

Additionally, the income variable coefficients indicate a superior good for the above mentioned counties, and an inferior good for the remainder of the counties. This conclusion is not unexpected for the more rural of the counties contributing participants. The tastes and preferences of rural counties might be expected to favor the more "common" sports, such as Cisco fishing, as opposed to the more "elite" sports such as skiing. Both Weber and Bingham counties, however, do

not fall into a rural classification. The influence of Hill Air Force Base in Weber County might account for the positive income coefficient in part.

A further refinement of evaluating the opportunity cost of time is necessary to overcome objections to the assumptions made in this study. The concept of time costs is not new, but it has not been imperically evaluated for a recreation good. Recreation models, however, have not been successfully predictive when neglecting time costs.

POLICY IMPLICATIONS

As previously discussed, the omission of the opportunity cost of time seriously underestimates the value of the recreation experience. Most agencies charged with the administration of public land, both state and federal, follow a specified procedure for valuing recreation days, usually found in an operations manual (e.g., Bureau of Land Management Manuals). This procedure is often to apply a dollar value per visitor day prescribed by the manual, adjusted by the type of recreation. The manuals use, at least in part, consumer willingness-to-pay as a basis for calculating the prescribed dollar values. The time cost of recreation or opportunity cost of time, however, has been omitted from these calculations. Therefore, the prescribed dollar values seriously underestimate the worth of recreation.

Irrespective of objections to applying a given dollar value to recreation, the application of dollar values which are deflated relative to the recreation's real worth to participants is highly questionable. To the extent to which the manuals' values are used to calculate benefit-cost ratios or other measures of economic "efficiency" on which allocations of fiscal monies and other resources are based, misallocation occurs due to the bias against recreation.

In order to assure allocation of resources which are unbiased and, in some sense, economically efficient, the values given to visitor days must be adjusted upward to include the value of the opportunity cost of time. Agencies should sponsor further investigation into the time costs

of recreation immediately, and adjust the valuation of recreation on public lands accordingly.

Appendix A. Results of regression, zero opportunity cost of time on weekends
Linear regression

Regr. No.	Variable	Regress Coeffic	"t"	Sig Lvl	"F"	Sig Lvl	R^2	Durbin-Watson Stat Low	Up	Rgres	Std Rgr. Err Non-Z[a]
1-1-1[b]	C[c]	634.473			12.54	.10	.53	1.21	1.55	1.56	
	PF[d]	-115.252	-4.42	.005							
	YI	0.00631	-0.58	.40							
1-1-2	C	639.376			12.58	.10	.53	1.21	1.55	1.57	
	PT	-124.523	-4.55	.005							
	YI	0.00340	-0.30	.50							
1-1-3	C	247.760			6.01	.25	.35	1.21	1.55	1.42	
	PH	- 37.379	-3.29	.005							
	YH	0.00778	1.23	.15							

[a]Regression coefficient for opportunity cost of time calculated at $\frac{1}{4}$ of daily income for weekends.

[b]Indicates state of origin-county of origin-regression number. See Appendix B.

[c]Constant

[d]Variables as listed in order are:
PF: price faced by the individual fisherman.
YI: income of each visitor (fisherman and non-fisherman).
PT: price faced by the individual visitor (fisherman and non-fisherman).
PH: price faced by each visiting household.
YH: household income.
OI: opportunity cost of each individual visitor.
OH: opportunity cost of each household.

Appendix A. Continued

Regr. No.	Variable	Regress Coeffic	"t"	Sig Lvl	"F"	Sig Lvl	R^2	Durbin-Watson Stat Low	Up	Rgres	Std Rgr. Err Non-Z
1-1-4	C	638.115			18.50	.10	.62	1.21	1.55	1.54	
	PF	- 95.175	-3.95	.005							2.48-97.02
	OI	- 5.150	-2.44	.025							0.21- 4.98
1-1-5	C	634.843			17.79	.10	.61	1.21	1.55	1.58	
	PT	- 94.488	-3.44	.005							2.74-99.95
	OI	- 5.192	-2.22	.025							0.23- 4.76
1-1-6	C	379.300			12.74	.10	.53	1.21	1.55	1.56	
	PH	- 34.830	-3.62	.005							0.96-35.1
	OH	- 3.287	-3.29	.005							0.09- 3.12
1-2-1	C	347.831			12.87	.10	.43	1.35	1.59	1.64	
	PF	- 40.942	-3.83	.005							
	YI	-0.00732	-1.63	.10							
1-2-2	C	373.311			10.54	.10	.38	1.35	1.59	1.39	
	PT	- 48.550	-3.46	.005							
	YI	-0.00696	-1.25	.15							
1-2-3	C	248.844			10.56	.10	.39	1.35	1.59	1.44	
	PH	- 39.843	-4.41	.005							
	YH	-0.00049	-0.16	.50							
1-2-4	C	339.199			22.84	.05	.58	1.35	1.59	1.59	
	PF	- 39.492	-3.16	.005							9.63-31.24
	OI	- 3.172	-3.84	.005							0.82- 3.24

Appendix A. Continued

Regr. No.	Variable	Regress Coeffic	"t"	Sig Lvl	"F"	Sig Lvl	R^2	Durbin-Watson Stat Low	Up	Rgres	Std Err	Rgr. Non-Z
1-2-5	C	368.088			16.60	.10	.50	1.35	1.59	1.59		
	PT	- 37.124	-3.05	.005							13.30	-38.87
	OI	- 3.209	-.285	.005							0.10	- 3.15
1-2-6	C	271.113			20.79	.05	.55	1.35	1.59	1.63		
	PH	- 24.817	-4.11	.005							6.04	-25.83
	OH	- 1.694	-3.54	.005							.48	- 1.57
1-3-1	C	496.134			7.32	.25	.32	1.34	1.58	1.46		
	PF	- 31.174	-2.18	.025								
	YI	-0.00126	-2.24	.025								
1-3-2	C	521.224			9.21	.25	.36	1.34	1.58	1.54		
	PT	- 33.136	-2.37	.025								
	YI	-0.00141	-2.51	.025								
1-3-3	C	274.146			6.93	.25	.23	1.34	1.58	1.22		
	PH	- 13.308	-3.5	.005								
	YH	-0.00021	-0.76	.50								
1-3-4	C	465.192			11.92	.10	.42	1.34	1.58	1.59		
	PF	- 28.956	-2.25	.025							12.85	-28.01
	OI	- 3.865	-3.15	.005							1.09	- 4.14
1-3-5	C	487.314			17.84	.10	.35	1.34	1.58	1.56		
	PT	- 32.243	-2.56	.025							12.60	-30.89
	OI	- 3.972	-3.62	.005							1.09	- 4.32

Appendix A. Continued

Regr. No.	Variable	Regress Coeffic	"t"	Sig Lvl	"F"	Sig Lvl	R^2	Durbin-Watson Stat Low	Up	Rgres	Std Err	Rgr. Non-Z
1-3-6	C	289.413			13.84	.10	.46	1.34	1.58	1.58		
	PH	- 13.663	-3.74	.005							3.65	-13.60
	OH	- 1.576	-3.80	.005							0.04	- 1.63
1-5-1	C	126.239			1.04	.50	.23	0.95	1.54	0.98		
	PF	- 46.266	0.81	.25								
	YI	0.00578	1.19	.15								
1-5-2	C	91.270			0.47	.50	.42	0.95	1.54	0.92		
	PT	- 36.400	-0.85	.25								
	YI	0.00040	0.70	.30								
1-5-3	C	72.021			0.60	.50	.14	0.95	1.54	0.76		
	PH	- 20.041	-1.08	.20								
	YH	0.00300	0.67	.30								
1-5-4	C	126.239			1.04	.50	.22	0.95	1.54	0.98		
	PF	- 46.266	0.80	.25							5.73	-46.29
	OI	- 1.450	1.10	.15							.12	- 1.46
1-5-5	C	91.270			0.40	.50	.05	0.95	1.54	0.56		
	PT	- 36.400	0.40	.50							4.28	-36.39
	OI	- 1.005	0.50	.50							.13	- 1.00
1-5-6	C	72.022			0.60	.50	.14	0.95	1.54	0.99		
	PH	- 20.041	-1.08	.20							1.84	-20.04
	OH	- 7.542	0.68	.25							.11	- 7.55

Appendix A. Continued

Regr. No.	Variable	Regress Coeffic	"t"	Sig Lvl	"F"	Sig Lvl	R^2	Durbin-Watson Stat Low	Up	Rgres	Std Err	Rgr Non-Z
1-6-1	C	532.176			13.45	.10	.34	1.49	1.64	1.75		
	PF	- 45.831	-4.57	.005								
	YI	-0.01345	-1.71	.05								
1-6-2	C	637.581			17.81	.10	.40	1.49	1.64	1.65		
	PT	- 73.569	-5.24	.005								
	YI	-0.01139	-1.28	.10								
1-6-3	C	283.989			13.17	.10	.33	1.49	1.64	1.63		
	PH	- 29.528	-5.10	.005								
	PH	-0.00228	0.54	.50								
1-6-4	C	553.012			36.99	.05	.58	1.49	1.64	1.77		
	PF	- 43.486	-5.97	.005							7.88	-42.84
	OI	- 7.283	-5.51	.005							1.22	- 7.92
1-6-5	C	627.441			33.96	.05	.58	1.49	1.64	1.71		
	PT	- 59.029	-4.95	.005							11.92	-59.14
	OI	- 7.439	-4.98	.005							1.49	- 8.06
1-6-6	C	342.479			34.85	.05	.57	1.49	1.64	1.77		
	PH	- 15.748	-4.84	.005							3.25	-15.44
	OH	- 3.277	-5.41	.005							0.61	- 3.88
1-9-1	C	452.864			16.95	.10	.32	1.57	1.68	1.66		
	PF	- 47.583	-5.41	.005								
	YI	0.00485	-0.78	.25								

Appendix A. Continued

Regr. No.	Variable	Regress Coeffic	"t"	Sig Lvl	"F"	Sig Lvl	R^2	Durbin-Watson Stat Low	Up	Rgres	Std Err	Rgr Non-Z
1-9-2	C	463.341			15.23	.10	.30	1.57	1.68	1.59		
	PT	- 59.849	-4.94	.005								
	YI	0.00402	-0.58	.40								
1-9-3	C	295.002			21.63	.05	.38	1.57	1.68	1.69		
	PH	- 24.447	-6.58	.005								
	YH	0.00023	0.78	.25								
1-9-4	C	451.315			27.97	.05	.44	1.57	1.68	1.66		
	PF	- 36.550	-4.33	.005							8.40	-38.21
	OI	- 4.488	-3.95	.005							1.13	- 4.99
1-9-5	C	461.944			25.70	.05	.42	1.57	1.68	1.59		
	PT	- 35.811	-3.64	.005							0.82	-37.73
	OI	- 4.874	-3.87	.005							1.25	- 4.82
1-9-6	C	326.533			42.65	.025	.54	1.57	1.68	1.74		
	PH	- 20.370	-6.22	.005							3.27	-21.14
	OH	- 2.524	-5.10	.005							0.49	- 2.69
2-1-1	C	407.670			3.05	.50	.26	1.28	1.57	1.34		
	PF	- 29.748	-1.99	.05								
	YI	-0.00515	-0.63	.30								
2-1-2	C	413.450			3.12	.50	.26	1.28	1.57	1.25		
	PT	- 31.426	-2.08	.025								
	YI	-0.00446	-0.54	.40								

Appendix A. Continued

Regr. No.	Variable	Regress Coeffic	"t"	Sig Lvl	"F"	Sig Lvl	R^2	Durbin-Watson Stat Low	Up	Rgres	Std Err	Rgr Non-Z
2-1-3	C	276.081			4.87	.25	.36	1.28	1.57	1.54		
	PH	- 19.456	-3.09	.005								
	YH	-0.00198	0.40	.50								
2-1-4	C	418.220			7.67	.25	.47	1.28	1.57	1.59		
	PF	- 26.593	-2.21	.025							12.00	-24.57
	OI	- 4.413	-2.71	.025							1.63	- 4.81
2-1-5	C	425.450			8.15	.25	.48	1.28	1.57	1.56		
	PT	- 26.954	-2.24	.025							12.04	-25.18
	OI	- 4.581	-2.79	.025							1.64	- 4.92
2-1-6	C	319.707			17.30	.10	.67	1.28	1.57	1.66		
	PH	- 15.889	-3.51	.005							4.53	-16.02
	OH	- 2.872	-4.04	.005							0.71	- 2.97
2-2-1	C	603.835			5.97	.25	.36	1.28	1.57	1.45		
	PH	-203.653	-2.75	.025								
	YI	0.01902	-1.29	.15								
2-2-2	C	724.114			4.30	.50	.33	1.28	1.57	1.35		
	PT	-316.027	-2.44	.05								
	YI	0.01293	-0.58	.40								
2-2-3	C	174.172			7.67	.25	.28	1.28	1.57	1.12		
	PH	- 29.750	-0.90	.20								
	YH	0.00045	0.72	.25								

Appendix A. Continued

Regr. No.	Variable	Regress Coeffic	"t"	Sig Lvl	"F"	Sig Lvl	R^2	Durbin-Watson Stat Low	Up	Rgres	Std Err	Rgr Non-Z
2-2-4	C	586.970			7.00	.25	.30	1.28	1.57	1.54		
	PF	-180.166	-2.55	.025							70.49	-186.36
	OI	- 6.492	-2.11	.025							3.07	- 6.22
2-2-5	C	707.931			5.50	.25	.39	1.28	1.57	1.48		
	PT	-261.078	-2.02	.05							128.9	-274.60
	OI	- 6.780	-1.40	.10							4.83	- 6.12
2-2-6	C	273.355			4.18	.25	.33	1.28	1.57	1.38		
	PH	- 43.386	-1.53	.10							28.30	- 41.42
	OH	- 2.880	-2.64	.025							1.09	- 2.44
2-3-1	C	491.731			1.16	.50	.53	0.55	1.75	1.69		
	PF	- 65.048	-0.91	.25								
	YI	0.00533	0.89	.25								
2-3-2	C	670.650			1.56	.50	.61	0.55	1.75	1.89		
	PT	-143.244	-1.52	.10								
	YI	0.00553	0.65	.25								
2-3-3	C	372.531			2.90	.50	.74	0.55	1.75	1.77		
	PH	- 47.336	-2.04	.05								
	YH	0.00104	0.81	.25								
2-3-4	C	376.844			3.11	.25	.76	0.55	1.75	1.90		
	PF	- 45.929	-0.82	.25							5.55	- 65.89
	OI	- 1.325	-1.35	.15							0.98	- 1.15

Appendix A. Continued

Regr. No.	Variable	Regress Coeffic	"t"	Sig Lvl	"F"	Sig Lvl	R^2	Durbin-Watson Stat Low	Up	Rgres	Std Err	Rgr Non-Z
2-3-5	C	597.014			1.38	.50	.57	0.55	1.75	1.76		
	PT	- 39.904	-0.87	.25							13.44	- 75.66
	OI	- 12.420	-0.69	.25							2.63	- 4.89
2-3-6	C	347.564			772.85	.01	.99	0.55	1.75	2.09		
	PH	- 21.680	-19.1	.005							11.32	- 11.45
	OH	- 4.486	-22.9	.005							1.96	- 6.57
2-5-1	C	727.132			7.14	.25	.48	1.05	1.53	1.55		
	PF	-221.582	-3.76	.005								
	YI	-0.00222	-0.53	.50								
2-5-2	C	810.725			11.46	.10	.60	1.05	1.53	1.66		
	PT	-243.646	-4.42	.005								
	YI	-0.00667	-0.66	.25								
2-5-3	C	645.730			4.00	.25	.34	1.05	1.53	1.46		
	PH	- 89.594	-2.82	.025								
	YH	-0.00251	-0.65	.25								
2-5-4	C	664.275			15.12	.10	.66	1.05	1.53	1.59		
	PF	-157.152	-2.98	.025							52.69	-171.64
	OI	- 4.884	-2.85	.025							1.71	- 4.92
2-5-5	C	735.214			20.86	.05	.73	1.05	1.53	1.56		
	PT	-183.052	-3.66	.005							50.04	-187.08
	OI	- 5.242	-2.84	.025							1.84	- 5.78

Appendix A. Continued

Regr. No.	Variable	Regress Coeffic	"t"	Sig Lvl	"F"	Sig Lvl	R^2	Durbin-Watson Stat Low	Up	Rgres	Std Rgr Err Non-Z
2-5-6	C	474.281			10.28	.10	.57	1.05	1.53	1.55	
	PH	- 68.556	-2.58	.025							26.53 - 72.25
	OH	- 4.122	-2.88	.025							1.43 - 4.61
2-7-1	C	272.788			8.99	.25	.71	0.95	1.54	1.68	
	PF	- 17.055	-2.14	.05							
	YI	-0.00899	-1.61	.10							
2-7-2	C	280.148			10.70	.10	.75	0.95	1.54	1.64	
	PT	- 17.573	-2.36	.025							
	YI	-0.00925	-1.73	.10							
2-7-3	C	198.021			8.72	.10	.71	0.95	1.54	1.54	
	PH	- 13.795	-3.81	.005							
	YH	-0.00238	-0.87	.20							
2-7-4	C	272.941			10.21	.10	.74	0.95	1.54	1.52	
	PF	- 16.364	-2.18	.05							7.52 - 18.40
	OI	- 2.397	-1.87	.05							1.27 - 3.27
2-7-5	C	279.360			12.18	.10	.77	0.95	1.54	1.68	
	PT	- 16.981	-2.42	.025							
	OI	- 2.441	-2.00	.05							1.22 - 2.48
2-7-6	C	201.529			9.79	.10	.73	0.95	1.54	1.59	
	PH	- 14.177	-4.17	.005							3.39 - 16.41
	OH	- 6.886	-1.20	.15							0.57 - 5.92

Appendix A. Continued

Regr. No.	Variable	Regress Coeffic	"t"	Sig Lvl	"F"	Sig Lvl	R^2	Durbin-Watson Stat Low	Up	Rgres	Std Err	Rgr Non-Z
3-1-1	C	354.114			4.23	.25	.46	0.95	1.55	1.04		
	PF	- 20.864	-2.65	.025								
	YI	-0.01030	-1.46	.10								
3-1-2	C	392.498			6.12	.25	.55	0.95	1.55	1.35		
	PT	- 24.771	-3.15	.005								
	YI	-0.01197	-1.66	.10								
3-1-3	C	289.629			3.03	.50	.37	0.95	1.55	0.92		
	PH	- 13.776	-2.39	.025								
	YH	-0.00662	-0.59	.40								
3-1-4	C	311.274			13.23	.10	.72	0.95	1.54	1.76		
	PF	- 14.914	-2.61	.025							5.72	-16.03
	OI	- 3.496	-3.74	.005							0.94	- 4.00
3-1-5	C	342.547			18.62	.10	.78	0.95	1.54	1.89		
	PT	- 18.183	-3.26	.005							5.58	-19.20
	OI	- 3.853	-4.14	.005							0.93	- 4.46
3-1-6	C	263.233			11.78	.10	.70	0.95	1.54	1.61		
	PH	- 8.979	-2.45	.025							3.66	-10.18
	OH	- 3.036	-3.41	.005							0.89	- 3.59

Appendix B. Results of regression, zero opportunity cost of time on weekends
Linear in logs regression (natural logs)

Regr. No.	Variable	Regress Coeffic	"t"	Sig Lvl	"F"	Sig Lvl	R^2	Durbin-Watson Stat Low	Up	Rgres	Std Err	Rgr Non-Z
1-1-1	C	6.34941			35.80	.05	.76	1.21	1.55	1.77		
	PF	-1.15521	-8.46	.005								
	YI	0.00056	0.53	.50								
1-1-2	C	6.39602			39.08	.05	.78	1.21	1.55	1.58		
	PT	-1.20404	-8.83	.005								
	YI	0.00044	0.40	.50								
1-1-3	C	5.84881			14.42	.10	.56	1.21	1.55	1.46		
	PH	-0.83009	-5.23	.005								
	YH	0.00384	0.92	.20								
1-1-4	C	6.18567			142.01	.01	.92	1.21	1.55	1.59		
	PF	-0.91542	-11.1	.005							0.13	-1.01
	OI	-0.07079	-7.1	.005							0.01	0.05
1-1-5	C	6.18220			145.73	.01	.93	1.21	1.55	1.68		
	PT	-0.90742	-10.3	.005							0.13	1.08
	OI	-0.07199	-6.9	.005							0.01	-0.04
1-1-6	C	6.08188			79.98	.025	.88	1.21	1.55	1.58		
	PH	-0.84424	-10.1	.005							0.08	-0.84
	OH	-0.06597	-7.7	.005							0.01	-0.03
1-2-1	C	6.21603			60.21	.025	.78	1.35	1.59	1.67		
	PF	-1.25990	-10.6	.005								
	YI	-0.00070	-0.48	.50								

Appendix B. Continued

Regr. No.	Variable	Regress Coeffic	"t"	Sig Lvl	"F"	Sig Lvl	R^2	Durbin-Watson Stat Low	Up	Rgres	Std Err	Rgr Non-Z
1-2-2	C	6.16615			57.03	.025	.77	1.35	1.59	1.59		
	PT	-1.21340	-10.3	.005								
	YI	-0.00113	-0.29	.50								
1-2-3	C	5.90799			29.36	.05	.64	1.35	1.59	1.56		
	PH	-0.98329	-7.65	.005								
	YH	-0.00016	-0.40	.50								
1-2-4	C	5.94962			233.03	.005	.93	1.35	1.59	1.66		
	PF	-0.97391	-13.5	.005							0.07	-1.17
	OI	-0.06486	-8.63	.005							0.01	-0.07
1-2-5	C	5.93507			234.66	.005	.93	1.35	1.59	1.65		
	PT	-0.95518	-13.9	.005							0.07	-1.13
	OI	-0.06568	-8.94	.005							0.01	-0.07
1-2-6	C	5.79594			174.78	.01	.91	1.35	1.59	1.76		
	PH	-0.83961	-13.0	.005							0.06	-0.95
	OH	-0.06518	-10.2	.005							0.01	-0.07
1-3-1	C	6.62471			9.28	.25	.36	1.34	1.58	1.44		
	PF	-0.70018	-3.79	.005								
	YI	-0.00724	-1.26	.15								
1-3-2	C	6.66167			11.11	.10	.41	1.34	1.58	1.59		
	PT	-0.68680	-3.86	.005								
	YI	-0.00842	-1.44	.10								

Appendix B. Continued

Regr. No.	Variable	Regress Coeffic	"t"	Sig Lvl	"F"	Sig Lvl	R^2	Durbin-Watson Stat Low	Up	Rgres	Std Err	Rgr Non-Z
1-3-3	C	6.18623			6.74	.25	.30	1.34	1.58	1.43		
	PH	-0.59302	-3.60	.005								
	YH	-0.00400	-0.72	.25								
1-3-4	C	5.99531			38.53	.05	.70	1.34	1.58	1.65		
	PF	-0.52445	-4.08	.005							0.12	-0.61
	OI	-0.07463	-6.36	.005							0.01	-0.12
1-3-5	C	6.01444			42.97	.025	.73	1.34	1.58	1.77		
	PT	-0.53233	-4.44	.005							0.11	-0.57
	OI	-0.00761	-6.54	.005							0.006	-0.014
1-3-6	C	5.94372			25.20	.05	.61	1.34	1.58	1.59		
	PH	-0.61259	-5.01	.005							0.12	-0.59
	OH	-0.06126	-5.19	.005							0.01	-0.09
1-5-1	C	3.16408			2.02	.50	.36	0.95	1.54	0.98		
	PF	-0.06904	-1.07	.20								
	YI	0.03350	-1.60	.10								
1-5-2	C	4.35636			00.20	.70	.10	0.95	1.54	0.77		
	PT	-0.08736	-0.48	.40								
	YI	0.00164	0.50	.30								
1-5-3	C	2.61273			1.41	.50	.28	0.95	1.54	1.23		
	PH	-0.47409	-1.58	.10								
	YH	0.00384	1.35	.10								

Appendix B. Continued

Regr. No.	Variable	Regress Coeffic	"t"	Sig Lvl	"F"	Sig Lvl	R^2	Durbin-Watson Stat Low	Up	Rgres	Std Err	Rgr Non-Z
1-5-4	C	3.47236			2.05	.50	.36	0.95	1.54	1.02		
	PF	-0.69041	-1.07	.20							0.64	-0.69
	OI	-0.33498	-1.60	.10							0.21	-0.34
1-5-5	C	4.37145			0.31	.60	.14	0.95	1.54	0.45		
	PT	-0.08736	-0.68	.25							0.40	-0.89
	OI	-0.01639	-0.54	.40							0.003	-0.02
1-5-6	C	2.96592			1.40	.50	.29	0.95	1.54	1.34		
	PH	-0.47409	-1.59	.10							0.29	-0.44
	OH	-0.38375	-1.35	.15							0.28	-0.38
1-6-1	C	7.09100			22.15	.05	.46	1.49	1.64	1.66		
	PF	-0.79200	-5.88	.005								
	YI	-0.01799	-1.34	.10								
1-6-2	C	7.15948			25.82	.05	.50	1.49	1.64	1.57		
	PT	-0.87416	-6.14	.005								
	YI	-0.01678	-1.19	.15								
1-6-3	C	6.17547			20.56	.05	.44	1.49	1.64	1.54		
	PH	-0.79526	-6.29	.005								
	YH	-0.00300	-0.51	.40								
1-6-4	C	6.29853			65.51	.025	.71	1.49	1.64	1.76		
	PF	-0.75397	-7.96	.005							0.09	-0.68
	OI	-0.07206	-7.09	.005							0.01	-0.04

Appendix B. Continued

Regr. No.	Variable	Regress Coeffic	"t"	Sig Lvl	"F"	Sig Lvl	R^2	Durbin-Watson Stat Low	Up	Rgres	Std Err	Rgr Non-Z
1-6-5	C	6.28798			76.89	.025	.74	1.49	1.64	1.68		
	PT	-0.73038	-7.45	.005							0.09	0.64
	OI	-0.07681	-7.35	.005							0.01	-0.04
1-6-6	C	6.14310			66.41	.025	.72	1.49	1.64	1.77		
	PH	-0.71119	-8.05	.005							0.09	-0.67
	OH	-0.06846	-7.16	.005							0.009	-0.05
1-9-1	C	6.44237			60.61	.025	.63	1.57	1.68	1.67		
	PF	-1.08161	-10.9	.005								
	YI	0.00260	0.70	.25								
1-9-2	C	6.42782			58.04	.025	.62	1.57	1.68	1.64		
	PT	-1.08144	-10.5	.005								
	YI	0.00283	0.75	.25								
1-9-3	C	6.29449			51.41	.025	.59	1.57	1.68	1.57		
	PH	-0.99084	-10.0	.005								
	YH	0.00327	0.91	.20								
1-9-4	C	6.13575			149.60	.01	.81	1.57	1.68	1.87		
	PF	-0.78512	-10.0	.005							0.08	-0.99
	OI	-0.06795	-8.13	.005							0.01	-0.07
1-9-5	C	6.14330			145.63	.01	.80	1.57	1.68	1.79		
	PT	-0.77797	-9.86	.005							0.08	-0.97
	OI	-0.06797	-8.18	.005							0.01	-0.07

Appendix B. Continued

Regr. No.	Variable	Regress Coeffic	"t"	Sig Lvl	"F"	Sig Lvl	R^2	Durbin-Watson Stat Low	Up	Rgres	Std Err	Rgr Non-Z
1-9-6	C	6.09289			102.25	.01	.79	1.57	1.68	1.91		
	PH	-0.79577	-10.6	.005							0.07	-0.97
	OH	-0.06220	-8.11	.005							0.01	-0.06
2-1-1	C	6.41615			7.01	.25	.45	1.28	1.57	1.59		
	PF	-0.77241	-3.45	.005								
	YI	-0.00123	-0.49	.50								
2-1-2	C	6.45134			7.42	.25	.47	1.28	1.57	1.45		
	PT	-0.80450	-3.60	.005								
	YI	-0.00098	-0.53	.40								
2-1-3	C	6.18937			7.73	.25	.48	1.28	1.57	1.53		
	PH	-0.68449	-3.78	.005								
	YH	-0.00080	-0.42	.50								
2-1-4	C	6.05626			22.90	.10	.73	1.28	1.57	1.68		
	PF	-0.60824	-3.91	.005							0.14	-0.70
	OI	-0.06169	-4.19	.005							0.01	-0.05
2-1-5	C	6.06512			23.80	.10	.75	1.28	1.57	1.87		
	PT	-0.61238	-3.88	.005							0.15	-0.73
	OI	-0.06124	-4.20	.005							0.02	-0.05
2-1-6	C	5.77885			39.36	.05	.82	1.28	1.57	1.76		
	PH	-0.51123	-4.76	.005							0.11	-0.64
	OH	-0.06455	-5.77	.005							0.01	-0.04

Appendix B. Continued

Regr. No.	Variable	Regress Coeffic	"t"	Sig Lvl	"F"	Sig Lvl	R^2	Durbin-Watson Stat Low	Up	Rgres	Std Err	Rgr Non-Z
2-2-1	C	5.36303			18.03	.10	.68	1.28	1.57	1.54		
	PF	-1.38456	-5.94	.005								
	YI	-0.00141	-0.47	.50								
2-2-2	C	5.25807			18.65	.10	.69	1.28	1.57	1.59		
	PT	-1.31220	-6.10	.005								
	YI	-0.00016	-0.32	.50								
2-2-3	C	5.00521			2.66	.25	.23	1.28	1.57	1.13		
	PH	-0.66307	-1.89	.05								
	YH	0.00404	-0.80	.25								
2-2-4	C	5.26328			38.50	.05	.80	1.28	1.57	1.66		
	PF	-1.10314	-5.66	.005							0.19	-1.38
	OI	-0.07296	-3.30	.005							0.02	-0.05
2-2-5	C	5.24801			36.54	.05	.81	1.28	1.57	1.78		
	PT	-0.97291	-4.98	.005							0.19	-1.29
	OI	-0.07954	-3.35	.005							0.02	-0.03
2-2-6	C	5.19625			11.80	.10	.58	1.28	1.57	1.59		
	PH	-0.82913	-3.32	.005							1.25	-0.73
	OH	-0.07616	-3.88	.005							0.02	-0.03
2-3-1	C	7.25222			6.33	.25	.78	0.55	1.75	1.76		
	PF	-1.56894	-3.24	.025								
	YI	0.00698	1.08	.20								

Appendix B. Continued

Regr. No.	Variable	Regress Coeffic	"t"	Sig Lvl	"F"	Sig Lvl	R^2	Durbin-Watson Stat Low	Up	Rgres	Std Err	Rgr Non-Z
2-3-2	C	7.14288			23.06	.05	.92	0.55	1.75	1.77		
	PT	-1.50153	-6.56	.005								
	YI	0.00580	1.52	.10								
2-3-3	C	6.31058			1.75	.50	.63	0.55	1.75	1.67		
	PH	-0.78554	-0.69	.25								
	YH	0.00022	0.47	.50								
2-3-4	C	6.16675			16.25	.10	.86	0.55	1.75	1.78		
	PF	-0.66308	-1.05	.20							0.06	-1.54
	OI	-0.05692	-1.06	.20							0.005	-0.05
2-3-5	C	6.96809			10.24	.10	.91	0.55	1.75	1.73		
	PT	-1.26122	-2.00	.10							0.06	-1.53
	OI	-0.00922	-0.38	.50							0.006	-0.04
2-3-6	C	5.74730			25.15	.05	.96	0.55	1.75	1.88		
	PH	-0.46559	-3.05	.025							0.13	-2.78
	OH	-0.05603	-4.12	.005							0.01	- .06
2-5-1	C	6.72267			14.94	.10	.66	1.05	1.53	1.52		
	PF	-1.82402	-5.38	.005								
	YI	0.00289	-0.62	.25								
2-5-2	C	6.38734			20.64	.05	.73	1.05	1.53	1.54		
	PT	-1.86629	-5.59	.005								
	YI	-0.00575	-0.99	.20								

Appendix B. Continued

Regr. No.	Variable	Regress Coeffic	"t"	Sig Lvl	"F"	Sig Lvl	R^2	Durbin-Watson Stat Low	Up	Rgres	Std Err	Rgr Non-Z
2-5-3	C	6.58903			14.32	.10	.66	1.05	1.53	1.55		
	PH	-1.50356	-5.20	.005								
	YH	-0.00207	-0.42	.50								
2-5-4	C	5.99069			87.56	.05	.92	1.05	1.53	1.68		
	PF	-1.00068	-7.08	.005							0.20	-1.72
	OI	-0.07468	-4.95	.005							0.01	-0.06
2-5-5	C	5.91958			110.28	.01	.94	1.05	1.53	1.65		
	PT	-0.89566	-5.39	.005							0.16	-1.59
	OI	-0.07911	-7.21	.005							0.01	-0.02
2-5-6	C	6.10080			107.03	.01	.93	1.05	1.53	1.76		
	PH	-1.10696	-8.20	.005							0.13	-1.41
	OH	-0.07078	-8.03	.005							0.01	-0.06
2-7-1	C	6.24307			24.13	.05	.87	0.95	1.54	1.67		
	PF	-1.04733	-5.70	.005								
	YI	-0.00043	-0.41	.50								
2-7-2	C	6.22858			25.34	.05	.88	0.95	1.54	1.55		
	PT	-1.03268	-5.97	.005								
	YI	-0.00061	-0.36	.50								
2-7-3	C	5.87025			14.92	.10	.81	0.95	1.54	1.56		
	PH	-0.78075	-5.04	.005								
	YH	-0.00127	-0.43	.50								

Appendix B. Continued

Regr. No.	Variable	Regress Coeffic	"t"	Sig Lvl	"F"	Sig Lvl	R^2	Durbin-Watson Stat Low	Up	Rgres	Std Err	Rgr Non-Z
2-7-4	C	6.09519			67.59	.025	.95	0.95	1.54	1.67		
	PF	-0.89172	-8.29	.005							0.09	-0.91
	OI	-0.04943	-3.32	.005							0.01	-0.05
2-7-5	C	6.11035			70.15	.025	.95	0.95	1.54	1.63		
	PT	-0.90219	-8.84	.005							0.10	-1.01
	OI	-0.04847	-3.30	.005							0.01	-0.04
2-7-6	C	5.98355			42.49	.025	.92	0.95	1.54	1.58		
	PH	-0.84315	-8.97	.005							0.09	-0.81
	OH	-0.03916	-3.30	.005							0.01	-0.04
3-1-1	C	7.96616			8.37	.25	.62	0.95	1.55	1.53		
	PF	-0.63512	-3.49	.005								
	YI	-0.04713	-2.48	.025								
3-1-2	C	7.12665			10.55	.10	.68	0.95	1.55	1.52		
	PT	-0.67129	-3.94	.005								
	YI	-0.04908	-2.56	.025								
3-1-3	C	7.37435			6.30	.25	.56	0.95	1.55	1.47		
	PH	-0.58162	-3.53	.005								
	YH	-0.03411	-0.88	.20								
3-1-4	C	5.73366			4.88	.25	.49	0.95	1.55	1.45		
	PF	-0.42107	-1.73	.10							0.24	-0.39
	OI	-0.03315	-1.39	.10							0.02	-0.03

Appendix B. Continued

Regr. No.	Variable	Regress Coeffic	"t"	Sig Lvl	"F"	Sig Lvl	R^2	Durbin-Watson Stat Low	Up	Rgres	Std Err	Rgr Non-Z
3-1-5	C	5.85598			6.04	.25	.55	0.95	1.55	1.36		
	PT	-0.48413	-2.04	.05							0.24	-0.43
	OI	-0.03326	-1.33	.10							0.02	-0.03
3-1-6	C	5.43651			13.03	.10	.72	0.95	1.55	1.57		
	PH	-0.31446	-2.15	.05							0.14	-0.39
	OH	-0.04540	-2.69	.025							0.01	-0.02

Appendix C. Results of linear regression, zero opportunity cost of time on weekends, for total data

Linear Variable	Regress Coeffic	"t"	Sig Lvl	"F"*	Sig Lvl	R^2
C	5111.59			26.04	.05	.13
PF	-678.83	-6.76	.005			
YI	-.00051	-0.84	.20			
C	5878.12			26.39	.05	.14
PV	-824.12	-6.51	.005			
YI	-.00080	-1.10	.15			
C	1748.05			32.40	.05	.16
PH	-149.62	-7.52	.005			
YH	-.00306	-1.79	.05			
C	5045.81			26.51	.05	.14
PF	-672.82	-6.76	.005			
OI	- 15.41	-1.23	.10			
C	5698.67			26.48	.05	.14
PV	825.48	-6.58	.005			
OI	- 17.60	-1.17	.15			
C	1613.16			31.90	.05	.16
PH	-151.44	-0.64	.005			
OH	- 49.68	-1.54	.10			

*degrees of freedom = 331.2

Appendix D. Results of log-linear regressions, zero opportunity cost of time on weekends, for total data (natural logs).

Variable	Regress Coeffic	"t"	Sig Lvl	"F"	Sig Lvl	R^2
C	8.4867			76.28	.025	.31
PF	-1.301	-12.05	.005			
YI	-0.029	- 0.75	.25			
C	9.1628			78.00	.025	.31
PC	-1.269	-12.05	.005			
YI	-0.025	- 0.64	.25			
C	8.6429			99.12	.025	.37
PH	-1.363	-13.80	.005			
YH	-0.049	- 1.33	.10			
C	-9.7169			76.66	.025	.31
PF	-1.293	-11.90	.005			
OI	-0.141	- 1.04	.15			
C	-10.2450			78.41	.025	.31
PV	-1.260	-11.91	.005			
OI	-0.13	- 0.99	.20			
C	6.4658			99.84	.01	.37
PH	-1.369	-13.95	.005			
OH	-0.21	- 1.64	.05			

APPENDIX E

Misspecification results in biasing the parameter estimates. For example, assume a true relationship of:

$Y = a + B_1X_1 + B_2X_2 + e.$

Now it is postulated that the relationship is in fact:

$Y = a + b_1X_1 + e.$

The estimate of the true parameters, b, is:

$b_1 = \frac{x_1y}{x_1^2}$, where x, y are differences, between observed and mean.

But this is equivalent, by substitution, to:

$b_1 = \frac{x_1\ (B_1X_1 + B_2X_2 + e)}{x_1^2}.$

Expected value of $b_1 = (B_1)\ \frac{x_1^2}{x_1^2} + (B_2)\ \frac{x_1x_2}{x_1^2} + \frac{x_1e}{x_1^2}.$

It can be shown that x_1e has an expected value, making all the normal assumptions, of zero, and therefore that:

$E(b_1) = B_1 + (B_2)\ k$, where k is a non-zero multiplier.

APPENDIX F

The state and county codes are:

County Number	County Name	Number of Observations
State 1, Utah		
1	Box Elder	25
2	Cache	36
3	Davis	35
*5	*Rich	10
6	Salt Lake	55
9	Weber	73
State 2, Idaho		
1	Bannock	20
2	Bear Lake	20
*3	*Bingham	5
5	Caribou	18
*7	*Franklin	10
State 3, Wyoming		
1	Lincoln	13

*Counties with 10 or less observations

APPENDIX G

ECONOMIC STUDY OF THE CISCO FISHERY OF BEAR LAKE, UTAH-IDAHO

Average Family Income**	0-4000																		
	4000-7000																		
	7000-9000																		
	9000-12000																		
	12000-16000																		
	16000																		
Out-of-State Permit	2-Day																		
	5-Day																		
Over-night	Motel																		
	Other																		
No. Cars Per Group																			
No. "Families" Per Group																			
No. unlicable Children																			
No. Unlic. Children (Over 12)																			
No. Licensed Children * (Over 12)																			
No. Unlic. Adult Fishermen																			
No. Licensed Adult Fishermen																			
Home town, or if part of longer trip, point of origin of this trip																			

* Children: Those still requiring adult support
** If more than one family per group

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