

Jobs or Salmon? The Reliability of Nonuse Stated Preferences

by

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Abstract

This paper reports on results for a graded-pair comparison questionnaire where respondents rate pairs of Pacific Northwest salmon preservation options. Each of the preservation options includes the number of jobs lost and the level of salmon preserved. Ordered-probit analysis is used to estimate WTP for salmon preservation and avoiding unemployment.

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Introduction

Although economists have long recognized that people may have nonuse values for environmental services of a natural resource, such as habitat for an endangered species (Weisbrod, 1964; Krutilla, 1967), people also may have nonuse values for nonenvironmental services, such as jobs associated with the use of natural resources (Rosenthal and Nelson, 1992; Portney, 1994; Nelson, 1995). These values may result from many of the same motives that are thought to influence nonuse values for environmental commodities. For example, the desire to preserve an employment base in a rural area may result from a broader, altruistic concern for preserving rural lifestyles. Traditionally, only nonuse values associated with environmental services have been included in policy decisions. This asymmetric treatment may result in inefficient policy decisions if people do in fact have nonuse values for nonenvironmental services, but those values are not included in benefit-cost decisions.¹ This study tests the hypothesis that positive willingness to pay (WTP) values exist for both environmental and nonenvironmental services.

To test this hypothesis, we designed a methodological study.² The general commodity selected for this study is the trade-off between salmon preservation and job loss in the Columbia River Basin. The Basin represents the largest U.S. habitat for salmon in the lower 48 states, but the population levels of salmon, as well as the number of unique sub-species (called “stocks”), are far below historic levels. Many scientists attribute this decline in the salmon population to the numerous hydroelectric dams within

the Columbia River Basin. Some of these dams delay or prevent the salmon's journey from freshwater streams to the Pacific Ocean and back again to spawn. As a result, some scientists and government officials have advocated removal of some hydroelectric dams as a way to preserve these salmon (U.S. Congress, 1992). Others fear that dam removal will result in job losses in the Columbia River Basin because industries that rely on the inexpensive hydroelectricity will lay-off workers in response to higher electricity costs.

In this paper, we use ordered-probit models to analyze the results of a graded-pair stated preference (SP) survey that asks respondents to rate different options for salmon preservation in the Pacific Northwest. Some of these options contain an increase in the number of threatened salmon stocks preserved, a decrease in the number of jobs, and a monthly surcharge on residential electric bills throughout the United States. Some options represent the status quo, where no threatened salmon stocks are preserved, no jobs are lost, and no surcharge is imposed. WTP estimates for salmon preservation options derive from differences in the respondents' ratings of the paired options.

The questionnaire has two versions, which differ only with respect to the range of attribute levels shown to respondents. The full-range version includes options that preserve as many as 40 salmon stocks, at a cost of up to \$10 per month, with as many as 10,000 fewer jobs in the Pacific Northwest. The low-range version contains options that will preserve only 20 stocks, result in no more than 4,000 jobs lost, and cost no more than \$5 per month. This split-sample design allows us to test a second hypothesis, whether resulting WTP estimates are sensitive to the range of attribute levels seen. The underlying premise is that respondents may not process the specific levels of unfamiliar

attributes, but simply recode the different levels as “high,” “medium,” and “low.” This test is analogous to a contingent valuation (CV) scope test.

Study Design and Administration

In developing the survey instruments, we used state-of-the-art procedures including a computerized, self-administered survey mode, and advanced pretesting techniques such as focus groups, a commodity-definition survey, one-on-one interviews, and a large-scale pretest. To elicit primarily nonuse values for salmon-job trade-offs in the Pacific Northwest, the surveys were administered in Atlanta, GA. A total of 548 respondents participated in the survey, split roughly equally between the two versions.

The computerized questionnaire has five primary sections:

1. Introduction to the survey and background information on salmon and jobs,
2. Five multiple-choice “quiz” questions,
3. The SP section, which contains 12 different pairs of salmon-jobs options, in a graded-pair format,³
4. Opinion/attitude questions, and
5. Sociodemographic questions.

The contents of the survey introduction, the opinion/attitude questions, and the socio-demographic questions are largely conventional. The graded-pair presentation is also conventional, and uses a 9-point scale. However, the “quiz” questions are less typical and merit further description.

The five multiple-choice “quiz” questions reinforce the key facts about salmon-job trade-offs presented in the survey overview section. When respondents answered the

quiz question incorrectly, the computer program provided the correct answer. The average quiz score in our survey was about 75 percent.

These quiz questions provide a way to gauge the respondent’s initial comprehension of the bundled commodity being valued in this study. These quiz questions respond to the NOAA Blue Ribbon Panel’s guideline that the CV practitioner must demonstrate that respondents fully comprehend the commodity they are valuing (58 *Fed. Reg.* 4613). Because this study measures nonuse values, including a method to measure and reinforce respondent comprehension is appropriate.

Theoretical Model

Graded-pair responses are ordinal ratings of utility differences between attribute-level pairs. Estimation strategy thus should account for the discrete, ordinal nature of the response variable. We assume that individual indirect utility can be expressed as a function of commodity attributes and personal characteristics. Specifically, the difference in indirect utility for commodity pair t , dU_t^i , often is specified as a simple linear function of attributes:

$$(1) \quad dU_t^i = V_{Rt}^i - V_{Lt}^i + \varepsilon_t^i = \left[\sum_h \beta_h^i \cdot X_{hRt} + \delta^i \cdot p_{Rt} \right] - \left[\sum_h \beta_h^i \cdot X_{hLt} + \delta^i \cdot p_{Lt} \right] + \varepsilon_t^i$$

where

- U_{st}^i is the difference in utility for individual i for commodity profile t
- $V^i(\cdot)$ is the nonstochastic part of the utility function with L and R denoting the left-side and right-side profiles for pair t , and $t = 1, \dots, 12$,
- X_{st} is a vector of attribute levels in profile t ,
- h indexes attributes

p_{st} is the cost of the commodity profile,
 β^i is a vector of attribute parameters,
 δ^i is the marginal utility of money, and
 ε_{st}^i is a disturbance term.

This specification assumes that attributes neither are substitutes nor complements for each other, so a change in the level of one attribute does not affect the marginal utility of any other attribute. However, because the survey collects 12 responses from each respondent, we estimate a panel model that accounts for correlated errors in each respondent's series of ratings. These errors give rise to a random-effects model where $\varepsilon_t^i = \mu_t^i + \mu^i$, μ_t^i is a common error term, and μ^i is an individual-specific error term.

Although β^i and δ^i are indexed by individual respondents, the effects of personal characteristics on utility differences do not appear directly in Equation (1) because respondent personal characteristics do not vary between the two profiles. Controlling for such variables requires interacting them with commodity attributes or price that do vary between profiles. For example, we can estimate the marginal utility of money as $\mu^i = \mu(Z^i)$ where Z^i is a vector of individual characteristics. Similarly, we can estimate $\beta^i = \beta(Z^i)$.

Given the discrete nature of the ratings data, the appropriate estimation approach is ordered logit or probit, which incorporates both the discreteness and the natural ordering of the data. This study uses ordered probit, which assumes the error term is normally distributed. Most ordered-category data contain no information on how scale might vary across respondents, and thus it usually is normalized uniformly to one.

However, graded-pair data include multiple observations for each respondent, and thus it is possible to obtain scale estimates. We can account for scale by making it a function of personal characteristics. Respondents who have difficulty solving the utility-difference problem and enter random or repetitive ratings will have unusually noisy ratings and thus larger estimated variance and smaller scale. The consistency of a respondent's rating pattern can vary by degree of attentiveness, comprehension of the commodity, age, and other factors.

Empirical Results

Table 1 contains a description of the variables used in the random-effects, ordered-probit models.

Table 2 contains the results of three models. The pooled model includes all the responses from the two versions of the survey. The signs of most of the variables are as anticipated. For the first two attributes, respondents are more likely to prefer profiles with higher levels of salmon preservation and lower levels of job losses. The interaction terms also perform as expected. Profiles with lower levels of job losses are more often selected by respondents who have experienced a recent lay-off in their family and by respondents who display a "pro-jobs" stance in the attitude questions. Profiles with higher levels of salmon preservation are more often selected by respondents who indicate that the level of salmon preservation is the most important attribute.

The marginal utility of money is modeled as a linear function of five covariates plus a constant term. Because WTP is derived through the ratio of job-salmon profile attributes to the marginal utility of money function, a positive coefficient means that an increase in the variables increases the marginal utility of money, thus decreasing WTP.

Respondents who have had a recent lay-off in their family, who indicate that the monthly surcharge is the most important attribute, or who have lived in the Pacific Northwest have lower WTP. Older respondents have a higher WTP. Respondents who indicate that the government is not doing enough to protect the environment have a lower WTP. This result may reflect the opinion that the government, not individuals, should provide for salmon preservation efforts.

The scale variables measure the amount of variance in the error term, indicating the amount of “noise” in the respondent’s ratings. The scale factor is estimated as a function of personal characteristics, thus controlling for heteroskedasticity across respondents. Positive coefficients indicate that subjects have less noise in their ratings. All of the scale variables in this model are positive. Respondents with higher quiz scores, who lived in the Pacific Northwest, who are older, who spent a larger portion of time answering the SP questions, and who are male have less noisy ratings. Rho is the intra-respondent correlation for the panel model. It is positive and significant, indicating that accounting for such correlation is important.

The likelihood ratio chi-square indicates that the overall model is significant at the one-percent level. In addition, this specification correctly predicts nearly 30 percent of the ratings, a 50 percent improvement over purely random responses.

In terms of WTP, this model indicates that respondents on average are willing to pay \$8.54 per month as a surcharge on their utility bill to preserve 20 salmon stocks (nearly 30 percent of the remaining unique stocks). Respondents indicated a negative WTP for job losses, indicating that they would be willing to pay to avoid job losses. To avoid the loss of 4,000 jobs in the Pacific Northwest (0.1 percent of the jobs in that

region), respondents are willing to pay \$2.85 on average. Thus, the results support the hypothesis that individuals have values for this particular nonenvironmental commodity.

Table 2 also contains the modeling results for two additional models, corresponding to each version of the questionnaire. The full-range version's results are similar to the pooled model. The most striking difference is that the coefficient on job levels now is insignificant, as is the coefficient on M_PNW in the marginal utility of money function. Despite some differences in the estimated parameters, the WTP values from this model are statistically indistinguishable from the WTP results from the pooled model.

The third model summarized in Table 2 represents the low-range version of the survey. These coefficients and significance levels are somewhat different. Most apparent is that several variables (I_LAIDOFF, M_NOTENOUGH, S_PNW, S_MALE, S_PERTIME) become insignificant. The average WTP value for preserving 20 salmon stocks remains around \$8.00, but the average WTP for avoiding the loss of 4,000 jobs is higher, more than \$4.00. However, these WTP estimates are not statistically different from the WTP estimates from the pooled model at the 90-percent confidence interval. There are larger confidence intervals around the WTP values from the low-range model.

Discussion of Results

These results demonstrate that individuals have nonuse values for nonenvironmental goods, based on their WTP to avoid job losses by others. One possible implication is that if nonuse values for changes in environmental goods or services are included in a benefit-cost analysis, then nonuse values for any associated changes in nonenvironmental goods and services also should be included. In this specific example,

ignoring the nonuse values for nonenvironmental services would result in an overall WTP for salmon preservation that is more than 30 percent too large.

Although there are differences in parameter estimates, the ratio of attribute parameters to the marginal utility of money is statistically the same across all three models. For our sample sizes, WTP estimates for both salmon preservation efforts and job-loss avoidance are not statistically different across the two versions of the questionnaire. These results did not demonstrate any sensitivity to the range of attribute levels. This finding suggests that respondents did pay attention to the specific levels of the salmon preservation efforts.

SP techniques appear to offer some promise in measuring nonuse values. This approach explicitly captures the marginal trade-offs in bundled commodities, which is the basis of welfare estimation. The repeated nature of the exercise provides multiple data points from each respondent. This relative richness of the data may permit the design and implementation of better reliability tests.

Application of these techniques is not without challenges. Respondent comprehension of the commodity remains a critical issue. Incorporating a “quiz” into the process can help identify and control for respondents who may not fully understand the commodity. Our results indicate that respondents with higher quiz scores have less noisy responses.

One area for future research is exploring whether respondents experience any learning or fatigue effects during the course of the survey (Johnson and Desvousges, 1997). Another research issue is the type of elicitation format and the sensitivity of results to this format. How would collapsing the scale to 5 or 7 points affect the results

of a graded-pair format? How do the results from a graded-pair approach compare to the results for a dichotomous, but repeated, choice among commodity profiles? Related to this issue is the development of guidelines for identifying respondents who reveal inconsistent preferences or who are “protesters” and determining whether their data should be included in subsequent analysis.

Footnotes:

¹ Some economists may argue that because jobs lost in one place are gained in another, these types of “transfers” have no role in benefit-cost analysis. However, from a nonuse perspective, it is not the actual displaced wages that may matter to people. What may matter to people is that others experience trauma when a job is lost and they uproot the family to secure employment elsewhere. Knowing that others suffer may cause a loss in utility for some individuals. This uncompensated loss in welfare is analagous to welfare losses associated with environmental existence values.

² This methodological study was not designed to produce representative nonuse values for the selected commodities. The results are not based on a random sample for the purpose of generalizing values to any population. Therefore, researchers or policy analysts should not transfer any of the results contained in this paper.

³ The survey actually included 15 ratings, where the first three profile pairs were repeated at the end of the series. For purposes of this analysis, the first three pairs were dropped from the statistical analysis.

Table 1. Description of Explanatory Variables in Models

VARIABLE NAME	DESCRIPTION
<u>Ordered-Probit Variables:</u>	
SALMON	The difference in the number of threatened salmon stocks preserved
JOBS	The difference in the number of jobs lost
I_PROJOBS	Respondent's "pro-jobs" rating, based on factor analysis of responses to attitude questions, interacted with job levels
I_LAIDOFF	Dummy variable for whether respondent or family member had been laidoff in the last 12 months, interacted with job levels
I_MOSTSALMON	Dummy variable for respondent indicating that the number of preserved salmon stocks was the most important attribute, interacted with salmon levels
<u>Marginal Utility of Money Variables:</u>	
M_COST	The natural log of the difference in the monthly surcharge
M_AGE	Respondent's age (mid-point of the age category)
M_LAIDOFF	Dummy variable for whether respondent or family member had been laidoff in the last 12 months
M_PNW	Dummy variable for whether respondent had ever lived in the Pacific Northwest
M_MOSTCOST	Dummy variable for respondent indicating that the monthly surcharge was the most important attribute
M_NOTENOUGH	Dummy variable for respondent indicating that the federal government does not do enough to protect the environment
<u>Scale Variables:</u>	
S_AGE	Respondent's age (mid-point of the age category)
S_SCORE	Respondent's quiz score (percent correct)
S_PNW	Dummy variable for whether respondent had ever lived in the Pacific Northwest
S_PERTIME	Proportion of SP completion time to total survey completion time
S_MALE	Dummy variable for respondent's sex

Table 2. Model Results

Variable	POOLED MODEL		FULL-RANGE MODEL			LOW-RANGE MODEL	
	Coefficient	T-ratio	Coefficient	T-ratio	Coefficient	T-ratio	
SALMON	0.488	5.98 ***	0.501	4.87 ***	0.448	2.98 ***	
JOBS	-0.011	-2.80 ***	-0.006	-1.29	-0.020	-2.14 **	
I_PROJOBS	-0.689	-3.41 ***	-0.438	-1.89 *	-1.629	-3.59 ***	
I_LAIDOFF	-0.198	-2.81 ***	-0.182	-2.17 **	-0.111	-0.68	
I_MOSTSALMON	0.457	5.31 ***	0.287	2.89 ***	1.015	5.23 ***	
M_COST	0.006	0.23	-0.034	-0.97	0.051	1.16	
M_PNW	0.035	2.37 **	0.012	0.67	0.097	3.08 ***	
M_AGE	-0.416	-8.13 ***	-0.355	-5.37 ***	-0.531	-6.06 ***	
M_MOSTCOST	0.035	2.29 **	0.033	1.67 *	0.070	2.82 ***	
M_LAIDOFF	0.079	3.48 ***	0.068	2.26 **	0.074	2.01 **	
M_NOTENOUGH	0.047	3.79 ***	0.062	3.94 ***	0.031	1.41	
S_AGE	0.500	5.41 ***	0.444	2.75 ***	0.853	6.67 ***	
S_SCORE	0.291	8.37 ***	0.289	4.64 ***	0.302	6.48 ***	
S_PERTIME	0.351	2.04 **	0.480	1.87 *	0.069	0.30	
S_PNW	0.114	2.95 ***	0.232	3.28 ***	0.039	0.73	
S_MALE	0.049	2.22 **	0.117	3.00 ***	-0.034	-1.21	
ALPHA1	-1.638	-70.22 ***	-1.679	-46.94 ***	-1.559	-49.11 ***	
ALPHA2	-0.764	-34.37 ***	-0.767	-22.16 ***	-0.712	-24.56 ***	
ALPHA3	0.025	1.55	-0.020	-0.83	0.078	3.50 ***	
ALPHA4	0.258	15.95 ***	0.184	7.88 ***	0.326	14.28 ***	
RHO	0.335	29.07 ***	0.317	19.32 ***	0.327	19.86 ***	
GOODNESS OF FIT STATISTICS							
Likelihood Ratio Chi-Sq.	3,165***		1,579***			1,604***	
Madalla's pseudo-r ²	0.38		0.39			0.37	
Percent Correctly Predicted	29.75		30.85			29.11	
Number of Observations	6,576		3,144			3,432	
Number of Respondents	548		262			286	
MEAN WTP ESTIMATES (\$ per month)							
	Point Estimate	90 Percent Conf. Intv.	Point Estimate	90 Percent Conf. Intv.	Point Estimate	90 Percent Conf. Intv.	
20 Salmon Stocks	8.54	7.04 10.78	8.57	6.85 11.35	8.29	6.02 13.62	
4,000 Jobs	-2.85	-1.04 -5.57	-1.59	-0.00 -4.52	-4.30	-0.66 -13.24	

*** Significant at the 1 percent level

** Significant at the 5 percent level

* Significant at the 10 percent level

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