An Empirical Evaluation of Experienced-Based Learning: A Ropes Course Illustration

A Selected Paper for the 1999 AAEA Annual Meeting

by

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Introduction

There has been increasing concern that the statistical estimates of the mean willingness to pay (WTP) for public goods may be biased as the statistical method or survey mechanism (as in Contingent Valuation Method, henceforth, CVM) may fail to consider the effects of substitute programs. Economic theory posits that when two or more items are competing for the same limited resource, an increase in expenditure on one, ceteris paribus, reduces spending on the other. So the WTP for a specific program or good depends on what substitutes or complements exist and are considered for that good. Any valuation program that neglects the presence/availability of budgetary substitutes and complements leads to a biased valuation of the public good in question.

The purpose of this paper is to present an outline of the substitution and sequencing test and provide results of a test involving voluntary checkoffs to see how the agenda presented to the respondents affect the valuation for one good, particularly, the nongame wildlife and endangered species fund. The success of nongame wildlife checkoff programs that emphasize saving non-game wildlife and endangered species allowed the rapid development of other competing programs in most states. On the 1996 tax returns to be processed in 1997, a survey conducted by Federation of Tax Administrators identified 163 check-off programs available to taxpayers in 41 states and the District of Columbia (In 1994, there was a total of 156 programs). This study uses aggregate data on checkoffs to examine donation behavior of the respondents. In the field of experimental economics, a 'valid' experiment requires two things: one, the clarity of payment mechanism and second, the provision rule, that is, what does the respondent get for the money he or she donates? In our experiment, both the rules are satisfied. The mode of payment is dollars and the end product of such a contribution is a change in the quantity of the good in question. So check-offs are acting as an indicator of people's donation levels for specific public goods.

Testing for Substitution Effects

Empirical Model, Estimation and Results

Our first task is to use an empirical model in a form that allows for statistical analysis. Empirical testing for the presence of substitution effects would be carried out with the use of a theoretically consistent functional form. The compensating variation function, similar to a production function is continuous, is concave and allows for the presence of substitution or complementarity effects. The compensating variation (CV) of a move from one situation to another is defined as the amount of money a contributor gives up in the new situation in order to stay as well off as before. So, we derive the benefit measure using the consumer expenditure function. Theoretically, the expenditure function (for q bundle of goods at prices *p*, and utility level *u*) takes the following form:

$$\min \sum p_i q_i \text{ subject to } u(q_1, \ldots q_n) = u \qquad (1.1)$$

The first order conditions to this problem are solved for the choice variables q_i in terms of the exogenous variables *p* and *u* or,

$$q_i = q_i(p, u) \qquad (1.2)$$

These represent the compensated demand functions for the good q_i and the expenditure function is derived as follows;

$$e(p, u) = \sum p_i q_i(p, u) \qquad (1.3)$$

Employing Hotelling's Lemma, we get the compensated demand functions by taking the derivative of the expenditure function with respect to prices:

$$\partial e(p, u) / \partial p_i = q_i(p, u) \qquad i = 1, \ldots, n \qquad (1.4)$$

Thus, CV is written as $CV = m^1 - e(p^1, u_0)$ (1.5)

We have modified the Cummings *et al.* (1994) model to accommodate our data. We define five endogenous variables- nongame wildlife (w), games and sports (g), education (e), children (c) and seniors (s)[1]. These are the most common funds in state income tax check-offs. The model is expressed as below:

$$\begin{aligned} Y = \sum \beta_i X_i &\textit{(single program effects including tax, income)} \\ &+ \sum \gamma_i X_i \textit{(refund effect)} \\ &+ \sum \beta_{ij} X_i X_j \textit{(program - interaction effects)} \qquad (1.6) \\ &+ \sum \beta_{iM} X_i M \textit{ (income effects)} \\ &+ \sum \beta_{iT} X_i T \textit{ (Tax status effects)} + e \end{aligned}$$

Here, Y is the reported average voluntary contribution to all programs summed together and X represents average (non-zero) contributions per contributor to the specific fund categories. M stands for personal median income of the state and T represents average state income tax receipts for each state for the fiscal year under consideration. The residuals are captured in the error term, e, which is assumed to be normally distributed. The reason behind the use of 'per contributor' data instead of 'per taxpayer' is the very low participation rates in the check-off programs. Many states limit the size of donations to the size of the refund, while some states permit taxpayers to increase their payments to cover check-off donations (cited in FTA Newsletter, March 1997). Hence, we use a dummy variable to capture this effect where the

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[1]Note that these programs are broad categories which is inclusive of all related programs, e.g., "sports" includes programs related to Olympics, bluegrass games, etc. and "seniors" includes both seniors and veterans programs.

dummy variable takes the value one, if the income tax form includes an option for individuals not receiving a refund to contribute to the check-off programs, and 0, otherwise.

To check for the existence of substitution effects between the different programs, we use real contributions as opposed to the binary variables used in Cummings, *et al*. Substitution effects between the check-off programs are defined here in terms of how the presence or inclusion of a program affects the marginal valuation of the other programs. The second order or cross product terms from the substitution matrix **H** has both same program and cross program effects. These second order program effects represent terms in the matrix of the form $\partial^2 s/ \partial p_i \partial p_j$ as they represent the effect of a change in valuation for program j on the marginal valuation of program i. If p_i and p_j are substitutes, then this term will have a negative sign, if they are complements, the sign will be positive and if the programs are viewed as independent by the respondents, then the term will be zero. The results of our estimation are listed in table 1.1. The estimated coefficients under varied parameter restrictions are presented in each of the three columns. The estimated mean donation levels by the contributors for each program for the entire data set of 30 states from 1984-1994 along with their standard errors is also reported in the table.[2]

Comparing the coefficient estimates across the models, we notice that the estimates are stable. In the first model, we notice that the single program terms are significant. The performance of the model is indicated by their respective adjusted R-squares. Most of the program interaction terms suggest that the programs are substitutes. The effect of option of contribution only from refunds is also significant. This implies that the average (non-zero) contributions to wildlife are significantly increased in those states that allowed all taxpayers to contribute to the fund. So, if policy makers are interested in increasing funds received from the

[2] Alabama, Arizona, California, Colorado, Connecticut, Delaware, Idaho, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Montana, Nebraska, New Jersey, New York, North Carolina, North Dakota, Ohio, Oregon, Pennsylvania, Rhode Island, South Carolina, Utah, Virginia, Vermont and Wisconsin

wildlife fund, states that allow payments to be made only from refunds should change this clause. Notice also that the tax receipts for each state have a positive and significant influence on contributions in all models while individual income has a negative and significant influence on contributions. This is a somewhat surprising result that indicates check-offs as a regressive source of revenue. This same conclusion is also reached by Revier and Harpman in 1992. However, in all the models, the marginal impact of both median income and tax receipts is extremely low. For the full model, the program-income interaction terms and the program-tax interaction are also significant.

We also tested for the independence of the different programs by using a Wald test which rejected the null hypothesis at 1% level of significance implying that the programs are not independent. This implies the respondent's valuation for a particular program is affected by the inclusion of other programs in the agenda. To investigate this issue further, we checked whether differences in mean donations exists with changes in the number of programs in the scheme. Results are reported in table 1.2. As the table indicates, the total average (non-zero) contributions decline by greater magnitude as the number of categories increases. So, our conclusion is that the contributors view very disparate public goods as either substitutes or complements.

Sequencing Effects- How Do They Affect Valuation?

Question-order Effects

Current literature on CVM studies places importance on sequencing effects. Sequencing occurs when several projects are evaluated in a sequential manner, and the willingness to pay for items shown later in the sequence keeps declining. This implies that respondent's assessment for values are interdependent, when they actually should be independent. When respondents have a fixed budget that they allocate for donations, then they perceive a wealth effect (Samples and Hollyer, 1990). Respondents tend to donate generously to the category that they first value, and hence, have lesser resources to donate for the subsequent categories, thus leading to a question order bias.

A formulation of the problem of valuation under sequencing effects is presented next. Consider an individual with the utility function;

$U = U(x_1, x_2, x, \mathbf{Q}, \mathbf{y})$ (2.1)

where x is the bundle of goods to be valued, **Q** is the current policy agenda and **y** is the vector of private goods and services. The subscripts denote goods valued in the sequence.

The solution to the problem is;

$\min (p_1 x_1 + p_2 x_2 + \mathbf{py})$ subject to $U(.) \geq U^0$ (2.2)

Assuming prices for private goods and services to be exogenous, the expenditure function takes the form;

$e = e(p_1, p_2, \mathbf{Q}, U^0)$ (2.3)

So, the Hicksian compensating surplus measure would be equivalent to:

$CV = e(p_1^*, p_2^*, \mathbf{Q}^0, U^0) - e(p_1^0, p_2^*, \mathbf{Q}^0, U^0) + e(p_1^*, p_2^*, \mathbf{Q}^0, U^0) - e(p_1^0, p_2^*, \mathbf{Q}^0, U^0)$

where $e(p_1^*, p_2^*, \mathbf{Q}^0, U^0) - e(p_1^0, p_2^*, \mathbf{Q}^0, U^0) \geq e(p_1^*, p_2^*, \mathbf{Q}^0, U^0) - e(p_1^0, p_2^*, \mathbf{Q}^0, U^0)$

due to the effect of question order bias.

Carson and Mitchell(1993) agree that sequencing matters and that people place less value on a particular good when it is placed down in a WTP sequence, but the opposite holds for WTA sequence. Kahnemann and Knetsch (1992) note that one problem in working with the top-down allocation framework is ambiguity as conditions under which the goods are provided are not well specified and it is up to the respondents to make different assumptions about these conditions. In our check-off model, the wildlife fund and the childrens' fund are the most common funds among states. Among the thirty states that we use, all the states have wildlife fund and twenty-eight of them have children fund too. Hence, we examine these two funds for the year 1994 to check for the presence of sequencing effects.[3]

[3]Year 1994 is chosen because of the availability of tax-forms for that year alone.

Model Specification and Testing

To examine the effects of asking respondents to respond to a number of sequential questions in a single tax form, we created two separate equations for average (non-zero) contributions to the wildlife and the childrens' funds separately. A simple ordinary least square regression model was run to capture the sequencing effect by the use of a dummy variable. The equations are represented as follows:

$$WAVG = \beta_0 + \beta_1 DUM1 + \beta_2 NUMBER + \beta_3 AVG + \beta_4 INC \qquad (2.4)$$

$$CAVG = \gamma_0 + \gamma_1 DUM1 + \gamma_2 NUMBER + \gamma_3 AVG + \gamma_4 INC \quad (2.5)$$

WAVG and CAVG are the average (non-zero) contributions per contributor for the wildlife and the childrens' fund in the year 1994. DUM1 is a dummy variable which takes the value 1, when wildlife is placed first in the sequence and 0, otherwise. Similarly, DUM2 is the binary variable, taking the value 1 when children fund immediately follows the wildlife fund and 0, otherwise. NUMBER represents the number of categories in the sequence of funds to be valued, AVG is the total average (non-zero) contributions per contributor to all funds summed together and INC is the median income of the state for that year. Since we are limited by the unavailability of individual data on income, we use the median income of the state as a proxy for the average income of the contributor. The results of our regression are expressed in table 2.1. The t-statistics are expressed in the parentheses.

The above regression confirms the existence of a sequencing effect as both the dummy variables are significant and positive at 5 % level of significance with a magnitude of $1.75 and $2.43 respectively. Number of categories as well as total average (non-zero) contributions have a positive and significant influence on average (non-zero) contributions. Notice that median income has a significant and positive influence on average (non-zero) contributions for wildlife but it ceases to be significant for the childrens' fund.

Now, using the terminology developed by Samples and Hollyer (1990), let the value for wildlife (W), given the presence of children (C) at the 1994 price level be defined as WTP

(W|C) and similarly, the value of children, in the presence of wildlife is represented as WTP (C|W). Now, if respondents perceive wildlife and children to be substitutes, then WTP (W|0)[4] > WTP (W|C) because the value of a good is greater in the absence of its substitutes. In our dataset, the above is found true as the mean WTP(W| 0) averaged over 9 states is $9.14, while WTP(W|C) averaged over 22 states is $7.74.

Next, we carried out a test wherein we seek to check if value attained for W is higher if it is placed first in the sequence than if it is placed lower, i.e., if $WTP(W_1)>WTP(W_2)$ or not. A similar exercise is also carried out for childrens' program when children is placed second in the sequence than when it is placed lower. The results of this exercise are summarized in table 2.2. We notice the WTP for both the programs varied depending upon their placement in the check-off sequence.

Results of the Sequencing Test

Our exercise confirms that the sequencing effects exist in the check-off donations and therefore, values elicited under different sequential setting differ. This leads us to believe that problems encountered in a CVM questionnaire that inhibit researchers' ability to get 'valid' estimates also exist in the checkoff mechanism. Perhaps, this occurs due to the differences respondents perceive in the choice set made available to them by believing that the programs are ranked according to their relative importance.

People may have a relatively inflexible budget that they allocate for donation purposes and are willing to pay more for the good they donate to first, thus leading to a smaller budget for the

[4]WTP(W|0) implies value of W in the absence of C.

subsequent programs. Hence, the possible inability of respondents to be ‘insensitive’ to the sequence of questions is an issue that suggests a possible avenue for further research.

Summary of the Estimation Results

Overall, our study supports the importance of agenda effects in influencing the level of payments for environmental improvements. As in CVM, voluntary donations also depend upon the order of options and the presence of substitute options. Hence, donations as a welfare measure needs to be examined more critically. Therefore, the reliability of this mechanism in interpreting these statistics as donation levels or willingness-to-pay in some narrow sense needs more rigorous research.

Table 1.1 : Variation Function Parameter Estimates and Statistics[a]

Independent variables[b]	No restrictions	No program and income/tax program interactions	No income/tax program interactions
Refund (R)	0.23* * (0.084)	0.22* (0.091)	0.16* (0.078)
Wildlife (W)	0.48* * * (0.018)	0.47* * * (0.013)	0.50* * * (0.011)
Children (C)	0.23* * * (0.071)	0.06* * (0.016)	0.28* * * (0.085)
Seniors (S)	0.09* (0.110)	0.17 (0.020)	0.04* (0.056)
Games and Sports (G)	0.50* * * (0.093)	0.04* (0.023)	0.40** * (0.075)
Education (E)	0.24* (0.140)	0.20* (0.022)	0.19* (0.141)
Tax (T)	0.003* * * (0.001)	0.002* * * (0.001)	0.020* (0.000)
Income (I)	-0.002* * * (0.002)	-0.001* (0.003)	-0.010* (0.000)
W*C	-0.012* * * (0.004)	-	-0.016* * * (0.003)
W*S	-0.003* (0.007)	-	0.001 (0.210)
W*G	-0.029* * * (0.005)	-	-0.025* * * (0.005)
W*E	-0.018** (0.008)	-	-0.016* (0.008)
C*S	-0.009 (0.005)	-	-0.001 (0.003)
C*G	-0.001 (0.007)	-	-0.001 (0.003)

Independent variables[b]	No restrictions	No program and income/tax program interactions	No income/tax program interactions
C*E	-0.003* (0.020)	-	-0.003* (0.003)
S*G	-0.012* (0.005)	-	-0.002 (0.004)
S*E	-0.006 (0.007)	-	-0.001 (0.003)
G*E	-0.009* (0.005)	-	0.006* (0.005)
W*I	0.161* * * (0.001)	-	-
C*I	0.101 (0.001)	-	-
S*I	-0.200 (0.000)	-	-
G*I	-0.000 (0.001)	-	-
E*I	0.001* (0.001)	-	-
W*T	-0.004* * * (0.000)	-	-
C*T	-0.003* (0.000)	-	-
S*T	-0.000 (0.000)	-	-
G*T	-0.000 (0.000)	-	-
E*T	-0.002 (0.009)	-	-

Independent variables[b]	No restrictions	No program and income/tax program interactions	No income/tax program interactions
Adjusted R-square	0.89	0.82	0.88
F-value	88.391	188.95	124.82
Degrees of Freedom	283	304	293

[a] Standard errors in parentheses;
* * * implies significance at 1% level
* * implies significance at 5 % level
* implies significance at 10% level
[b]Mean values of variables where number of observations equal 313: W = 5.48; C = 2.12; S = 0.90; G = 0.90; E = 0.57; I = 33,976; T = 457.

Table 1.2 : Magnitude of the Agenda Problem

Number of categories	Proportion of wildlife contributors to total contributors	Average donations to wildlife	Number of observations
One	1.00	$7.37	96
Two	0.55	$5.63	42
Three	0.42	$3.27	26
Four	0.33	$2.47	42
Greater than four	0.24	$1.62	43

Table 2.1: Testing for a Question Order Effect for year 1994 [a]

Explanatory Variables (Number of Observations: 28)	Equation 1 (Dependent variable - WAVG) Adj. R-square 0.88 F- value 62.38	Equation 2 (Dependent variable - CAVG) Adj. R-square 0.49 F-value 10.93
DUM1	1.75 (3.12)	-
DUM2	-	2.43 (2.03)
NUMBER	0.33 (4.48)	1.05 (4.40)
TOTAL AVERAGE	0.90 (11.24)	0.61 (2.40)
MEDIAN INCOME	5.36 (1.40)	-7.20 (-0.56)

[a] T-statistics are shown in parentheses

Table 2.2: Mean Values of Wildlife and Children under the Sequencing Effect

Test Version	Program valued	Mean values (WTP)	N
Total of 30 states where W is placed before C	W C	$ 8.18 $ 3.40	30 28
When W is not placed first in the sequence	W C	$5.12 $4.22	4 4
When W is placed first in the sequence	W C	$ 8.73 $ 3.26	26 24
When W is the only program to be valued	W	$ 9.14	8
When there are more than one programs	W C	$ 7.74 $ 5.50	22 19
When C is placed immediately after W	W C	$8.39 $ 5.94	9 9
When C is placed much lower in the sequence	W C	$8.06 2.20	21 19

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