Gender and Willingness-to-pay for Recreational Benefits from Water Quality Improvements

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Abstract. The economics literature has recently turned its attention to the existence of gender differences in various aspects of choice behaviour. This paper focuses upon such differences as may exist in the valuation of environmental resources. Firstly, the paper presents several reasons why women are expected to have a lower willingness-to-pay (WTP) for environmental improvements than do men. Secondly, in order to establish the empirical extent of gender differences the paper presents a model for estimating individual-specific benefits from environmental improvements. CVM referenda data from are collected and used in a double-bounded probit model to estimate female versus male WTP for remedial actions designed to improve three different water-based recreational activities in a previously highly polluted area. For these data, the paper finds that, even after controlling for income differences, women consistently have lower WTP values. The findings in this paper have potentially important consequences for the subsequent calculation of aggregate benefits from contingent valuation models that ignore the role of gender. Since women generally constitute about one half of a population base, turning a blind eye to gender means that aggregate WTP values will overstate the extent of benefits from environmental improvements.

Keywords: non-market valuation, gender, willingness-to-pay, recreation

1. INTRODUCTION

Non-market benefit estimation techniques such as contingent valuation have been used extensively to elicit the population's valuation of environmental improvements. Over the last fifteen years economists have scrutinized these techniques keenly. The literature has focused upon a wide range of issues including the theoretical basis for willingness-to-pay measures, the correct method to implement survey vehicles to obtain the necessary data, and the specification of the estimating equations (Hanemann, 1994; Diamond and Hausmann, 1994).

While concern has been expressed in the literature about the appropriate method for aggregating the estimated mean or median WTP values for heterogeneous groups in society (Swallow et. al., 1994), there has been no explicit examination of the issue of gender differences. The social psychology literature suggests that women are likely to answer valuation questions in a fashion that is systematically different from men (Stern et al., 1993). While gender is not a variable that is frequently used to obtain WTP values, a review of the recent economics literature that does gender supports the
social psychology view. In particular, women have significantly lower valuations than men in a number of recent dichotomous choice contingent valuation models (Kealy, et al., 1990; Cameron and Englin, 1991; Swallow et. al., 1994; Alberini et al., 1995).

This paper examines this gender difference phenomenon. First, it discusses the reasons why women might be expected to have lower WTP values than their male counterparts. Second, using data from a contingent valuation study of recreational improvements for Hamilton Harbour, the paper discusses how to obtain individual-specific WTP estimates for three different types of recreational activity in the Harbour. Mean values from these individual estimates are compared for men and women. The paper concludes with a discussion of the importance of including gender in contingent valuation studies and the dangers of a potential bias in aggregate benefits when gender is ignored.

2. CONCEPTUAL FRAMEWORK

In order to obtain WTP measures for environmental quality improvements leading to better recreational opportunities, this paper adopts a constructed markets (Carson, 1991) or contingent valuation framework. An hypothetical scenario is described to survey respondents. They are asked to "vote" for or against the payment of a specific amount of money in order to fund the activities that will lead to the outcome described to them. In making their decision, it is assumed that survey respondents answer as if they are using an expenditure function (E) as the basis for their answer. This function depends upon the vector, **P**, of prices of market goods, two different levels of environmental quality (the base level and the improved level), base utility, U^0, and selected socio-demographic characteristics that act as individual taste parameters.

Suppose the level of the environmental good (q) increases from q^0 to q^1, then the difference between two expenditure functions represents the Hicksian compensating surplus or maximum WTP for this increase. This is shown in equation (1).

$$WTP = E\ (\mathrm{P}\ , q^0;\ U^0, T\ ) - E\ (\ \mathrm{P}, q^1; U^0, T\ ) \tag{1}$$

This expression says that the value that an individual places upon the (marginal) change in the quantity of the environmental good is equal to the reduction in expenditure on purchased goods that is necessary to achieve the utility level obtained prior to the improvement in the environmental good. The first component of the right hand side is simply the individual's nominal income, y^0. Thus, an individual's WTP has an upper bound equal to that person's income and a lower bound equal to zero.

It is now possible to discuss the nature of differential valuations for recreational service flows as expressed by men and women. Gender differences may arise in various ways. First, assuming that men and women have the same tastes for recreational activities and identical expenditure functions, it is possible to have differences in their valuations of marginal improvements. These might arise because of systematic, gender-related differences in constraints such as income and time available for recreational activities. There is Canadian evidence to suggest that women systematically earn less than men (Scott and Lochhead, 1997; Drolet, 1999) even after controlling for hours of work and type of employment. There is also evidence to suggest that women spend more time than men on family-related service flows (e.g., child-care, household maintenance, etc.) and have less time available to devote to leisure activity (Deem, 1982; Harrington and Dawson; 1995; Statistics Canada, 1999). For example, a recent general social survey on time use shows that average free time for males aged 25-34 is 5.2 hours per day while the comparable figure for females in the same age group was 4.7 hours. Furthermore, average daily time spent on active leisure for males in this age group was one hour, while for females it was 0.7 hours. Given these observations it is reasonable to expect that the upper bound on the WTP for a woman would be on average lower than that for a man. Furthermore, given a normal distribution of WTP values, the mean WTP for women would be lower than for men.

A second possible reason for gender differences in valuation is that men and women may have different tastes for recreational activities. These may, in turn, be related to skill acquisition. If enjoyment of recreational activities requires the prior acquisition of skills, then those individuals who are more time-constrained (and thus less experienced) are likely to have lower valuations of improvements to those activities (Shaw and Jakus, 1996; Smith, 1997). As discussed above, there is evidence to suggest that Canadian women have less time available for recreational activities.

3. EMPIRICAL FRAMEWORK

Equation (1) cannot be estimated as shown. However, as Willig (1976) shows, it can be expressed as a WTP function in equation (2).

$$WTP = f\ (\mathrm{P}\ , q^1\ ,\ q^0,\ y^0, T\ ) \tag{2}$$

This can be used as the basis for developing an empirical model to estimate gender-dependent WTP functions for recreational improvements using data from a referendum-type contingent valuation question (Cameron and James, 1987). To implement this approach, the researcher assumes that each individual has an unobserved true WTP for an environmental improvement that depends upon one's income, gender, socio-demographic characteristics, and tastes.

This function is represented in equation (3) where log WTP_i is the log of the unobserved WTP for the ith respondent, x_i represents a Mx1 vector of relevant variables for the ith respondent, G_i represents a dummy variable taking on a value of 1 if the ith respondent is male and 0 if the ith respondent is female, and ε_i is the error term assumed to be normal with mean zero and standard deviation, σ. (There are a number of ways in which gender differences could be incorporated into the estimation model. The one chosen for this work represents the most accessible. Two alternatives have been examined in preliminary work. The first uses gender interaction terms with the elements of the M vector of socio-demographic characteristics, notably, income. Early work with this formulation was stymied by the high degree of collinearity in the variables. A second alternative is to estimate separate WTP functions using only male, then only female data. This work is on-going.)

$$\log WTP_i = x_i'\beta + \beta_G G_i + \varepsilon_i \tag{3}$$

When a respondent is asked to vote in favour or against the payment of a specific amount of money in order to obtain the improvement, it is expected that he will compare his true WTP with the requested amount. If the requested amount is less than or equal to the true WTP, he says "yes". Otherwise, he says "no". Given an individual's response the researcher knows whether or not the log of an individual's WTP is greater than or lesser than the logarithm of the requested payment, t_i. One difficulty with this approach is the broad spectrum of potential WTP values encompassed within the bounds of zero and the requested payment. The researcher can narrow the bounds of the individual's true WTP by asking a conditional or follow-up referendum question about the same recreational improvement. The follow-up question uses information about the first response to determine whether to ask a respondent to pay a higher or lower amount than first requested. The advantage of this double-bounded approach is that it yields more efficient results than can be obtained from the single-bounded method (Hanemann et al., 1991).

We exploit the bounds upon each individual's WTP as revealed by the responses given to the two contingent valuation questions. Thus, each respondent belongs to one of four groups according to his pair of responses. The ith person in Group #1 (yes response to both questions) has the following bounds upon his willingness-to-pay.

$$\log t_i^L \leq \log WTP_i < \log t_i^H \tag{4}$$

In equation (4) $\log t^L_i$ is the logarithm of the lowest acceptable payment requested of the ith respondent - in this case, this will be the amount from the second referendum question - and $\log t^H_i$ is the logarithm of the highest potential payment acceptable to the ith respondent - in this case, this could be as large the individual's income. The bounds for the other three groups are established in a similar fashion.

Each respondent is randomly offered one of several starting payments for the first referendum question. Thus, the specific combination of high and low payments for any respondent depends upon the particular version of the survey received by the respondent and his own yes/no responses to the contingent valuation scenarios payment questions. Once these bounds have been established for each person, the researcher defines a log-likelihood function for the entire population of N respondents. This function has a component attributable to each of the four groups described above and is estimated using maximum likelihood techniques. Such an equation is shown in (5). It assumes a population of n respondents. In this equation Φ represents the standard normal cumulative density function of the logarithm of the unobservable WTP. The parameters to be estimated are the vector β and the scalars β_G and σ. Each β coefficient represents the marginal contribution of each regressor to the estimate of the WTP and the scalar σ is the scale variable, representing the standard deviation of log WTP.

$$\begin{aligned}\log L &= \sum_{n=1}^{N} \log\ l_n \\ &= \sum_{n=1}^{N} \log [\Phi(\frac{\log t_n^H - x'_n \beta - \beta_G\ G_n}{\sigma}) \\ &\quad - \Phi(\frac{\log t_n^L - x'_n \beta - \beta_G\ G_n}{\sigma})]\end{aligned} \tag{5}$$

Individual-specific WTP values are calculated directly from the estimated parameters and individual-specific characteristics. Thus, the parameter estimates are readily interpreted with regard to their effects on WTP values.

4. SURVEY DATA DESCRIPTION

The data used to estimate equation (5) came from a 1995 contingent valuation mail survey of residents of the Hamilton Harbour watershed area in Ontario, Canada, home to over 500,000 people. Dillman’s (1978) approach to conducting surveys was followed. Prior to World War II, the Harbour had a history of being a recreational attraction, but since that time it had been used intensively by industrial firms and municipal sewage treatment plants. Since the late 1980's it has been the focus of remediation efforts aimed at improving water quality (Rodgers, 1992). While fishing and boating are commonly pursued recreational activities, swimming in the Harbour - which at one time had been a popular activity - was prohibited due to sewage effluent contamination and resulting bacteria levels. Since 1994, however, water quality has improved enough to permit the reopening of several beaches. In addition, the first of several improvements to the beach area, such as the construction of a children’s water park and play area have been made, while modifications to fish habitat have begun to encourage the return of popular recreational fishing species. These changes have been publicized in the region and appear to have led to renewed interest in the use of the Harbour for recreational pursuits.

Variable	Women	Men	F-Statistic
Age (years)	47.8	49.9	2.011
Household Income ($ 1994)	49,254	57,215	10.386 *
Married and/or Live Common Law (%)	50	78	65.371*
Live with Children Under 18 (%)	38	33	1.303
Educated Beyond High School (%)	53	50	0.834
State of Hamilton Harbour	2.6	2.5	4.397*
Went Boating in 1994 (%)	8.9	14.6	5.735*
Plan to Boat After Project Completion (%)	36	45	6.455*
Went Fishing in 1994 (%)	3.9	8.8	6.770*
Plan to Fish After Project Completion (%)	34	53	25.740*
Went Swimming in 1994 (%)	3.9	4.6	0.004
Plan to Swim After Project Completion(%)	58	53	1.560

Table 1: Mean values for variables in the survey data

Variable Name	WTP Functions for Each Activity		
	Swimming	Fishing	Boating
Gender	0.1307 ** (0.0857)	0.2321 * (0.0998)	0.1495 (0.9856)
Income	0.7169 * (0.1328)	0.8309 * (0.1513)	0.0369 * (0.0155)
Plan to Do Activity	0.7789 * (0.0882)	0.8882 * (0.1001)	0.9142 * (0.1099)
Marital Status	-0.1725 * (0.0932)	-0.1788 ** (0.1061)	-0.1719 (0.1061)
Dummy for First Question	0.4228 * (0.0900)	0.2938 * (0.0919)	0.5572 * (0.1056)
Constant	2.0285 * (0.1220)	1.6328 * (0.1444)	1.5666 * (0.1372)
Scale	0.8788 * (0.0457)	0.9907 * (0.0559)	0.9632 * (0.0667)

Table 2: Parameter Estimates for Three Separate WTP Functions

	Estimated Values For Women ($)	Estimated Values For Men ($)	Estimated Gap (Men - Women) ($)
Swimming	27.69 (11.83)	30.55 (12.82)	2.86
Fishing	14.88 (8.15)	21.49 (10.94)	6.61
Boating	13.82 (7.65)	19.54 (8.75)	5.72

Table 3: Mean Willingness-to-Pay Estimates

A total of 1151 surveys were sent out and 732 were returned. Respondents were asked to value water quality improvements to Hamilton Harbour that would result in specific improvements to swimming, recreational fishing, and recreational boating. The survey used an increase in a household's water bill or rent (for tenants) as the payment vehicle. Respondents were randomly assigned one of three initial payment offers, ranging between $10 to $40 per household per year. These were determined after both open-ended and closed-ended question pre-testing and discussions with focus groups. Then, conditional upon an individual's first response, a second payment offer was made and a yes or no voted recorded.

Table 1 presents sample mean values by gender for some variables of interest. A single asterisk (*) is used to indicate that the mean values for men and women are significantly different at a 5 % level of significance. Of note is that there is a statistically significant difference in the household incomes reported by men and women in the sample, with women reporting lower incomes. In addition, although not statistically significant, far fewer women than men in the sample are married or living common-law and a larger number of women reside with children under 18 years of age. This combination of variables suggests that women have less money and may have less time to spend on recreational pursuits (unless these activities involve children). In addition, there is a statistical difference in the degree to which male and female respondents view the degree of pollution in Hamilton Harbour. They could choose from amongst four alternatives: 1 (somewhat polluted), 2 (very polluted), 3 (extremely polluted, but capable of being restored), and 4 (extremely polluted, and beyond restoration). Women see it as being more polluted than men. Finally, women are much less likely to have gone fishing or boating or to plan to do these activities once the improvements have taken place. The same is not true for swimming, however.

5. RESULTS

5.1 Estimated Willingness-To-Pay Functions

Since each survey respondent was asked to value improvements to three different recreational activities in Hamilton Harbour, separate WTP functions for each of swimming, fishing, and boating were specified following equation (3). In order to obtain parameter estimates for each WTP function all useable data observations (numbering 713 in total, of which there were 280 observations from female survey respondents) were included. The following explanatory variables were included in each estimated function: income, a dummy variable for gender (with one being male), a dummy for marital status (with one being married), a dummy for the individual's plan to undertake the activity in the future (with one being yes). In addition, since the ordering of questions regarding these three activities was different across four different versions of the survey, a dummy was added which took the value of one if the item had been asked first and zero otherwise. Earlier work has suggested that the question order matters (Halvorsen, 1996, Dupont, 2000).

Table 2 shows the parameter estimates for each of the three estimated WTP functions. For the most part, the estimated coefficients are significantly different from zero - the standard errors are shown in brackets. A single asterisk denotes the parameter estimate is significantly different from zero at the 5 % level, while a double asterisk denotes the parameter estimate is significantly different from zero at the 10 % level. An important result is that the estimated coefficients on the gender variable are positive in each instance, implying that being male has a positive impact upon WTP. In addition, higher WTP values for each recreational activity are associated with higher incomes, a dummy variable for planned participation in the activity, and whether the activity was the first item in the sequence of three recreational activity questions asked. Being married, on the other hand, is associated with a lower willingness-to-pay

Table 3 reports on the summary statistics of individual-specific estimated WTP values. A given individual's WTP is obtained by combining the estimated functions with that individual's specific values for the included parameters. A simple mean of these individual estimates is then calculated, along with an estimate of the standard deviation (in brackets). In order to illustrate the WTP differential present in male-female valuations, summary statistics are presented separately for men and women. Not surprisingly, the estimated standard deviations for women are smaller than for men.

The results in Table 3 support the hypothesis put forth earlier in this paper. Namely, women on average have lower WTP values than men do, although the values are not statistically different from one another since each female WTP falls within one standard deviation of each male WTP and vice versa. If we define the WTP gap as the difference between the male and female WTP, then the size of the gap is largest for fishing and smallest for swimming. Based upon this data sample, female users would rank the three activities from highest to lowest in the following order: swimming, boating, and fishing. Males would rank the activities: swimming, fishing, and boating.

Coefficient Name	**Women Only**	**Men Only**	**All**
Have Children	18.872 * (4.265)	2.573 (11.100)	14.297 * (4.862)
Plan to Do Activity	28.209 * (4.470)	7.663 (11.230)	22.937 * (5.083)
University/College Graduate	11.064 * (3.689)	8.330 (6.786)	9.318 * (3.824)
Favour Project	-2.292 (5.745)	48.815 * (20.356)	6.855 (6.838)
Degree of Pollution in Hamilton Harbour	-3.449 (2.812)	-2.536 (7.056)	-2.861 (3.030)
Constant	4.576 (8.433)	-20.011 (16.061)	2.066 (8.668)
R^2	0.813	0.458	0.569
Sum of Squared Residuals	638.890	1442.584	2712.977

Table 4: OLS Results of Differences in Male/Female Valuations

5.2 Determinants Of Gender Differences In Willingness-To-Pay

According to results from the previous section, income was found to be an important determinant of WTP and women were found to have systematically lower valuations on average (along with lower incomes). This finding is consistent with the hypothesis put forth earlier in the paper. However, other factors may play a role. In order to examine the role of these other factors without the conflicting role of income, further regression analysis was performed. The data for this analysis consisted of mean values for socio-demographic characteristics and estimated WTP of each of the three recreational activities (swimming, fishing, and boating) for men and women separately in each of ten different income categories. In order to generate this data, WTP values for each activity were included only if they were calculated for respondents who received a survey in which that activity appeared first in a sequence of referenda questions.

Table 4 presents the results of three different estimations. The first column refers to the results of an OLS estimation that regressed female WTP upon a set of five regressors and a constant. The second column refers to the same model estimated with male WTP as the regressand. Finally, the third column shows the results of a third regression using both sets of data together. In each case the estimated coefficients can be interpreted in the following way: at each income level, the coefficient shows the change in WTP according to the presence of a particular characteristic. For women the most important non-income factors in the determination of WTP for the three recreational activities are the presence of children, plans to do the activity, and being a university/college graduate. For men, the most important determinant of WTP is a yes response to the question asking the respondent whether he is in favour of the remediation project being completed. The fit for women appears to be much better than for men.

Using the data provided in the table, a Chow test was done to investigate whether men and women respond statistically in the same way. The critical F value (with 6, 46 degrees of freedom) and 5% level of significance is 2.31, while the sample F value is 2.33. Thus, at the 5 % level the data just rejects the hypothesis that men and women respond in the same way.

6. CONCLUSIONS

This paper examines an issue that has been ignored in the economics literature concerned with benefit estimation. The issue is whether women respond differently to contingent valuation questions than do men and the implications of such differences for the WTP estimates obtained from referendum-type questions. The paper makes a case for the systematic income gap between men and women as an important determinant of differential WTP values. However, tastes may also play a role and that aspect is also investigated. The empirical results support the hypothesis that women have significantly lower WTP values than men do for three different types of improved recreational activities. Having children, planning to do the activity, and being a university graduate are the most important determinants of a female's WTP, outside of income. For men, the most important determinant is that the project is deemed to be a favorable one.

The findings in this paper have potentially important consequences for the subsequent calculation of aggregate benefits from contingent valuation models that ignore the role of gender. Women generally constitute about one half of a population base. If gender is ignored in the WTP function, then the empirical research in this paper suggests that the mean WTP values calculated from models that ignore gender will be biased upwards. This bias will be compounded when aggregate benefits are simply found by multiplying the mean WTP by the number of individuals in the population.

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