The Effect of Future Availability of Information on Willingness to Pay

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Abstract

This paper analyzes the effect that potential future availability of information has on willingness to pay in a contingent market characterized by uncertainty and irreversibility. In particular, I test whether the effect is consistent with the predictions of Zhao and Kling's (forthcoming) theory of commitment cost. The analysis is performed using the results of a contingent valuation study designed to estimate the degree to which local residents value improved water quality in Clear Lake, a spring-fed, glacial lake located in north-central Iowa. The results show that willingness to pay is highly sensitive to the potential for future learning. Offering survey respondents the opportunity to delay their purchasing decision until more information is available led to a significant decrease in willingness to pay. This suggests that contingent valuation practitioners must take care to accurately represent the potential for future learning or else risk biased valuation estimates.

Key words: commitment cost, contingent valuation, real options.

THE EFFECT OF FUTURE AVAILABILITY OF INFORMATION ON WILLINGNESS TO PAY

Environmental economists have long recognized the importance of providing respondents with adequate information when eliciting willingness to pay within the contingent valuation framework. For example, studies have shown that information about resource quality, the price and availability of substitutes, and the respondents' budget constraints all significantly affect willingness to pay. Less attention has been given to the dynamic nature of the value formulation process and how it might be affected by uncertainty and the potential availability of future information. However, in a contingent market characterized by uncertainty and the potential for future learning, the ability to delay an irreversible decision may have a significant effect on respondents' willingness to pay in the current period.

Zhao and Kling (forthcoming) have developed a model focusing on what they call "commitment cost." Their model uses real options theory to analyze the effect of potential future learning on willingness to pay (WTP) in the presence of uncertainty and irreversibility.

My goal in this study is to test whether offering survey respondents the opportunity to delay the decision to "purchase" an environmental quality improvement affects willingness to pay and, in particular, whether the effects are consistent with the predictions of the commitment cost model. Data for this analysis were collected in the fall of 2000 using a survey designed to estimate the value area residents place on improved water quality in Clear Lake, a spring-fed, glacial lake located in north-central Iowa. In order to gauge the impact of potential learning on WTP, some respondents were told that the hypothetical referendum contained in the survey instrument represented their final chance to vote on improving water quality. Others were told that, should the referendum fail, they would be given a second chance to vote on the same initiative once further water quality research had been conducted. Respondents were also presented with varying degrees of uncertainty regarding the extent of improvement that would follow from the proposed clean-up measures. The survey's results suggest that, under certain circumstances, offering respondents the ability to delay their decision significantly reduces willingness to pay.

Background

To date, empirical work on the effect of information on WTP primarily has focused on a static value formulation problem. In their survey of the literature, Blomquist and Whitehead (1998) present the respondent's maximization problem as

$$\max \ U(q_1, q_2, x) \text{ subject to } p'x \leq m,$$

where $U(\cdot)$ is the utility function, q_1 is the environmental good of interest, q_2 is a vector of substitute environmental goods, x represents all private goods, m is the respondent's income, and p is a vector of prices. The authors point out that empirical work on the effects of information on valuation has focused on information regarding the quality of q_1, the price and availability of q_2, and information reminding respondents of their budget constraint. For example, Samples, Dixon, and Gowen (1986); Bergstrom, Stoll, and Randall (1990); and Blomquist and Whitehead (1998) show that information regarding resource quality significantly impacts valuation. With respect to the price and availability of substitutes, empirical work by Boyle, Reiling, and Phillips (1990) suggests that information regarding changes in the price of alternative outdoor activities has no effect on WTP for a related good. Similarly, Loomis, Gonzalez-Caban, and Gregory (1994) find that information regarding the price and availability of substitutes has no significant effect on WTP when respondents are familiar with the resource being valued. However, a more recent study by Whitehead and Blomquist (1997) finds that such information plays a significant role for respondents unfamiliar with the resource. And while Loomis, Gonzalez-Caban, and Gregory find that providing respondents with information regarding their budget constraint has no effect on WTP, Cummings and Taylor (1999) and List (forthcoming) show that such information can significantly reduce WTP.

While the empirical literature has established the importance of information in the practice of contingent valuation, it largely has ignored the dynamic issues associated with the value formulation process. To date, work that considers these issues primarily has been theoretical. For example, Hoehn and Randall (1987) propose what they call the value formulation problem. They model the formulation of stated benefit measures as subject to two types of error: that due to imperfect information and that due to time constraints. Imperfect communication arises when survey designers try to convey complex policy issues to respondents. Misunderstanding or miscommunication of these issues leads to greater uncertainty surrounding the value of the good in question. The result is a decrease in reported WTP. Likewise, placing constraints on the amount of time respondents have to consider valuation questions cuts short their utility maximization process and leads to a decrease in reported WTP.

Also of interest is the quasi-option-value literature based on the work of Arrow and Fisher (1974) and Henry (1974). In contrast to Weisbrod's (1964) original concept of option value, which today is viewed essentially as a risk premium, quasi option value (QOV) may be non-zero even when agents are risk neutral. QOV takes into account not only uncertainty but also the irreversibility of development and the resulting asymmetry of the development decision. This asymmetry follows from the fact that the decision to preserve a resource in the current period can be reversed if the decision is made to develop in the future. On the other hand, the decision to develop in the current period cannot be reversed in the future because the landscape has been irreparably altered. Faced with uncertainty and asymmetric irreversibility, there exists an incentive to delay development until more information becomes available. An agent who considers these issues will pursue less development in the current period than would a naive agent. QOV is equal to a shadow tax that induces the efficient level of development from the naive agent. As Hanemann (1989) puts it, QOV is the conditional value of perfect information, conditional, that is, on the resource being preserved today. Conrad (1980), Viscusi (1988), Hanemann (1989) and Usategui (1990), among others, have added to the theoretical work related to QOV.

Little empirical work has been published on the magnitude of QOV relative to expected consumer surplus. An exception is work on mining development by Greenley, Walsh, and Young (1981), though their survey design and theoretical underpinnings have been criticized (see Brookshire, Eubanks, and Randall 1983; Freeman 1984; Mitchell and Carson 1985; and Hanemann 1989).

Zhao and Kling look at the formulation of WTP in a dynamic setting characterized by uncertainty, irreversibility, and the potential for future learning. Given that an agent is uncertain about the actual value of the good she is interested in buying, delaying the transaction may be in her best interest if more information regarding the good's value can be gained by waiting. Therefore, in order to commit to the purchase now and forgo future learning opportunities, the agent must be compensated by being offered a lower price than would have been acceptable were future learning not an option. The authors refer to this compensation as the commitment cost.

Zhao and Kling's theory predicts that the cost of commitment increases as agents (*i*) are more uncertain about a good's value, (*ii*) expect that more information about a good will be available in the future, (*iii*) are more patient in consuming a good, (*iv*) expect to encounter more difficulty in reversing a transaction, and (*v*) have less freedom in choosing when to make decisions.

Commitment Cost: A Formal Model

To better see how commitment cost might affect WTP, I develop a mathematical model that is an extension of the one presented by Zhao and Kling (2000). I begin with a simple, two-period, time-separable utility function:

$$U(m,G) = u_1(m,G) + b\,u_2(m,G)\,, \tag{1}$$

where m represents per-period income, G represents environmental quality, and b is the discount factor. The status quo level of environmental quality is denoted by G_0. A higher level of environmental quality G can be purchased in the current period, the future period, or not at all. If G is purchased in the current period, it can also be enjoyed in the future at no additional cost. For example, G might be achieved through a package of government-sponsored mitigation efforts such as establishing buffer strips and retiring agricultural land around a lake in order to reduce nutrient inflow. In this study, the agent's decision to "purchase" improved environmental quality will be thought of as her voting yes on a hypothetical referendum that would both implement the policies intended to improve environmental quality and impose a \$$p$ tax on area households.

In this model, I assume that the agent is uncertain about the value of *G*. This could be due to uncertainty either regarding the degree to which water quality would be improved if the proposed policies were implemented or regarding how much benefit the agent actually would derive from those improvements. Formally speaking, the agent's beliefs regarding *G* are represented by the distribution function $F_0(G)$ and the corresponding density $f_0(G)$. A signal arriving in the second period provides more information about *G*. This signal is denoted by $s \in S \subset \mathbb{R}$, where *S* is the set of all possible signals and $\mathbb{R}$ is the real number line. In the context of the Clear Lake study, the signal could be thought of as more accurate information regarding the degree of water quality improvement brought about by proposed mitigation efforts. Qualified by the true value of *G*, the possible signals are described by the conditional density function $h_{s|G}(s)$. The unconditional density function for *s* can then be defined as $h(s) = \int h_{s|G}(\cdot)dF_0(\cdot)$. Observing *s*, the agent updates her beliefs about *G* according to Bayes's rule: $f_{G|s} = h_{s|G}(\cdot)f_0(\cdot)/h(\cdot)$.

Let EU_1 denote the agent's expected utility if she purchases *G* in the current period. Since the new level of environmental quality can be enjoyed now and in the future, I write this as

$$EU_1 = E_G\left(u\left(m - p, G\right) + b\,u\left(m, G\right)\right), \tag{2}$$

where *p* is the price of implementing the new environmental policy, and $E_G(\cdot)$ represents expectation over *G*. Let $V(p,s)$ be the agent's expected surplus from delaying the purchase until after observing *s*. That is,

$$V(p,s) = \int \left(u(m-p,G) - u(m,G_0)\right) dF_{G|s}(G). \tag{3}$$

If the agent waits until the future period to observe the signal, she will buy the good if and only if $V(p,s) \geq 0$. Let EU_2 denote the agent's expected utility if she delays the purchasing decision. This can be represented as

$$EU_2 = u\left(m, G_0\right) + b\ \Pr(S_{P1})E_G\left(u\left(m-p, G\right) \mid s \in S_{P1}\right) + b\ \Pr(S_{P2})u\left(m, G_0\right), \tag{4}$$

where $S_{P1}(p) = \{s \in S \mid V(p,s) \geq 0\}$ and $S_{P2}(p)$ is the compliment of $S_{P1}(p)$. In other words, $S_{P1}(p)$ is the set of all signals that will induce the agent to purchase *G* in the second period, while $S_{P2}(p)$ is the set of signals that will lead the agent to opt for the status quo level of environmental quality G_0.

Given a functional form for *U*(·), it is possible to calculate a closed-form expression for the commitment cost *CC*. I assume that

$$u(\cdot) = a\,\frac{m^r}{r} + (1-a)\frac{G^r}{r}. \tag{5}$$

This is a monotonic transformation of the familiar constant elasticity of substitution (CES) utility function, where $a \in [0,1]$ is the weight the agent puts on income, and $r \leq 1$ relates to the agent's elasticity of substitution ($s = 1/(1-r)$). One of the benefits of the CES utility function is that the linear, Cobb-Douglass, and Leontief utility functions are all special cases corresponding to $r = 1$, 0, and $-\infty$, respectively.

Taking into account uncertainty, irreversibility, and the opportunity for learning, the agent's decision in the current period is whether to buy now or to delay the decision until next period when more information will be available. In this dynamic framework, the rational agent's maximum willingness to pay, wtp^R, is the critical price, p^R, that leaves her indifferent between committing to *G* in the current period and delaying her decision until the future. Recalling that EU_1 is the agent's expected utility from buying today, the equation can be written as

$$EU_1 = \frac{a}{r}(m-p)^r + \frac{1-a}{r}E_G(G^r) + b\left(\frac{a}{r}m^r + \frac{1-a}{r}E_G(G^r)\right). \tag{6}$$

Similarly, EU_2 can be written as

$$\begin{aligned} EU_2 = {} & \frac{a}{r}m^r + \frac{1-a}{r}G_0^r \\ & + b\left[\Pr(S_{P1})\left(\frac{a}{r}(m-p)^r + \frac{1-a}{r}E_G(G^r \mid s \in S_{P1})\right) + \Pr(S_{P2})\left(\frac{a}{r}m^r + \frac{1-a}{r}G_0^r\right)\right], \end{aligned} \tag{7}$$

where S_{P1} and S_{P2} are as defined above, and

$$V(p,s)=\frac{a}{r}\left((m-p)^r-m^r\right)+\frac{1-a}{r}\left(\int G^r dF_{G|s}-G_0^r\right). \tag{8}$$

Equating $EU_1(p^R)$ and $EU_2(p^R)$ yields

$$wtp\equiv p^R=m-\left(m^r-\frac{A}{\left(1-b\,\Pr(S_{P1})\right)}\right)^{\frac{1}{r}}, \tag{9}$$

where

$$A=(1+b)\frac{1-a}{a}\left(E_G(G^r)-G_0^r\right)-b\,\Pr(S_{P1})\frac{1-a}{a}\left(E_G(G^r\mid s\in S_{P1})-G_0^r\right). \tag{10}$$

On the other hand, a naive agent who ignores the potential for learning sees her decision as being whether to buy in the current period or never to buy. While I assume the naive agent recognizes that the benefits from purchasing G in the current period can be enjoyed in the future period, I also assume that she does not realize that delaying her purchasing decision may allow her to avoid a "bad purchase" (i.e., a purchase that yields negative surplus). Thus, the naive agent's willingness to pay wtp^N is the critical price p^N such that the she is indifferent between purchasing the environmental improvement in the current period and never purchasing it. Given the assumptions on $U(\cdot)$, I derive p^N by equating $EU_1(p^N)$ and $EU_2(p^N)$ as follows:

$$EU_1(p^N)=E_G\left(u\left(m-p^N,G\right)+b\,u\left(m,G\right)\right)=(1+b)u\left(m,G_0\right)=EU_2(p^N), \tag{11}$$

$$\frac{a}{r}(m-p^N)^r+\frac{1-a}{r}E_G(G^r)+b\left(\frac{a}{r}m^r+\frac{1-a}{r}E_G(G^r)\right)=(1+b)\left(\frac{a}{r}m^r+\frac{1-a}{r}G_0^r\right), \tag{12}$$

$$(m-p^N)^r=m^r+(1+b)\left(\frac{1-a}{a}G_0^r\right)-\frac{1-a}{a}E_G(G^r)-b\left(\frac{1-a}{r}E_G(G^r)\right). \tag{13}$$

Rearranging, I derive

$$wtp^N \equiv p^N = m - \left(m^r - (1+b)\frac{1-a}{a}\left(E_G(G^r) - G_0^r\right)\right)^{\frac{1}{r}}. \tag{14}$$

In the absence of future learning, the rational agent's problem reduces to that of the naive agent, and the price p^N leaves both indifferent between purchasing the new higher level of quality now and settling for the status quo level. However, offered the opportunity for learning, the rational agent's willingness to pay falls to $wtp^R \leq wtp^N$. In this context, the commitment cost can be thought of as the amount by which the price of the environmental improvement must be reduced in both periods to make the rational agent indifferent between purchasing now and delaying the decision until more information becomes available. In other words, commitment cost is the difference between wtp^N and wtp^R. Thus, I can write *CC* as the following closed-form expression:

$$CC = wtp^N - wtp = \left(m^r - \frac{A}{\left(1 - b\ \Pr(S_{P1})\right)}\right)^{\frac{1}{r}} - \left(m^r - (1+b)\frac{1-a}{a}\left(E_G(G^r) - G_0^r\right)\right)^{\frac{1}{r}}, \tag{15}$$

where *A* is defined as in equation (10), and *CC* is positive as long as $\Pr(S_{P1}) > 0$ and $E_G(G^r \mid s \in S_{P1}) > E_G(G^r) > G_0^r$.

Design of the Contingent Valuation Survey Instrument

To test for the effects of potential learning and uncertainty on WTP, I use a technique similar to that used by Mansfield (1999). Specifically, I estimate respondent *i*'s stated willingness to pay as

$$WTP_i = wtp_i^N + CC_i + e_i, \tag{16}$$

where wtp_i^N is the naive agent's willingness to pay as defined in equation (14), e_i is a mean-zero error term, and CC_i captures respondent *i*'s commitment cost. For the purpose of my analysis, I model CC_i as

$$CC_i = D_i^{Delay}\left(g^{Delay} + g^{HiVar} D_i^{HiVar}\right), \tag{17}$$

where D_i^{Delay} is a dummy variable equal to 1 if respondent *i* can potentially delay her decision, and D_i^{HiVar} is a dummy variable equal to 1 if respondent *i* faces a high degree of uncertainty regarding water quality after the proposed improvements. Although simple, this formulation takes into account the two key relationships identified in the theory above: commitment cost is present only when there is potential for future learning, and commitment cost varies according to the degree of uncertainty the respondent faces.

Following Cameron (1988), WTP_i can be estimated from dichotomous choice data by noting that the probability that agent *i* votes yes ($Y_i = 1$) on a referendum to improve environmental quality is

$$\begin{aligned}\Pr\left(Y_i = 1\right) &= \Pr\left(WTP_i \geq T_i\right) \\ &= \Pr\left(wtp_i^N + CC_i + te_i \geq T_i\right) \\ &= \Pr\left(e_i \geq \frac{T_i - wtp_i^N - CC_i}{t}\right) \\ &= 1 - \Pr\left(e_i \leq \frac{T_i - wtp_i^N - CC_i}{t}\right),\end{aligned} \tag{18}$$

where T_i is the policy price faced by respondent *i* and t is the standard error of e_i. Assuming e_i is drawn from the extreme value error distribution yields the following logistic expression for the probability of a yes response:

$$\Pr(Y_i = 1) = \left(1 + \exp\left(\frac{-T_i - wtp_i^N - CC_i}{t}\right)\right)^{-1}. \tag{19}$$

The corresponding log likelihood function is

$$\begin{aligned}\ln L = &\sum_i -Y_i \ln\left(1 + \exp\left(\frac{-T_i - wtp_i^N - CC_i}{t}\right)\right) \\ &+ \sum_i (1 - Y_i)\left[\left(\frac{-T_i - wtp_i^N - CC_i}{t}\right) - \ln\left(1 + \exp\left(\frac{-T_i - wtp_i^N - CC_i}{t}\right)\right)\right].\end{aligned} \tag{20}$$

After using maximum likelihood estimation to fit parameters to this model, an estimate of respondent *i*'s willingness to pay $\widehat{WTP}_i$ can be calculated as follows:

$$\widehat{WTP}_i = \frac{\widehat{wtp}_i^N + \widehat{C}C_i}{-\hat{t}}. \tag{21}$$

Finally, mean WTP can be estimated by taking the average of the $\widehat{WTP}_i$ estimates.

A contingent valuation model (CVM) survey instrument was designed to value various plans for improving the water quality at Clear Lake in northern Iowa. The survey first described the lake's current condition in terms of water clarity, color, odor, fish catch, and the frequency of algae blooms and beach closings. Next, the survey described three future water quality scenarios corresponding to different degrees of environmental mitigation. Each of these scenarios was followed by a referendum-format CVM question designed to elicit respondents' willingness to pay in order to achieve the conditions described. Hoehn and Randall (1987) show that the referendum mechanism is demand revealing so long as respondent *i* believes that all respondents face the same policy price, and that the referendum will pass if the majority votes in favor of the proposed project. Strictly speaking, truth telling is a voter's weakly dominant strategy when voting is costless. A copy of the survey instrument is included in Appendix A.

Prior to the actual mailing of the survey, the instrument was presented to a focus group of local residents to test its clarity and realism. This was followed by a mailed pretest. In its final form, the survey was sent to a random sample of 900 households in the cities of Clear Lake and Ventura, Iowa, both of which are located on Clear Lake. Survey Sampling, Inc., a Connecticut-based market research firm, drew the sample from the white pages of the telephone directory. Of these 900 surveys, 132 were eventually returned as undeliverable. Following the procedure laid out by Dillman (1978), a follow-up postcard and survey were sent to those households that did not respond to the initial mailing. The eventual response rate among surveys successfully delivered was about 70 percent.

A summary of the respondents' socioeconomic characteristics can be found in Table 1. Compared to the most recent county-level census data, survey respondents, on average, were significantly more likely to be older, to be college-educated, to be male, to be

TABLE 1. Characteristics of survey respondents

Variable	Definition	Mean	Standard Deviation	County Average
Income	Total household income	56,000	44,000	51,000
Education	1 if college graduate	0.36	0.48	0.16
Age	The respondent's age	55	15	47
Gender	1 if male	0.65	0.48	0.47
Family size	Includes adults and children	2.6	1.3	2.3
Homeowner	1 if own home	0.91	0.29	0.72
Year-round resident	1 if year-round resident	0.95	0.22	–

homeowners, and to live in a larger household. Respondents' average income was not significantly different from the county average. While no county-level data was available for year-round residency, it is likely that seasonal residents were underrepresented in the sample because many seasonal residents do not receive mail at their Clear Lake addresses.

Six versions of the survey were sent out, each differing in terms of the degree of uncertainty surrounding water quality after the proposed improvement, and in terms of the potential for future learning. Survey version 1 presented respondents with a low degree of variance (e.g., water clarity between 6 and 8 feet after improvements) and no potential for future learning. The color photo and diagram used to depict this low level of uncertainty can be found in Appendix B. The absence of future learning potential was written into the CVM question as follows:

> Further, suppose this survey represents the State's only chance to gather information about what kind of value people put on Clear Lake. Please respond as if this will be your final opportunity to vote on the issue, and that if the following referendum fails to pass, there will be no future programs to improve water quality at Clear Lake.
>
> Would you vote "yes" on a referendum that would *adopt* the proposed program but *cost* you $*x* (payable in five $*x*/5 installments over a five-year period)?

Version 2 again presented respondents with low variance but allowed for potential future learning by offering respondents a second chance to vote on the referendum:

> Further, suppose that if the referendum passes, the improvements would proceed immediately. However, if the referendum fails, any plans to improve the lake would be delayed for *one year* while further research takes place into the causes of lake pollution as well as alternative clean-up approaches. After this delay, any new information from studying the lake will be made available and you will then get a final chance to vote on the same referendum.
>
> Would you vote "yes" on a referendum that would *adopt* the proposed program but *cost* you $*x* (payable in five $*x*/5 installments over a five-year period)?

Version 3 differed from version 2 only in that respondents were told that, should the initial referendum fail, five years would pass before they would be given a second chance to vote. Versions 4, 5, and 6 were analogous to versions 1, 2, and 3 except that respondents faced a higher degree of uncertainty in terms of the expected water quality (e.g., water clarity between 2 and 12 feet after the proposed improvements). The color diagram used to depict this higher level of uncertainty appears in Appendix C. The results show no significant difference between the responses of those who were offered the one-year delay and those who were offered five. This suggests that any perceived gains from delaying the decision an additional four years were offset by the associated delay of improvements in water quality. Therefore, for the sake of simplicity, I combined the results from versions 2 and 3, and from versions 5 and 6.

Commitment cost theory predicts that respondents would be willing to pay less in the current period (i.e., would be less likely to vote yes) for proposed improvements when given the opportunity to delay their decision until more information is available. Likewise, the theory predicts that, given the potential for learning, respondents would be willing to pay less in the current period when faced with higher variance. Put in terms of testable hypotheses, commitment cost theory predicts the following:

$$\text{H1: } WTP^{NoDelay} > WTP^{Delay}$$

$$\text{H2: } WTP^{Delay}_{LoVar} > WTP^{Delay}_{HiVar}$$

$$\text{H3: } WTP^{NoDelay}_{LoVar} > WTP^{Delay}_{LoVar}$$

$$\text{H4: } WTP^{NoDelay}_{HiVar} > WTP^{Delay}_{HiVar}$$

The superscripts in these hypothesis tests refer to whether survey respondents had any chance to delay their decision until more information became available. Specifically, $WTP^{NoDelay}$ represents willingness to pay in the absence of the possibility of a future referendum, while WTP^{Delay} represents willingness to pay given that a second referendum would be held should the first fail. The subscripts refer to the degree of variance respondents faced. Notations WTP^{Delay}_{LoVar} and WTP^{Delay}_{HiVar} represent willingness to pay given the potential for learning when faced with low and high variance, respectively.

Results of the Contingent Valuation Model Analysis

After deleting the responses of residents who did not answer the CVM question, did not provide relevant socioeconomic information, or whose surveys were spoiled, 357 responses remained.[1] Of these, 43 respondents answered a follow-up question in such a way as to indicate that they did not understand the CVM question or considered it unrealistic. These respondents may not have given serious consideration to the policy price, in which case their responses to the CVM question would contain little or no information regarding their valuation of the resource. Therefore, I treat such answers as protest responses and exclude them from the following analysis.

Table 2 presents the results of the logistic regression described in the previous section. The results in the second column are from a regression in which all agents are assumed to have identical preferences. In order to confine a to the unit interval, I set $a = e^x/(1+e^x)$ and estimated *x*. Likewise, to restrict r to the $(-\infty,1]$ interval, I set $r = -e^y + 1$ and estimated *y*. The results in the third column are from a regression allowing a and r to vary with income, ignoring the interval restriction in the case of a. More specifically, I estimate a_i as $a_{Intercept} + a_{Income} m_i$ and r_i as $-\exp(r_{Intercept} + r_{Income} m_i) + 1$.[2]

As shown in Table 2, both estimates of t are negative and highly significant, indicating the demand curve for improved environmental quality is downward sloping. The estimate for a reported in the second column is very close to one, indicating

TABLE 2. Regression results with protest responses deleted

Variable	Homogeneous Preferences	Heterogeneous Preferences
t	-0.00116** (-3.59)[a]	-0.000927** (-2.59)
a	0.988** (86.3)	-
$a_{Intercept}$	-	1.02** (146)
a_{Income}	-	-0.00112** (-3.96)
r	0.249 (1.01)	-
$r_{Intercept}$	-	0.416 (1.35)
r_{Income}	-	-0.0266** (-2.91)
g^{Delay}	-0.823** (-2.85)	-0.732** (-2.45)
g^{HiVar}	0.530 (1.60)	0.463 (1.38)
Percent correct	63 percent	66 percent

[a] Asymptotic *t* ratios are in parentheses.
* Significant at the 0.05 level.
** Significant at the 0.01 level.

respondents put much greater weight on income than on water quality.[3] In the case where a is allowed to vary across individuals, the coefficient a_{Income} is negative and highly significant, indicating that respondents put more weight on environmental quality as their income increases. The point estimate $a = 0.961$ is simply the average of the a_i estimates. I calculated the 95 percent confidence interval around this estimate (0.934, 0.989) using a bootstrapping technique. One thousand realizations of $a_{Intercept}$ and a_{Income} were drawn from a multivariate normal distribution with a variance-covariance matrix and mean vector taken from the maximum likelihood estimation whose results are presented in Table 2. For each of these draws, I calculated an $\hat{a}$ that was the average over all respondents. The reported confidence interval is generated by ranking these 1,000 $\hat{a}$ estimates and deleting the highest and lowest 25.

The estimates of r reported in the second column of Table 2 lie on the interior of the $(-\infty,1]$ range and are significantly different from one, indicating that while there is some degree of substitutability between money and environmental quality, the two are not perfect substitutes. The same is true for point estimate $r = 0.501$ and the associated 95 percent confidence interval (0.203, 0.656) that follow from the $r_{Intercept}$ and r_{Income} estimates reported in the third column. As described for a, this confidence interval was calculated by bootstrapping. The estimate for r_{Income} is negative and highly significant. Considered in conjunction with the restriction $r = -\exp(r_{Intercept} + r_{Income} m_i) + 1$, this indicates that respondents with higher income are more willing to substitute money for environmental quality.

Both estimates of g^{Delay} are negative and highly significant. This suggests that offering survey respondents the opportunity to delay their decision until more information becomes available reduces WTP in the current period. This is in keeping with the predictions of commitment cost theory.

Estimates of g^{HiVar} are not significantly different from zero in either of the reported regressions, failing to support Zhao and Kling's prediction that commitment cost will be greater for individuals facing greater uncertainty. This may seem surprising given that uncertainty is a necessary condition for the existence of commitment cost. However, the survey was only able to vary uncertainty surrounding the expected degree of water quality improvements. The survey could not address uncertainty regarding the value respondents might eventually derive from the improvements once they have been realized. Therefore, finding that g^{HiVar} is not significantly different from zero may be interpreted as meaning that the latter type of uncertainty is the one driving commitment cost.

For both regressions, a chi-squared test rejects the null hypothesis that the g coefficients jointly equal zero at the 0.05 level (c^2 = 8.80 [2] and c^2 = 8.69 [2], respectively).

Table 3 shows estimates of mean WTP, conditional on both the opportunity for learning and the level of uncertainty. Again, for the sake of comparison, I include the results of both regressions. The confidence intervals were calculated using a bootstrapping technique similar to that used for a and r.

Table 4 presents the hypothesis tests suggested in the previous section. A positive number in the second and third columns indicates that the relative magnitude of the WTP estimates was qualitatively in line with the predictions of the commitment cost model. Based on the results of H1, I am able to reject the null hypotheses of no difference at the 0.05 significance level for both regressions. This suggests that, overall, WTP in the

TABLE 3. Willingness-to-pay estimates

Version	Homogeneous Preferences	Heterogeneous Preferences
All versions	$852	$868
	(750, 2582)[a]	(657, 2083)
No delay	1152	1144
	(938, 3525)	(761, 3113)
Potential delay	665	694
	(489, 2386)	(380, 2143)
Low variance	776	788
	(651, 2595)	(545, 1956)
High variance	977	992
	(777, 2833)	(653, 2021)
Low variance, no delay	1171	1153
	(943, 2835)	(800, 2619)
Low variance, delay	512	543
	(319, 2308)	(271, 1273)
High variance, no delay	1128	1132
	(919, 2758)	(793, 2792)
High variance, delay	877	898
	(564, 2709)	(443, 2050)

[a] 95 percent confidence intervals are in parentheses.

TABLE 4. Hypothesis tests

Alternative Hypothesis[a]	Difference in WTP Homogeneous Parameters	Difference in WTP Heterogeneous Preferences
H1: $WTP^{NoDelay} > WTP^{Delay}$	$487* (2.01)[b]	$450* (1.74)
H2: $WTP^{Delay}_{LoVar} > WTP^{Delay}_{HiVar}$	-365 (-1.53)	-355 (-1.40)
H3: $WTP^{NoDelay}_{LoVar} > WTP^{Delay}_{LoVar}$	659** (2.90)	610** (2.43)
H4: $WTP^{NoDelay}_{HiVar} > WTP^{Delay}_{HiVar}$	251 (0.933)	234 (0.920)

[a] The null hypothesis is that there is no difference between the two WTP measures.
[b] Estimated standard errors are in parentheses.
* Significant at the 0.05 level using a one-sided *t* test.
** Significant at the 0.01 level using a one-sided t test.

current period is significantly reduced when survey respondents are offered the opportunity to delay their purchasing decision until more information becomes available. This is as predicted by the commitment cost model. Based on the results of H3, I can reject the null at the 0.01 level. The interpretation here is similar to that from H1. In tests

H2 and H4 I cannot reject the null hypothesis at conventional levels of significance. This fails to support the prediction that that commitment cost is increasing in the degree of uncertainty facing respondents.

Concluding Remarks

In this paper, I test for the effects of potential future learning on WTP in the presence of uncertainty and irreversibility and whether those effects are consistent with Zhao and Kling's theory of commitment cost. Using a survey instrument designed specifically to measure WTP given varying degrees of uncertainty and learning potential, I collected data from Clear Lake area residents regarding their valuation of a proposed project to improve water quality in Clear Lake. My findings show that respondents' willingness to pay is indeed sensitive to the potential for future learning. This is consistent with Zhao and Kling's theory of commitment cost and suggests that CVM practitioners must take care to accurately represent the potential for future learning or else risk-biased results. The effect of increased variance on WTP, however, was insignificant. Thus, while my results lend support to the theory of commitment cost in the broadest sense, they do not confirm the theory's prediction that commitment cost increases with uncertainty.

These results have important implications for the design of stated preference surveys. If uncertainty, irreversibility, and the potential for learning are inherent to the policy under consideration, then commitment cost is relevant to the eventual policy decision, and stated preference questions should be written to reflect this. My analysis suggests that it is especially important for the survey instrument to accurately convey the potential for learning, as this determines whether the respondents' problem is static or dynamic.

Suppose, for example, that policymakers are considering converting an empty commercial lot into a public park. Assume that money spent on the project cannot be recouped, that there is some degree of uncertainty regarding the benefit local residents will derive from the park if it is built, and that the project can be reasonably delayed until some future date when residents may have a better estimate of the park's value. In this situation, commitment cost is policy relevant. In order to avoid overestimating WTP, a CVM instrument intended to estimate the value of the proposed project must be written so that it captures commitment cost. In particular, the instrument should explicitly note the potential for delay and subsequent learning.

On the other hand, suppose the issue under consideration is whether to save a pristine wilderness area from imminent and irreversible commercial development. In this case, there is no potential for delaying the decision and thus no potential for future learning. Here, commitment cost is not policy relevant. Instead, the appropriate measure of welfare change is simply equivalent variation. A study that does not convey the immediacy of the decision may mistakenly capture commitment cost as part of its estimate of WTP, thus biasing the estimate downward.

An interesting area for future research would be to determine whether WTP estimates elicited by a "typical" CVM instrument that makes no reference to the potential for delay and future learning elicits results more similar to what I have referred to in this paper as $WTP^{NoDelay}$ or WTP^{Delay}. A survey similar to the one described in this paper was sent to Clear Lake visitors. The primary difference between these two surveys was that the version sent to visitors made no reference to future learning potential. Comparing the results elicited from area residents with those elicited from visitors suggests that the typical CVM survey format is associated with WTP estimates more similar to $WTP^{NoDelay}$. However, it is difficult to make any definitive conclusions based on the results from two very different samples.

Endnotes

1. A typographical error in one of the survey versions left the CVM question ambiguous. While the error was corrected in the second mailing, 61 surveys were still thrown out.
2. A third regression was performed allowing a, r, g^{Delay} and g^{HiVar} to vary with income. The results are not reported here since the null hypothesis $g^{Delay}_{Income} = g^{HiVar}_{Income} = 0$ could not be rejected at conventional significance levels (c^2 = 0.89 [2]).
3. Unfortunately, since a and b only appear together in the expression for *wtpN*, they cannot be estimated separately. The estimate of a reported in Table 2 corresponds to $b = 0.9$. Appendix D contains estimates of a corresponding to other values of b. All other parameters in the model are unaffected by the choice of b.

Appendix A: The Clear Lake Survey

In order to make intelligent decisions concerning the future of Clear Lake, it is important to understand how the lake itself is used, as well as how this use would be affected by possible changes in the quality of the lake. The answers you give to the questions in this survey are very important in this process. Please try to answer each of the questions below. Finally, please keep in mind that, whenever we refer to Clear Lake, we are referring to the lake itself, not the town.

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

IN THIS SURVEY WE WILL ASK YOU SOME QUESTIONS ABOUT potential changes to the water quality of Clear Lake during the coming years. First, however, we will give you some information on the current condition of the lake. Please read this information carefully before answering the questions that follow.

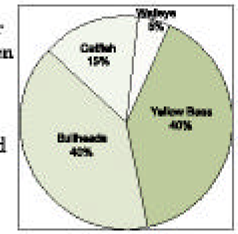
Clear Lake's Current Condition

The quality of a lake can be described in many ways. One measure of water quality is the clarity of the lake water. Water clarity is usually described in terms of how far down into the water an object is visible. The clarity of Clear Lake at the present time is about one-half to one foot. This means that objects are only visible down to about one foot under the surface of the water. The average water clarity of Clear Lake in 1953 was about ten feet.

Another measure of water quality is the amount of nutrients and other substances contained in the water. Water quality degradation can result from a number of sources, including runoff from the surrounding community containing fertilizers used for lawn care and from local agricultural sources. Currently these nutrients contribute to the occurrence of algae blooms in the lake, usually 10 to 12 times per year. Under some circumstances, these blooms can be a health concern, causing skin rashes and allergic reactions. In the past, concerns about bacteria present in Clear Lake have resulted in beach closings.

The overall quality of the water can have an impact on other conditions of the lake. Poor water quality results in an undesirable color and odor to the lake water. Currently, the color of Clear Lake varies between bright green and brown. The water has a mild odor that many describe as "fishy," with occasional periods of strong odor.

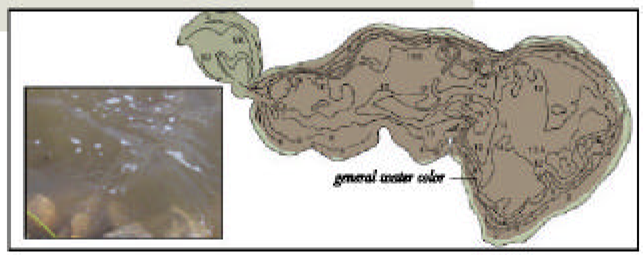
Finally, the quality of the water impacts the variety and quantity of fish in the lake. Currently, Clear Lake has a large quantity of walleye, but the largest percentages of the fish caught in the lake are fish that are considered somewhat less desirable. The chart indicates the type of fish that have been caught in the lake over the past year. While the rate at which fish are caught varies from year to year and from season to season, the typical catch rate has been 1 fish every 2 hours of fishing during the peak fishing months (May and June).



Experts believe that improved water quality would not significantly increase the number of fish in Clear Lake, but would increase the variety of fish species caught, including bass, perch, muskie, and pike.

Overall, the current condition of Clear Lake can be summarized in terms of

Water clarity	objects distinguishable 6 inches to 1 foot under water
Algae blooms	10 to 12 per year
Water color	bright green to brown
Water odor	mild odor, occasionally strong
Bacteria	possible short-term swim advisories
Fish	low diversity, good walleye



IN THE NEXT FEW QUESTIONS, WE WILL BE ASKING YOU how you would vote on a special ballot regarding the water quality of Clear Lake. While there is currently no such ballot being considered, we would like you to respond *as if* you were voting on the project and, in each case, as if it were the *only* project available. Please answer the questions in order and do not go back and revise your earlier answers.

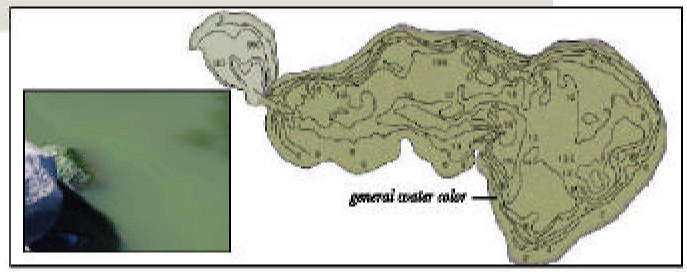
When you think about your answer, it's important to keep in mind that people tend to be more generous when payments are hypothetical than when they are real. The idea is that it is very easy for people to say that they are in favor of improving the lake when they know no real money will ever change hands. However, if the proposed payments are real, people might be more inclined to think about their other options and how they would otherwise spend that money. So in answering the following questions, please keep in mind both the benefits from maintaining Clear Lake's water quality and the impact that passage of the referendum would have on your own pocketbook. In other words, please answer *as if* it were a real referendum.

Finally, the following questions ask you to consider making hypothetical payments. You might think of this payment as taking the form of higher state or local taxes. With this in mind, please answer the questions as carefully and honestly as possible.

Plan A

If nothing is done to improve the water quality of the lake it is likely to deteriorate over the next decade. Suppose that the deteriorated conditions at Clear Lake would be as follows:

Water clarity	objects distinguishable 1 inch to 5 inches under water
Algae blooms	constant
Water color	fluorescent green
Water odor	always strong
Bacteria	frequent swim advisories and/or beach closings
Fish	low diversity, mostly rough fish



Further, suppose the Iowa Department of Natural Resources (DNR) developed a program that would avoid this deterioration and instead maintain the current conditions of the lake.

1. Would you vote "yes" on a referendum that would *adopt* the proposed program (in which case water quality would not deteriorate as described under **Plan A**), but *cost* you $90 (paid over five years at $18 per year)?

   - ❑ NO
   - ❑ YES

2. To help us better understand your answers, please indicate the single most important reason for your response to the preceding question:

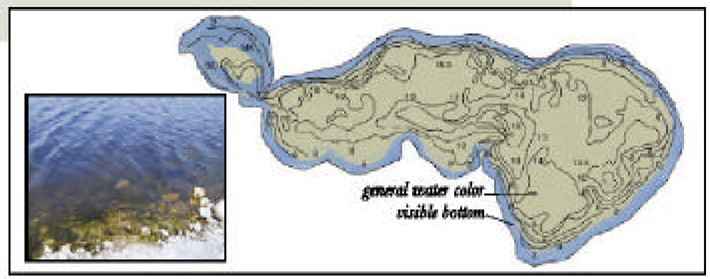
   - ❑ The DNR program would not be a good use of my money.
   - ❑ The DNR program would be a good use of my money.
   - ❑ The plan is not realistic or is unclear.
   - ❑ It is not appropriate to use a referendum like this one to determine water quality.
   - ❑ I already contribute to environmental causes as much as I can afford.
   - ❑ No one should have the right to damage the lake in the first place.
   - ❑ I do not support tax increases under any circumstances.
   - ❑ Other:____________________

Plan B

Now suppose the DNR has developed a program that would actually improve the quality of Clear Lake. This program might include establishing protection strips along the edge of the lake to reduce runoff from the surrounding area or other structural changes to the lake.

These changes would avoid further deterioration to the lake and, in fact, improve the lake over the next five to ten years to the following conditions:

Water clarity	objects distinguishable 2 to 4 feet under water
Algae blooms	6 to 8 per year
Water color	green to brown
Water odor	occasional mild
Bacteria	occasional swim advisories
Fish	low diversity, good walleye



3. Would you vote "yes" on a referendum that would *adopt* the proposed program but *cost* you $810 (paid over five years at $162 per year)?

- ❑ NO
- ❑ YES

4. To help us better understand your answers, please indicate the single most important reason for your response to the preceding question:

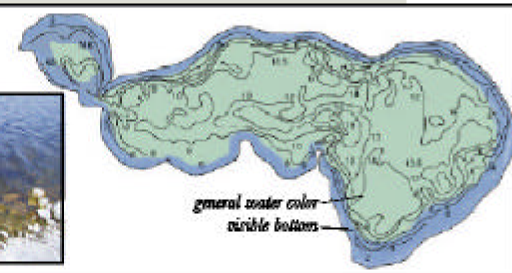
- ❑ The DNR program would not be a good use of my money.
- ❑ The DNR program would be a good use of my money.
- ❑ The plan is not realistic or is unclear.
- ❑ It is not appropriate to use a referendum like this one to determine water quality.
- ❑ I already contribute to environmental causes as much as I can afford.
- ❑ No one should have the right to damage the lake in the first place.
- ❑ I do not support tax increases under any circumstances.
- ❑ Other:_______________

Plan C

Now suppose that additional investments could be made such that conditions at Clear Lake would improve even further. These changes could include retiring some land from agricultural use, and programs to control nutrient runoff from urban and agricultural lands.

Suppose these changes would avoid further deterioration at the lake and, in fact, improve the lake over the next ten to twenty years to the following conditions:

Water clarity	objects distinguishable 6 to 8 feet under water
Algae blooms	3 to 4 per year
Water color	green to blue
Water odor	occasional mild
Bacteria	infrequent swim advisories
Fish	high diversity



Further, suppose this survey represents the State's only chance to gather information about what kind of value people put on Clear Lake. Please respond as if this will be your final opportunity to vote on this issue, and that if the following referendum fails to pass, there will be no future programs to improve water quality at Clear Lake.

5. Would you vote "yes" on a referendum that would *adopt* the proposed program but *cost* you $1410 (paid over five years at $282 per year)?

- ❑ NO
- ❑ YES

6. To help us better understand your answers, please indicate the single most important reason for your response to the preceding question:

- ❑ The DNR program would not be a good use of my money.
- ❑ The DNR program would be a good use of my money.
- ❑ The plan is not realistic or is unclear.
- ❑ It is not appropriate to use a referendum like this one to determine water quality.
- ❑ I already contribute to environmental causes as much as I can afford.
- ❑ No one should have the right to damage the lake in the first place.
- ❑ I do not support tax increases under any circumstances.
- ❑ Other:____________________________

IN THIS SECTION, WE WOULD LIKE TO ASK YOU ABOUT YOUR opinions regarding which lake characteristics are important to you and your views regarding some specific proposals to change Clear Lake.

7. Assume you have a total of 100 importance points to assign to the lake characteristics below. Please indicate the importance of each item by allocating your 100 points among the items on this list. To indicate one item is more important to you than another, you should allocate more points to it. You do not need to give points to all of the items, but remember that the total needs to equal 100.

Water clarity	
Hard, clean, sandy lake bottom in swimming areas	
Lack of water odor	
Diversity of wildlife seen at Clear Lake	
Diversity of fish species/habitat	
Quantity of fish caught	
Safety from bacteria contamination/health advisories	
Total	**100**

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8. In order to improve water quality in the lake, changes in land use in the watershed may be needed. For example, it's likely that some land will need to be changed to low-impact use. If such changes occur, which of the following land uses do you favor? Please check all that apply.

	Strongly Support	Somewhat Support	Neutral	Somewhat Oppose	Strongly Oppose
Park lands	❑	❑	❑	❑	❑
Additional Conservation Reserve Program acreage	❑	❑	❑	❑	❑
Restored woodlands	❑	❑	❑	❑	❑
Restored prairie	❑	❑	❑	❑	❑
Restored wetlands	❑	❑	❑	❑	❑
Nature conservation area	❑	❑	❑	❑	❑
Constructed ponds	❑	❑	❑	❑	❑
Hunting reserves	❑	❑	❑	❑	❑
Restored riparian zones	❑	❑	❑	❑	❑
Perennial Agriculture	❑	❑	❑	❑	❑
Other	❑	❑	❑	❑	❑

9. A number of projects have been suggested to accomplish improvements in the lake. How do you feel about the following possibilities?

	Strongly Support	Somewhat Support	Neutral	Somewhat Oppose	Strongly Oppose
Increased park lands and recreational areas	❑	❑	❑	❑	❑
Building of a nature center or environmental park	❑	❑	❑	❑	❑
Purchase of easements for building buffer strips	❑	❑	❑	❑	❑
Increased land idling	❑	❑	❑	❑	❑
Restoration of Ventura Marsh to improve nutrient retention	❑	❑	❑	❑	❑
Non-motor boat days	❑	❑	❑	❑	❑
Increased no-wake zones	❑	❑	❑	❑	❑
Limiting motor horsepower	❑	❑	❑	❑	❑
Lake friendly restrictions on residential development	❑	❑	❑	❑	❑
Repair of storm drains	❑	❑	❑	❑	❑

10. Thinking about the past year, while you were visiting Clear Lake, what percentage of your time did you spend:

Activity	Percentage
Fishing	______%
Sailing	______%
Recreational boating (water skiing, power boating, jet skiing, etc.)	______%
Swimming/beach use	______%
Nature appreciation/viewing	______%
Snowmobiling and other winter recreation	______%
Camping	______%
Picnicking	______%
Other______________________	______%
	100%

INFORMATION ON YOU AND OTHER MEMBERS OF YOUR household will help us better understand how household characteristics affect an individual's use of and attitudes toward Clear Lake. It will also help us to determine how representative our sample is of the state of Iowa. All of your answers are strictly confidential. The information will only be used to report comparisons among groups of people. We will never identify individuals or households with their responses. Please be as complete as possible. Thank you.

11. Are you

❑ male ❑ female

12. What is your age?

❑ Under 18
❑ 18 – 25
❑ 26 – 34
❑ 35 – 49
❑ 50 - 59
❑ 60 - 75
❑ 76 +

13. What is the highest level of schooling that you have completed? (Please check only one)

❑ Eight years or less
❑ Some high school or less
❑ High school graduate
❑ Some college or trade/vocational school
❑ Two years of college or trade/vocational school
❑ College graduate
❑ Some graduate school
❑ Advanced degree

14. How many adults live in your household (over the age of 18)? ______

15. How many children live in your household (18 or under)?______

To help us better understand how you value your leisure time, we would now like to ask you about your work choices.

16. If you are currently employed, how many hours a week do you typically work? ______

17. If you are currently employed, do you have the option of working additional hours to increase your total income?

❑ No
❑ Yes—if so, what would your hourly wage be?
$______per hour

18. If you answered "no" to question 17, and you could have the option of working more or less hours, which would you prefer?

- ❑ Work more hours
- ❑ Work less hours

19. What was your total household income (before taxes) in 1999?

❑ Under $10,000	❑ $40,000-$49,999
❑ $10,000-$14,999	❑ $50,000-$59,999
❑ $15,000-$19,999	❑ $60,000-$74,999
❑ $20,000-$24,999	❑ $75,000-$99,999
❑ $25,000-$29,999	❑ $100,000-$124,999
❑ $30,000-$34,999	❑ $125,000-$149,999
❑ $35,000-$39,999	❑ Over $150,000

20. Do you own your home?

- ❑ No
- ❑ Yes

21. Are you a year-round resident?

- ❑ No
- ❑ Yes

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Please feel free to make any additional comments about your answers to these questions or about the survey itself. Thank you for your assistance with our Clear Lake Survey.

Comments:

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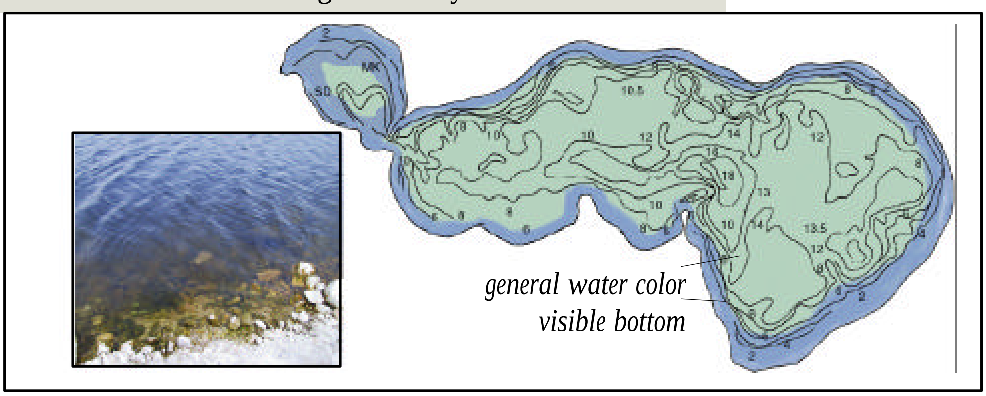
Appendix B: Low-Variance Graphic

Plan C

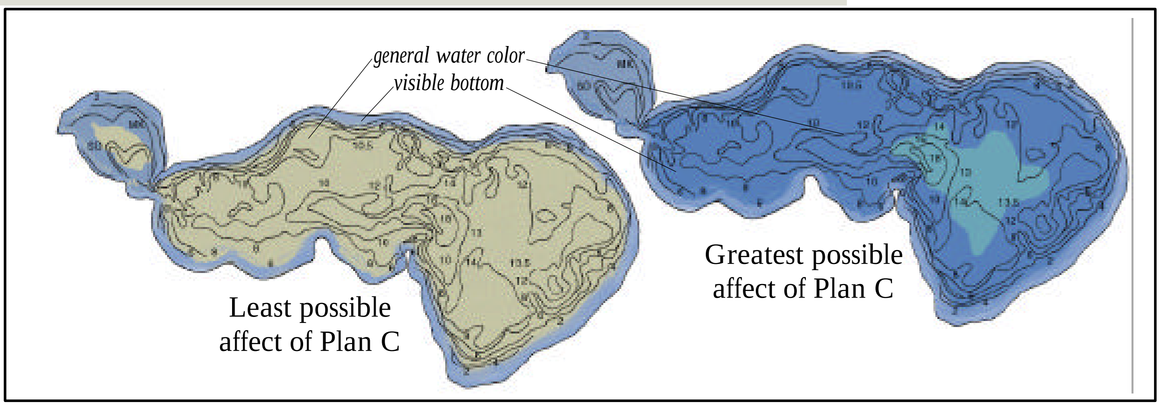
Water clarity	objects distinguishable 6 to 8 feet under water
Algae blooms	3 to 4 per year
Water color	green to blue
Water odor	occasional mild
Bacteria	infrequent swim advisories
Fish	high diversity



Appendix C: High-Variance Graphic

Plan C

Water clarity	objects distinguishable 2 to 12 feet under water
Algae blooms	0 to 8 per year
Water color	greenish brown to blue
Water odor	occasional mild to no odor
Bacteria	infrequent swim advisories to no advisories
Fish	low to high diversity



Appendix D: The Relationship between b and a

b **Value**	**Estimate of** a **Homogeneous Parameters**	**Estimate of** a **Heterogeneous Parameters**
1.0	0.989	0.963
0.9	0.988	0.961
0.8	0.988	0.960
0.7	0.987	0.957
0.6	0.986	0.955
0.5	0.985	0.953
0.4	0.984	0.950
0.3	0.983	0.947
0.2	0.982	0.944
0.1	0.980	0.940
0.0	0.978	0.936

References

Arrow, K., and A. Fisher. 1974. "Environmental Preservation, Uncertainty, and Irreversibility." *Quarterly Journal of Economics* 88: 312-19.

Bergstrom, J., J. Stoll, and A. Randall. 1990. "The Impact of Information on Environmental Commodity Valuation Decisions." *American Journal of Agricultural Economics* 72: 614-21.

Blomquist, G., and J. Whitehead. 1998. "Resource Quality Information and Validity of Willingness to Pay in Contingent Valuation." *Resource and Energy Economics* 20: 179-96.

Boyle, K., S. Reiling, and M. Phillips. 1990. "Species Substitution and Question Sequencing in Contingent Valuation Surveys Evaluating the Hunting of Several Types of Wildlife." *Leisure Science* 12: 103-18.

Brookshire, D., L. Eubanks, and A. Randall. 1983. "Estimating Option Price and Existence Values for Wildlife Resources." *Land Economics* 59: 1-15.

Cameron, T. 1988. "A New Paradigm for Valuing Non-Market Goods Using Referendum Data: Maximum Likelihood Estimation by Censored Logistic Regression." *Journal of Environmental Economics and Management* 15: 355-79.

Conrad, J. 1980. "Quasi-Option Value and the Expected Value of Information." *Quarterly Journal of Economics* 95: 813-20.

Cummings, R., and L. Taylor. 1999. "Unbiased Value Estimates for Environmental Goods: A Cheap Talk Design for the Contingent Valuation Method." *American Economic Review* 89: 649-65.

Dillman, D. 1978. *Mail and Telephone Surveys: The Total Design Method*. New York: Wiley and Sons.

Freeman, A. 1984. "The Size and Sign of Option Value." *Land Economics* 60: 1-13.

Greenley, D., R. Walsh, and R. Young. 1981. "Option Value: Empirical Evidence from a Case Study on Recreation and Water Quality." *Quarterly Journal of Economics* 96: 657-73.

Hanemann, M. 1989. "Information and the Concept of Option Value." *Journal of Environmental Economics and Management* 16: 23-37.

Henry, C. 1974. "Option Values in the Economics of Irreplaceable Assets." *Review of Economic Studies: Symposium on the Economics of Exhaustible Resources* 41: 89-104.

Hoehn, J., and A. Randall. 1987. "A Satisfactory Benefit-Cost Indicator from Contingent Valuation." *Journal of Environmental Economics and Management* 14: 226-47.

List, J. Forthcoming. "Do Explicit Warnings Eliminate the Hypothetical Bias in Elicitation Procedures? Evidence from Field Auctions of Sportscards." *American Economic Review*.

Loomis, J., A. Gonzalez-Caban, and R. Gregory. 1994. "Do Reminders of Substitutes and Budget Constraints Influence Contingent Valuation Estimates?" *Land Economics* 70: 499-506.

Mansfield, C. 1999. "Despairing Over Disparities: Explaining the Difference Between Willingness to Pay and Willingness to Accept." *Environmental and Resource Economics* 13: 219-34.

Mitchell, R., and R. Carson. 1985. "Option Value: Empirical Evidence from a Case Study of Recreation and Water Quality: Comment." *Quarterly Journal of Economics* 100: 291-94.

Samples, K., J. Dixon, and M. Gowen. 1986. "Information Disclosure and Endangered Species Valuation." *Land Economics* 62: 306-12.

Usategui, J. 1990. "Uncertainty, Information, and Transformation Costs." *Journal of Environmental Economics and Management* 19: 73-85.

Viscusi, W. 1988. "Environmental Policy Choice with an Uncertain Chance of Irreversibility." *Journal of Environmental Economics and Management* 15: 147-57.

Weisbrod, B. 1964. "Collective-Consumption Services of Individualized-Consumption Goods." *Quarterly Journal of Economics* 78: 471-77.

Whitehead, J., and G. Blomquist. 1997. "Do Reminders of Substitutes and Budget Constraints Influence Contingent Valuation Estimates: Comment." *Land Economics* 71: 541-43.

Zhao, J., and C.L. Kling. Forthcoming. "A New Explanation for the WTP/WTA Disparity." *Economics Letters*.

———. 2000. "Willingness to Pay, Compensating Variation, and the Cost of Commitment." CARD Working Paper 00-WP 251, Center for Agricultural and Rural Development, Iowa State University.