5-2004

Comparison of the Contingent Valuation Method and the Stated Choice Model for Measuring Benefits of Ecosystem Management: A Case Study of the Clinch River Valley, Tennessee

Yuki Takatsuka
University of Tennessee - Knoxville

To the Graduate Council:

I am submitting herewith a dissertation written by Yuki Takatsuka entitled "Comparison of the Contingent Valuation Method and the Stated Choice Model for Measuring Benefits of Ecosystem Management: A Case Study of the Clinch River Valley, Tennessee." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Economics.

Robert A. Bohm, Major Professor

We have read this dissertation and recommend its acceptance:

Matthew N. Murray, David B. Eastwood, Steven L. Stewart

Accepted for the Council:

Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

To the Graduate Council:

I am submitting herewith a dissertation written by Yuki Takatsuka entitled "Comparison of the Contingent Valuation Method and the Stated Choice Model for Measuring Benefits of Ecosystem Management: A Case Study of the Clinch River Valley, Tennessee." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Economics.

Robert A. Bohm
Major Professor

Michael J. McKee
Major Professor

We have read this dissertation
and recommend its acceptance:

Matthew N. Murray

David B. Eastwood

Steven L. Stewart

Acceptance for the Council:

Anne Mayhew
Vice Chancellor and Dean of
Graduate Studies

(Original signatures are on file with official student records.)

Comparison of the Contingent Valuation Method and the Stated Choice Model for Measuring Benefits of Ecosystem Management: A Case Study of the Clinch River Valley, Tennessee

A Dissertation
Presented for the
Doctor of Philosophy
Degree
The University of Tennessee, Knoxville

Yuki Takatsuka
May 2004

DEDICATION

This dissertation is dedicated to my parents,

Yasuo and Etsuko Takatsuka.

I truly thank my parents for their support and endless love
during this educational endeavor.

ACKNOWLEGEMENTS

I would like to express my deep appreciation to my advisors, Dr. Robert Bohm and Dr. Michael McKee for their guidance and support during my dissertation work. This research would never have been completed without their tremendous assistance. I am sincerely grateful to my committee, Dr. Matthew Murray, Dr. David Eastwood, and Dr. Steven Stewart for their guidance and tutelage. I especially want to thank Dr. Matthew Murray and Dr. Steven Stewart for their friendships and efforts to push me to challenge to the next door. I will never forget their supports.

I have truly enjoyed my time at the Department of Economics and wish to thank all of those who have touched my life during my time in Knoxville. Donna Kemper, Susan McGee, and Amanda Carter supported my personal and professional development. My special appreciation goes to them.

I appreciate financial support from the Scholarly Research Grant Program of the College Business Administration at the University of Tennessee.

Lastly, I would like to thank Kunihiko Sam Taira, whose support, encouragement, and love brought me happiness during my dissertation work.

ABSTRACT

Several recent studies have compared the stated preference contingent valuation method (CVM) and discrete choice analysis for non-market value. The studies suggest that values derived from the two different methods differ because of the information presented in the contingent market. One explanation is that in the CVM consideration of substitutes typically amounts to a statement reminding the respondent of a budget constraint. In the choice analysis, consideration of substitutes is part of the survey design and the decision process. An alternate explanation is that information on the suite of complementary changes is explicitly recognized in the choice models and is assumed to be constant in the choice analysis. Another difference between the two analyses is experimental aspects; the choice model has an iteration format in questions, but not the CVM.

The subject of this dissertation pertains to issues of substitutes and experiment aspects between the CVM and discrete choice model, comparing the values of environmental quality changes in the upper Clinch River, Tennessee. In the first test, three sample surveys are created: a choice model survey; a standard CVM survey where complements to the policy change are not considered; and a "rational expectations" version of contingent valuation where the complements to the policy change are explicitly stated in the survey. In the second test, an additional survey is created for examining the experimental differences between the two models. It is a CVM survey containing multinomial questions like the choice model.

These two tests provide evidence that the welfare estimates derived by the choice model are much higher than the corresponding CVM, even though questioners for both models are conditioned to provide either the same information on substitutes for a policy or the same number of multinomial questions between the two models. Another finding is that people may not be sensitive to embedding, but depend upon attributes in questions. These findings suggest that when individuals face the two different formats, such as referendum and choice formats, the psychological aspects of individual decision behavior are carefully concerned.

TABLE OF CONTENTS

LIST OF TABLES

TABLE

Chapter 1

Introduction

1.1 Introduction

Currently, the contingent valuation method (CVM) is the most commonly used method to measure individual willingness to pay (WTP) for environmental goods and services. The CVM is a survey method asking individuals to reveal their personal valuations for increments or decrements of unpriced non-market goods by using contingent markets (Randall et al. 1983). These markets define the status quo level of provision and the offered increment or decrement condition, the institutional structure under which the good is to be provided, the payment method, and the decision rule that determines whether or not the offered program is implemented. The CVM is a part of a class of preference elicitation methods called "stated preference techniques." Another class of major non-market valuation techniques that rely on observation of actual behavior is known as "revealed preference techniques," i.e. averting behavior, hedonic price, and travel cost methods. Since the revealed preference technique requires observing individual behaviors, it is harder to apply to estimate values of public goods, especially when they are national rather than local public in nature (Cropper, 1994). Also, measurements of environmental quality change are hardly observable. As a consequence, the CVM, which asks individuals to consider hypothetical questions, is often more useful for eliciting individuals' WTP for environmental goods and services than revealed preference techniques.

Although many studies have employed the CVM, the method has been criticized for its alleged inaccuracy in measuring economic values (Diamond and Hausman, 1994; Hannemann, 1994). When responding to the typical CVM, individuals are required to answer a question involving payment for an environmental quality change. The critical point is the accuracy of the question in which only one specific scenario is asked. The scenario must be designed very carefully, keeping in mind that errors found after the survey cannot be adjusted. (Louviere, 1994).

Because of this drawback, an alternative stated preference technique is now gaining acceptance among economists attempting to measure WTP for environmental goods and services. It is called the choice model. The origin of the technique is in conjoint analysis, which is a method used to represent individual preferences in multi-attribute contexts. That is, individuals are asked to choose the best alternative or rate/rank alternatives having varying values. While this method has been widely used in marketing for the last 20 years (McFadden, 1986; Louviere, 1988; Wittink and Cattin, 1989; Green and Srinivasan, 1990), it has seen only limited application in economics (Louviere and Timmermans, 1990; MacKenzie, 1993).

The choice model is basically a modification of the CVM. The similarity between the two models is that questions are hypothetical scenarios. However, the choice model claims to have greater accuracy with regard to the characteristics used to describe an event. While the CVM asks individuals about a single event on outcome, the choice model asks them to choose their preferred option from a "choice set" made up of different configurations of multiple events or outcomes. Each configuration consists of a different set of attributes. The key advantage of using the choice model over the CVM,

therefore, is that the method does not rely on a specific case of environmental change (Boxall et al., 1996). Rather it relies on multiple attributes in a choice situation. A second advantage of the choice model is its experimental aspect (Boxall et al., 1996). Individuals choose one event among several options having a variety of attributes. Thus, individuals consider tradeoffs among the attributes, and the tradeoffs are reflected in the choice.

Because of the different structures of the two models, several studies have emphasized the difference in estimated WTP between the two models. It has been found that individuals behave differently when they face different formats of hypothetical questions. For example, response rates, bid amounts, and “maybe” answers appears to be affected by different structures. Controlling for the format, however, still leaves the question: Are the WTP estimates derived from the CVM and the choice model the same? The subject of this dissertation is a comparison between the CVM and choice models. The focus is on individual decisions about welfare values for environmental quality changes which depend only upon the stated attributes and experimental aspects of survey questions.

1.2 Background Literature

Both the choice model and the CVM utilize a random utility model (RUM) to explain individual preferences. Based on neoclassical economic theory, WTP estimates derived by the CVM and choice model should be the same. However, several recent studies have shown that results of WTP estimates derived from the CVM and the choice

model differ (Desvougas et al., 1987; Margat et al., 1988; Ready et al., 1995; Barett et al., 1996; Stevens et al., 2000).

Desvouges et al. (1987) compared the traditional CVM and contingent rankings for water quality in the Monogahela River. The result was that mean water use values derived from the direct CVM questions were three to four times less than the values estimated from the ranking study. This suggests that values derived from conjoint analysis would be much higher than those derived from the traditional CVM format.

Magat, et al. (1988) used the open-ended CVM and a paired comparison approach, which is essentially the choice method, to estimate values for risk reduction associated with a set of market goods (bleach and drain openers). They found that respondents stated values below their true reservation prices for the commodities being valued. In other words, the CVM approach created incentives for respondents to underestimate their true values, while the choice method eliminated this incentive, producing more accurate WTP estimates.

Ready, et al. (1995) compared the traditional CVM (dichotomous choice format) and the conjoint analysis (polychotomous choice format), and found that the conjoint analysis showed higher response rates and much higher estimates of WTP. They found that in the polychotomouse choice format, there were much higher rates of "yes" responses, and the scenario of the polychotomouse format seemed to be less influenced by individual behaviors than the the dichotomous choice format. Barett (1996) also suggested that estimates derived from conjoint analysis were four to five times larger than the corresponding CVM estimates based on their analysis two different water purification programs. Stevens, et al. (2000) concluded that conjoint WTP estimates

were biased upwards, since conjoint WTP estimates counted 'maybe' responses as 'yes' responses.

Most studies have conducted that value estimates derived from the choice model were larger than the corresponding CVM estimates, yet a result tested by Boxall, et al. (1996) found that CVM estimates of changes in environmental quality, which were affecting moose habitats, were much higher than estimates derived from the choice model. They suggested the reasons might be that in the CVM analysis the respondents were not considering substitution possibilities.

Stevens, et al. (2000) pointed out three major reasons for the WTP discrepancies between the CVM and the choice model. The first reason is based on psychological perspective. Irwin, et al. (1993) mentioned that the process of making choices in the choice model format may be quite different from those associated with making decisions about WTP. For example, respondents may react differently when choosing among commodities that have an assigned price as compared to making dollar valuations of the same commodities.

The second reason is that respondent uncertainty about decisions may cause the difference between the CVM and the choice model. Normally, the choice model contains a polychotomous choice format, while the CVM format is dichotomous. Thus, the choice model may allow respondents to answer from a wider range of consideration, which helps respondents to decide questions more easily and accurately (Ready et al., 1995). Indeed, several empirical studies (Champ, et al., 1997; Elkstrand and Loomis, 1997; Alberini, et al., 1997; Wang, 1997) indicated that respondent uncertainty affected WTP estimates in the CVM format. For example, Champ et al. (1997) tested a case of donations for an

environmental good. They concluded that if all respondents knew their answers with certainty in the CVM format, then the mean CVM and actual donations were not statistically different.

The third saurce of the different estimates between the CVM and the choice model formats deals with substitutes for the cost of changing environmental quality. Here the substitutes are equivalent to attributes, not including the cost, of a scenario in a question. The CVM traditionally consists of only one attribute; the model has only one substitute. On the other hand, the choice model consists of more attributes in a scenario than the CVM; the model has more substitutes for the cost of accepting the scenario. Substitutes for a question in the choice model more accurately exist than ones in the CVM format. Thus, those substitutes reflect respondent preferences and explain the tradeoff in more detail. As shown by Gan and Luzar (1993), the choice model is considered as an extension of the referendum closed-end CVM, because the choice model normally contains more attributes and attribute levels than the CVM. Boxall, et al. (1996) found that the CVM estimates are biased upward because the CVM format contains fewer substitutes in a survey question.

1.3 Statement of Problems and Goals of the Dissertation

The third source of discrepancies between the CVM and the choice model estimates seems to be especially critical. If an individual consideration of a tradeoff is dealt with in a different manner in terms of substitutes, the WTP estimates derived from the CVM and the choice model would obviously produce disparate results. Without

taking care of this problem, comparisons between the CVM and the choice model are difficult.

Moreover, experimental aspects in the choice model must lead to dispersion between two models. The contingent valuation model has a one-shot question format, while the choice model asks individuals the same type of questions repeatedly. To compare the two models, the single-question format in the CVM versus the multiple question format in the choice model need to be provided same conditions in a quesion.

The goal of this dissertation is to compare the ability of the CVM and the choice model to elicit WTP for environmental change, focusing on the substitute problem and the experimental aspect issue. To achieve this goal, the WTP for environmental quality change in the Clinch River Valley, Tennessee, is evaluated based on data derived from mail surveys. The dissertation proceeds as follows:

Chapter two consists of theoretical considerations. The random utility model (RUM), the microeconomic framework used to model the individuals' preferences for environmental goods, is introduced.

Chapter three explains the survey design. Three surveys are described first: The choice model survey (CHOICE), the traditional contingent valuation survey (TRAD-CVM), and the modified contingent valuation survey (MOD-CVM). In addition, the multinomial contingent valuation survey (MULT-CVM), the pooled traditional contingent valuation (POOLEDTRAD-CVM), and the pooled modified contingent valuation (POOLEDMOD-CVM) are explained.

Chapter four provides a discussion of the analysis of the choice model (CHOICE). Welfare values are estimated for a variety of policy options. Results are presented with

and without social characteristics. As explanatory variables, social characteristics may play an important role in determining welfare values.

Chapter five examines the CVM. Welfare measures for all CVM models (TRAD-CVM and MOD-CVM, MULT-CVM, POOLEDTRAD-CVM, POOLEDMOD-CVM) are calculated using a logit model for the referendum type questions and by OLS and the Tobit model for open-ended type questions. Like the CHOICE case, estimates with social characteristics and without them are examined separately.

Chapter six discusses the comparison between the CVM and the choice model, and chapter seven concludes the dissertation and presents plans for future research.

Chapter 2

Theoretical Considerations

2.1 Random Utility Model

Both CV and conjoint studies utilize a random utility model (RUM) to explain individuals' preferences. RUM models rely on choice behavior and assume that individuals will choose the alternative that gives them the highest level of utility. That is, RUM models estimate the probability that an individual will select a choice based on the attributes of each possible alternative. If the utility of alternative i is greater than the utility of alternative j, then the individual will choose i. Utility is comprised of both deterministic components (environmental quality, income, etc.) and random components that are unobservable to the researcher.

Boxall, et al. (1996), Roe, et al. (1996), and Stevens, et al. (1997) describe discrete choices in a utility maximizing framework. The utility for the choice of the alternative i for each individual is given by:

$$U^i(q^i,z) \; , \tag{2.1}$$

where the utility of alternative i for the individual is a function of the q attributes of i, and z represents individual characteristics. Equation (2.1), however, is not particularly valuable to measure welfare because it doesn't reflect the tradeoffs that individuals must make in order to consume a bundle of goods. Thus, we typically consider the indirect

utility function, which expresses utility as a function of income and prices, because it is conditional on the choice of the alternative i:

$$U^i = v^i (p^i, q^i, M, z) + \varepsilon^i \, , \tag{2.2}$$

where p and M represent price of the state of the world i and the income of the individual. Utility is comprised of an objective or deterministic component (v^i) and a unobservable random error component (ε^i).

The scale of measurement can be shifted by simply transforming U^i by any strictly monotonically increasing function, because the utility is ordinal (Ben-Akiva, 1985). If the utility of alternative i is greater than another alternative j ($U^i > U^j$), then the probability of the individual choosing alternative i is:

$$Pr(i) = Pr\{ U^i > U^j \} \tag{2.3}$$

$$= Pr\{ v^i (p^i, q^i, M, z) + \varepsilon^i > v^j (p^j, q^j, M, z) + \varepsilon^j \} \tag{2.4}$$

$$= Pr\{ \varepsilon^j - \varepsilon^i < v^i (p^i, q^i, M, z) - v^j (p^j, q^j, M, z) \} \tag{2.5}$$

We assume that the indirect utility function has a linear form. If we denote $\beta = [\beta_1, \beta_2, \ldots, \beta_k]'$ as the vector of k unknown parameters, the indirect utility function is:

$$v^i = X^i \beta_k \tag{2.6}$$

$$= \beta_1 + \beta_2 x^i{}_2 + \beta_3 x^i{}_3 + \ldots + \beta_k x^i{}_K \tag{2.7}$$

$v^j = X^j\beta_k$ (2.8)

$= \beta_1+\beta_2 x^j{}_2+ \beta_3 x^j{}_3+ \ldots+ \beta_k x^j{}_K$ (2.9)

We see that both utilities have the same estimated from in their vectors of parameters.

2.2 Estimating Welfare Value by Using the Binomial Logit Model

In non-market valuation and natural resource damage assessment, the policy maker needs to assess welfare changes due to changes in environmental quality. The CVM and the choice models are increasingly being formulated in a random utility framework, which allows this type of measurement.

If there are two alternatives in the CVM, then generally the binary logit model is employed. The binary distribution arises from the assumptions that $\varepsilon= \varepsilon^j-\varepsilon^i$ is logistically distributed. The cumulative and density logistic functions are respectively as follows:

Cumulative Logistic Function

$$F(\varepsilon) = \frac{1}{1+\exp(-\rho\varepsilon)} \quad (2.10)$$

Density Logistic Function

$$f(\varepsilon) = \frac{\rho \exp(-\rho\varepsilon)}{(1+\exp(-\rho\varepsilon))^2} \tag{2.11}$$

where ρ is a positive scale parameter and $-\infty<\varepsilon<+\infty$. For convenience we generally make the assumption $\rho=1$(Ben-Akiva and Lerman, 1985).

The assumption is that ε is logistically Gumbel distributed (Type I extreme value distributed). Under the assumption that ε is logistically distributed, the choice probability for alternative i is given by:

$$\Pr(i)=\Pr\{ U^i > U^j\} \tag{2.12}$$

$$= \frac{1}{1+\exp(-(v_i - v_j))} \tag{2.13}$$

$$= \frac{\exp(v_i)}{\exp(v_i)+\exp(v_j)} \tag{2.14}$$

The odds ratio in favor of alternative i, which is the ratio of the probability that the individual will choose the alternative i to the probability that he/she will not choose it, is as follows:

$$\frac{\Pr(i)}{1-\Pr(i)} = \frac{\exp(v_i)}{\exp(v_j)} \tag{2.15}$$

$$= \exp(v_i - v_j) \tag{2.16}$$

The logit, which is the log of the odds ratio, is given by:

$$\ln\left(\frac{\Pr_i}{1-\Pr_i}\right) = v_i - v_j \tag{2.17}$$

$$= \Delta v \tag{2.18}$$

To estimate the welfare impacts, i.e., willingness-to-pay, for a change from the status quo state (alternative j) of the world to the chosen state (alternative i), the following formula is used:

$$v^i\,(p^i,q^i,m\text{-}CV,z)+\varepsilon^i= v^j\,(p^j,q^j,m,z)+\varepsilon^j, \tag{2.19}$$

where CV (compensating variation) is the income adjustment necessary to leave the individual as well off with bundle i as she was with bundle j.

Again, the indirect utility function has a linear form. When the function has (k-1) unknown parameters plus COST, a measure of individual's cost of choosing a new state (alternative i), we could denote the difference in the indirect utility function as

$$\Delta v = v_i - v_j \tag{2.20}$$

$$=X^i\beta_k - X^j\beta_k \tag{2.21}$$

$$=\beta_1+\beta_2\,(x^i{}_2 - x^j{}_2)+\beta_3\,(x^i{}_3 - x^j{}_3)+\ldots+\beta_{k-1}\,(x^i{}_{k-1} - x^j{}_{k-1})+a(COST), \qquad (2.22)$$

$$=\beta_1+\beta_2\,(\Delta x_2)+\beta_3\,(\Delta x_3)+\ldots+\beta_{k-1}\,(\Delta x_{k-1})+a(COST) \qquad (2.23)$$

where a is the marginal utility of income, or coefficient of COST attribute.

From (2.18) and (2.23), the logit of choosing alternative i is:

$$\ln\left(\frac{\Pr_i}{1-\Pr_i}\right) = v_i - v_j = \Delta v \qquad (2.24)$$

$$=\beta_1+\beta_2\,(\Delta x_2)+\beta_3\,(\Delta x_3)+\ldots+\beta_{k-1}\,(\Delta x_{k-1})+a(COST), \qquad (2.25)$$

where, COST (i.e., CV) is welfare value (WTP) for changing alternative from i (new state) to j (status quo). The median WTP can be calculated at the point the probability of the individual choosing alternative i is 50 percent ($\Pr_i$=.50), where the odds ratio becomes 1, and the logit becomes 1. In other words, the median WTP is estimated when $\Delta v=0$. Under this condition, equation (2.25) is rearranged to:

$$\beta_1+\beta_2\,(\Delta x_2)+\beta_3\,(\Delta x_3)+\ldots+\beta_{k-1}\,(\Delta x_{k-1})+a(COST)=0 \qquad (2.26)$$

Therefore, the CV can be written as:

$$CV=\frac{1}{-a}(\beta_1+\beta_2(\Delta x_2)+\beta_3(\Delta x_3)+\ldots+\beta_{k-1}(\Delta x_{k-1})) \tag{2.27}$$

2.3 Estimating Welfare Value by Using the Multinomial/Conditional Logit Model

If an individual chooses one alternative among several options, the multinomial logit model or the conditional logit model is used. With the multinomial logit model, the effects of the independent variables are allowed to differ for each outcome. Alternatively, with the conditional logit model, characteristics of the outcomes are used to predict the choice that is made (Long, 1997); the conditional logit model assumes that the characteristics of the choice determine choice outcome.

From equation (2.14), the probability of choosing alternative m from j alternatives is:

$$\Pr(m)=\frac{\exp(\rho v^m)}{\Sigma_{j=1}^{J}\exp(\rho v^j)} \tag{2.28}$$

Again the scale factor, ρ, is typically assumed to equal 1(Ben-Akiva and Lerman, 1985).

In the multinomial logit model, we assume that Pr(m) is a function of the linear combination of $x\beta_m$. The vector $\beta_{m=}(\beta_{0m\ldots}\ \beta_{km\ \ldots}\ \beta_{Km})'$ includes the intercept β_{0m} and coefficients β_{km} for the effect of x_k on outcome m. Thus, the probability of choosing alternative m from J alternatives for the multinomial logit model is:

$$\Pr(m) = \frac{\exp(x_i \beta_m)}{\Sigma_{j=1}^{J} \exp(x_i \beta_j)} \tag{2.29}$$

The multinomial logit model can also be expressed in terms of the odds ratio, as was done in the binomial logit model in equation (2.15). The odds ratio of outcome m versus outcome n given x is:

$$\frac{\Pr(m)}{\Pr(n)} = \frac{\dfrac{\exp(x_i \beta_m)}{\Sigma_{j=1}^{J} \exp(x_i \beta_m)}}{\dfrac{\exp(x_i \beta_n)}{\Sigma_{j=1}^{J} \exp(x_i \beta_j)}} \tag{2.30}$$

$$= \frac{\exp(x_i \beta_m)}{\exp(x_i \beta_n)} \tag{2.31}$$

$$= \exp(x_i [\beta_m - \beta_n]) \tag{2.32}$$

Taking logs shows that the multinomial logit model is linear in the logit:

$$\ln(\frac{\Pr(m)}{\Pr(n)}) = x_i (\beta_m - \beta_n) \tag{2.33}$$

When we assume $\beta_n = 0$, the equation for the comparison with outcome n simplifies to

$$\ln(\frac{\Pr(m)}{\Pr(1)}) = x_i (\beta_m - \beta_1) = x_i \beta_m \tag{2.34}$$

This format is simply equivalent to the equation (2.25) for the binominal logit model. Therefore, the welfare estimation can be calculated the same way as the binominal logit model.

In the multinomial logit model, the coefficients differ for each outcome. The idea is hard to apply for the choice model, because we assume that the impact of the attributes of environmental quality are the same across all alternatives; only the attribute levels differ across the alternatives. In the conditional logit model, the coefficients for a variable are the same for each outcome, but the values of the variables differ for each outcome. Thus, the conditional logit model is employed to estimate CV for the choice model. In the conditional logit model, the predicted probability is:

$$\Pr(m) = \frac{\exp(z_{im} r)}{\Sigma_{j=1}^{J} \exp(z_{ij} r)}, \tag{2.35}$$

where z_{im} are the variables when the i th outcome is m, and γ_k is a single vector for z_k. The odds ratio of outcome m versus outcome n given x is:

$$\frac{\Pr(m)}{\Pr(n)} = \frac{\dfrac{\exp(z_{im} r)}{\Sigma_{j=1}^{J} \exp(z_{ij} r)}}{\dfrac{\exp(z_{in} r)}{\Sigma_{j=1}^{J} \exp(z_{ij} r)}} \tag{2.36}$$

$$= \frac{\exp(z_{im} r)}{\exp(z_{in} r)} \tag{2.37}$$

$$= \exp([z_{im} - z_{in}]\gamma) \quad (2.38)$$

Taking logs shows that the conditional logit model is linear in the logit:

$$\ln(\frac{\Pr(m)}{\Pr(n)}) = ([z_{im} - z_{in}]\gamma) \quad (2.39)$$

When we assume z_{in}=0, equation (2.39) is:

$$\ln(\frac{\Pr(m)}{\Pr(1)}) = z_{im}\gamma \quad (2.40)$$

Since the format of this equation (2.40) is the same as the one of the multinomial logit model (equation 2.34), the welfare estimates can be generated by using the same process of welfare measurement as the multinomial logit model.

Hanemann (1982) expressed the value of a welfare change as follows:

$$CV=(1/-a)\ [\ln\Sigma_{i\chi C} \exp(v^i)- \ln\Sigma_{i\epsilon C} \exp(v^j)], \quad (2.41)$$

where v^j and v^i represent utility before and after the change, a is the marginal utility of income (the coefficient of the COST or price attribute), and C is the choice set of the individual. If there are three options (one being the status quo), an individual will compare these options and choose one, while trading off attributes. However, Boxall et

al. (1996) argue that the CV format ignores substitutes. They show that the conditional logit formulation of the choice model incorporates substitution possibilities through the denominator of equation (2.28). In this sense, we can restrict equation (2.41) to only two choice levels (one being the status quo) in an attribute:

$$CV=(1/-a)\ [\ln \exp(v^i)-\ln \exp(v^j)], \tag{2.42}$$

which reduces to:

$$CV=(1/-a)\ [\exp(v^i)-\ \exp(v^j)]. \tag{2.43}$$

And thus the welfare measure can be determined by calculation:

$$CV=(1/-a)\ [v^i-\ v^j]. \tag{2.44}$$

This equation is the same as equation (2.27).

2.3.1 Estimating Welfare Value by Using the Krinsky and Robb Procedure

Haab and McConnell (2003) argue that expected welfare values estimated by equation 2.44 are random variables, since the parameter vectors are estimated and are random variables. Many researchers are interested in e confidence intervals for the welfare values. One of the best methods to elicit willingness to pay is the Krinsky and

Robb[1] (1986) procedure (Haab and McConell, 2002). The Krinsky and Robb procedure points out the potential significant errors in an approximation of linear function. The method was developed by Park, et al. (1991), Creel and Loomis (1991), and Kling (1991) for a non-market valuation context. Park, et al. applied the Krinsky and Robb approach to approximate the distribution of willingness to pay, using the information of the distribution of estimated parameters and the variance-covariance matrix from the estimated multinomial logit model. A large number of drawings[2] are made from a normal distribution with variance-covariance matrix and mean estimated parameter in order to create a new parameter vector. Morrison (1991) calculated willingness to pay using each new vector, ranked the WTP estimates, and obtained 90 or 95 percent confidence. Willingness to pays by the Krinsky and Robb procedure tends to be adjusting the mean WTP estimated by the normal procedure, which is used by equation 2.44.

2.4 Different Attributes in the Two Models

At first blush, WTP estimates derived by the CVM and the choice model should be the same. However, the CVM has fewer substitutes in a question than the choice model, as shown by Boxall et al. (1996). That is, q in equation (2.2), which represents attributes, is exhibited differently in the CVM and the choice model formats. Therefore,

---

[1] Krinsky and Robb (1986) developed confidence intervals when they proposed a simulation method. Their technique was applied to estimate confidence intervals for elasticities which complicated nonlinear factions of the estimated parameters.

[2] Krinsky and Robb (1986) advised that a thousand drawings is sufficient to obtain an accurate distribution. For example, to obtain a 90 percent confidence interval the rank of the 50th and the 950th willingness to pay are used for the lower and upper band respectively.

CV, estimates of WTP estimates derived from equation (2.32) differ between the two formats, since v^i is $v^i (p^i,q^i,m,z)$. Comparison between the CVM and the choice model should be required to have the same attributes (q) in the questions. If this condition is not satisfied, then the welfare estimates derived from the CVM and CHOICE will differ in a neoclassical economic concept. In the next chapter, a CVM survey consisting of the same attributes (q) is described.

Chapter 3

Survey Design

3.1 Four Types of Survey

In this dissertation environmental quality changes in the upper Clinch River of Tennessee are evaluated by using four different types of survey. The first three surveys are created for a test of substitutes depending upon the number of attributes in a WTP question. As already noted, a valid comparison of the CVM and the choice model should use the same substitutes in a question. The three surveys are:

1. Choice Model Survey (CHOICE)
2. Traditional Contingent Valuation Analysis Survey (TRAD-CVM), with fewer substitutes than the CHOICE
3. Modified Contingent Valuation Analysis Survey (MOD-CVM), with the same number of substitutes as CHOICE

The choice model generally contains multiple questions/choice sets in a survey, while the CVM contains a single question. The experimental aspects of the choice model must be taken into account also. In order to control for this factor, a CVM survey containing an experimental aspect must be created. The fourth survey is:

4. Multinomial Contingent Analysis Survey (MULT-CVM), which has the same number of questions/choice sets CHOICE has.

In addition to the four surveys, two additional data sets are created by combining the TRAD-CVM, MOD-CVM and the MULT-CVM, which are:

5. Pooled Traditional Contingent Analysis Survey (POOLED TRAD-CVM)., which combines the TRAD-CVM and MULT-CVM
6. Pooled Modified Contingent Analysis Survey (POOLED MOD-CVM), which combines the MOD-CVM and MULT-CVM

Each survey contains three parts: Questions about the Clinch River Valley, questions about willingness to pay to improve the Clinch River, and questions about these respondents. Throughout the four surveys, the questions about the Clinch River Valley and the background of respondents are the same. Appendixes 1, 2, 3, and 4 present the CHOICE, TRAD-CVM, MOD-CVM, and MULT-CVM surveys respectively.

3.2 Background Information on the Clinch River Valley and Survey Procedures

This study is based on a case study of the willingness of the residents in the subject location, Tennessee, to pay for improving the environmental quality of the river. The upper Clinch River represents one of the last free-flowing river segments in the Tennessee River system. It spread over approximately 3,800 square miles of land and possess one of the most diverse concentrations of freshwater mussels and fish species in North America. (Twenty-two mussels and eleven fish species are listed as endangered or threatened.) The river runs through Anderson, Campbell, Claiborne, Grainger, Hancock,

and Union counties in Tennessee. This study targeted those areas. According to county-level 2001 data from the census presented by SCAN/US, INC. (2002), the total population of the areas was 188,938. The number of households was 77,590. The number of households with children was 25,743, which was 33.2 percent of the total households. The median age of the population was 40 years old. As to race, 96.2 percent of population was Caucasian. The average household income was $40,534 per year.

3.3 Survey Design in CHOICE, TRAD-CVM, and MOD-CVM

Choice model surveys are complex by nature. Each possible choice comprises bundles of attributes, with each attribute having different levels. The survey incorporates extensive discussion that defines the attributes and attribute levels as they pertain to the Clinch River Valley. Because the potential for miscommunication between the researcher and the survey recipient via the survey instrument is great, two formal focus groups of 6 and 11 subjects and three informal focus groups were used to refine the survey design. The first informal group was conducted in September of 2000 using staff and students of the University of Tennessee. The second informal focus group was conducted by an expert facilitator in St. Paul, VA in November of 2000. The third and fourth focus groups were conducted at the University of Tennessee in January and February of 2001. The final focus group was conducted in Oak Ridge, TN in February of 2001 using residents of Anderson County, TN, the westernmost county in our study area.

The focus groups allowed us to identify which attributes might be correlated with environmental management changes which were important to the residents of the Clinch River Valley. In addition, the study of the focus groups permitted honing in on changes

in the levels of an attribute that were meaningful to survey respondents. The survey was administered in split samples to 2,500 households in the Clinch River Valley. Principles from Dillman's Total Design Method, which includes multiple personalized contacts, were followed. The delivery envelope for the survey was personalized and included a cover letter, the survey (a twenty page booklet), supporting documents, and a stamped return envelope.[3] Surveys were printed on legal size (8.5"*14") paper folded as a booklet and stapled along the spine. The supporting documents were printed on letter size paper. Approximately two to three weeks after the survey was mailing out, a reminder/thank you postcard was sent to thank participants and encourage/remind non-respondents that their responses were valuable to us.

Three hundred CHOICE, six hundred fifty TRAD-CVM, and six hundred fifty MOD-CVM surveys were mailed to randomly selected households in Anderson, Campbell, Claiborne, Grainger, Hancock, and Union counties in Tennessee from January to February of 2002. Due to the low response rate for the surveys, a second set of surveys was distributed to other residents, who were also randomly selected, in October 2002. Two hundred CHOICE, four hundred TRAD-CVM, and four hundred MOD-CVM surveys were mailed to the second group.

3.3.1 Definition of Attributes in CHOICE

The choice model involved four attributes: improvement of aquatic life, improvement of sport fishing, improvement of water quality, and cost to a household for

---

[3] A token of appreciation for filling out the survey, such as $1 or $2, had been planned to include in the delivery envelop, but the St. Paul focus group strongly recommended against it. Several subjects said that they would be less likely to return the survey if money were included.

improving environmental quality. Aquatic life is a proxy for endangered mussels and other non-game fish. The changes are in terms of diversity, abundance, and distribution throughout the watershed. Sport fishing includes small mouth bass, trout, etc. The changes are in terms of number and average size. The changes in water quality are in terms of concentrations of selected toxic pollutants (copper, chromium, nickel, and zinc) and conventional ones (ammonia, phosphorous, pH, and dissolved oxygen). There were three attribute levels for aquatic life: partially recovered, full recovered, or continued decline (status quo); three levels for sport fishing: increased by 20 %, decreased by 20 %, or no change (status quo); and three levels for water quality: good, poor, or fair (status quo). The range for cost to the household was from $0 to $100. It was decided by the result of pilot surveys, which is a normal range for this type of survey.

The TRAD-CVM and MOD-CVM included two types of questions: referendum questions and open-ended questions. Respondents were asked first whether or not they would be willing to pay $X for improving the environmental quality of the rivers, and second how much was their maximum willingness to pay for the improvement.

In the TRAD-CVM, respondents were asked first whether or not they would be willing to pay $X for improving only aquatic life in the rivers and then the open-ended question. To make this situation clear, we described to respondents "scenario 1," in which only aquatic life improved, but sport fishing and water quality remained unchanged.

On the other hand, the MOD-CVM surveys included four attributes in a question that were the same as in the CHOICE questions. Respondents considered whether or not to accept a hypothetical "scenario 2," in which values of all three environmental

attributes changed. After the referendum question, an open-ended question like the ones of the TRAD-CVM were asked.

Substitutes for the cost of changing environmental quality needed to be equal if welfare estimates derived by the two models were to be compared. In CHOICE, there were three substitutes for the cost of changing environmental quality: improvement in ecology, an increase of size and amount of sport fishing, and improvement of water quality. Thus, when individuals determined their decisions in the CHOICE, they might explicitly recognize the information on the suite of change of the three attributes, comparing each option. However, in the CVM, the consideration of substitutes is typically subjected to their budgets. In the TRAD-CVM (scenario 1), individuals were able to consider the ecological improvement versus their costs. There was no consideration for substitution between their costs and sport fishing/water quality. In the MOD-CVM (scenario 2), the cost per each household was a substitute for changing not only aquatic life but also sport fishing and water quality. That is, the TRAD-CVM consisted of only one substitute of the cost for the policy. On the other hand, the MOD-CVM consisted of three substitutes, the same as the CHOICE question form.

3.3.2 Socio Economic Variables

Throughout the three types of surveys, the same questions about social characteristics were included in order to observe the effect or interaction between these variables and attributes of the river system. The variables are Education (EDUC), age (AGE), sex (MALE), income (INCOME), place of birth (BORN), number of years living in the valley (YEARS), ratio of years staying in the valley out of his/her whole life

(RLIFE), household size (HHSIZE), number of children (CHILD), political party (REPUB, DEMOC), political view (POLVI), vote (VOTE), fishing license (FISHLIC), environment organization (ENVOEG), race (WHITE), the biggest problems in the valley (ECONOMY, CRIME, PEDUC, DRUG, ENV, HEALTH), visits of the river (VISITR), number of visits (NUMV), activity in the river (BOAT, FISH, HIKE, CAMP, WORK, PICNIC, BICYCLE), the main purpose of use of the river (MIMPR), and information about the water quality (INFO). The full definitions of the socio-economic variables are presented in Table 3.1.

3.3.3 Analysis of Environmental Quality in CHOICE

The choice model was developed using linear functional forms for the indirect utility functions and estimated by the conditional logit model. To express qualitative attributes, normally dummy variables or effects codes (Louviere et al., 2000) are used. The advantages of using effects codes over dummy variables are discussed in chapter 4. Here one concept of effects codes is discussed. For example, if there are three attribute levels, two columns in the design matrix are constructed. The first two levels are coded as dummy variables, but the third level, which should be the status quo, is coded "-1" in both columns.

In this study, the attribute aquatic life has three levels: partially recovered, fully recovered, and continued decline (status quo). The coded attribute consists of two variables (columns): partially recovered (PRECOV) and fully recovered (FRECOV). If an individual chooses "partially recovered," then the code 1and 0 are entered in PRECOV and FRECOV columns respectively. If the individual chooses "fully recovered," then the

Table 3.1. Definition of Socioeconomic Variables

Variable	
EDUC	1 if elementary/ high school graduate; 2 high school graduate; 3 vocational certification; 4 some college/associate degree; 5 college graduate; 6 post-graduate degree
AGE	Age
MALE	1 if male; 0 if female
VISITR	1 if visited the river in the past year; otherwise 0
NUMV	1 if 1-2 visits; 3 if 3-5 visits; 5 if 6-10 visits; 7 if 11-20 visits; 9 if 11-20 visits; 11 if 21-50 visits; 13 if more than 50 visits
MIMPOR	1 if the most important use of the river is recreation, such as fishing, boating and hiking, or feeding fish and animals, or providing water for use in homes; otherwise 2
INFO	1 if had any information about water quality in the river in the past few months; otherwise 0
BORN	1 if born in Clinch area; otherwise 0
YEARS	Number of years living in the valley
RLIFE	Ratio of year of living in the valley out of his/her entire life
HHSIZE	Number in household
OVER 18	Number of people over 18 years old per household
CHILD	Number of children per household
REPUB	1 if republican; otherwise 0
DEMOC	1 if democrat; otherwise 0
POLVI	1 if strong liberal; 2 if liberal; 3 if slightly liberal; 4 if middle of the road; 5 if slightly conservative, 6 if conservative; 7 if strongly conservative
VOTE	1 if currently registered to vote; otherwise 0
FISHLIC	1 if purchased a Tennessee fishing license within the last three years; otherwise 0
ENVORG	1 if a member of any environmental organizations; otherwise 0
BOAT	1 if boating is the most common activity on the river; otherwise 0

Table 3.1. Continued

BOAT	1 if boating is the most common activity on the river; otherwise 0
FISH	1 if fishing is the most common activity on the river; otherwise 0
HIKE	1 if hiking is the most common activity on the river; otherwise 0
CAMP	1 if camping is the most common activity on the river; otherwise 0
WORK	1 if work is the most common activity on the river; otherwise 0
PICNIC	1 if picnic is the most common activity on the river; otherwise 0
BICYCLE	1 if bicycle is the most common activity on the river; otherwise 0
INCOME	1 if $5000; 2 if $15000; 3 if $25000; 4 if $35000; 5 if $45000; 6 if $65000; 7 if $75000; 8 if $85000; 9 if $95000; 10 if $105000; 11 if more then $105000
ECONOMY	1 if economy/jobs is the issue of most concern in the valley; otherwise 0
CRIME	1 if crime is the issue of most concern in the valley; otherwise 0
PEDUC	1 if public education is the issue of most concern in the valley; otherwise 0
DRUG	1 if drug abuse is the issue of most concern in the valley; otherwise 0
ENV	1 if environmental quality is the issue of most concern in the valley; otherwise 0
HEALTH	1 if public health is the issue of most concern in the valley; otherwise 0

code 0 and 1 are entered in the two columns respectively. If the individual chooses "status quo,' then the code –1 and –1 are entered in the two columns respectively.

The CHOICE survey consists of four attributes, in which three attributes have three levels. Thus, there are two variables (columns) for each the three attributes. Since the cost of household (COST) is a continuous variable, coding is not used for the variable. The definition of the attributes using effects codes are described in Table 3.2, and the coding according to the CHOICE scenario (see Appendix 1) is presented in the Table 3.3.

3.3.4 Experimental Aspects in CHOICE

As mentioned in Chapter 1, the choice model has an experimental aspect (Boxall et al., 1996). Individuals are asked to choose their preferred option from a "choice set," which is made up of different packages (options). A package consists of a different level of characteristic attributes of the situation.

In the CHOICE survey, individuals were asked eight questions; that is, the survey consisted of eight choice sets. Each choice set had 3 packages (options), in which one of them was the status quo. Three attributes had three levels and one had one level. The possible combination for the packages is 27 (=3^3x1). In the entire survey, twenty four packages (=3x8), were needed. Eight of them were the status quo, and the rest of sixteen were needed to be selected randomly out of the total twenty seven combinations. Excel were used for this selection process.

Table 3.2. Definition of Attribute Variables in CHOICE Using Effects Codes

Variable	
COST	Cost to Household
PARTIALLY RECOV	1 if aquatic life is partially recovered; -1 if continued decline; 0 if fully recovered
FULLY RECOV	1 if aquatic life is fully recovered; -1 if continued decline; 0 if partially recovered
INCREASE FISH	1 if the amount of sport fishing is increased by 20%; -1 if decreased; 0 if no change
DECREASE FISH	1 if the amount of sport fishing is decreased by 20%; -1 if increased; 0 if no change
GOOD WATER Q	1 if water is suitable for swimming and fish are edible, -1 if fair; 0 if poor
POOR WATER Q	1 if water is suitable for neither swimming and fish consumption, -1 if fair; 0 if good

Table 3.3. Effect Codes Design (CHOICE Survey Scenario; See Appendix 1)

Attributes		Aquatic Life		Sport Fishing		Water Quality		Cost
Choiceset (Question)	Option	PRECOV	FRECOV	INCREASE FISH	DECREA SE FISH	GOOD WATE R Q	POOR WATER Q	COST
1	a	0	1	-1	-1	-1	-1	100
1	b	-1	-1	-1	-1	0	1	50
1	c	-1	-1	-1	-1	-1	-1	0
2	a	0	1	0	1	1	0	25
2	b	1	0	0	1	1	0	10
2	c	-1	-1	-1	-1	-1	-1	0
3	a	1	0	-1	-1	1	0	5
3	b	-1	-1	1	0	0	1	10
3	c	-1	-1	-1	-1	-1	-1	0
4	a	0	1	1	0	0	1	5
4	b	-1	-1	0	1	-1	-1	5
4	c	-1	-1	-1	-1	-1	-1	0
5	a	1	0	1	0	-1	-1	75
5	b	-1	-1	1	0	1	0	100
5	c	-1	-1	-1	-1	-1	-1	0
6	a	0	1	1	0	1	0	50
6	b	0	1	-1	-1	-1	-1	10
6	c	-1	-1	-1	-1	-1	-1	0
7	a	0	1	0	1	0	1	75
7	b	1	0	1	-1	0	1	25
7	c	-1	-1	-1	-1	-1	-1	0
8	a	-1	-1	-1	-1	1	0	75
8	b	1	0	0	1	0	1	100
8	c	-1	-1	-1	-1	-1	-1	0

Since individuals were asked eight questions repeatedly, question order bias[4] had to be considered. The consistency of the individuals' behaviors is taken into consideration. Thus, the CHOICE survey is divided into two subsets: the CHOICE 1 and CHOICE 2. The order of the six questions in the CHOICE 2 is reversed from that in the CHOICE 1. If individual behavior is consistent, this division of sample should have no effect of empirical results.

3.4 Survey Design of MULT-CVM

Like the TRAD-CVM, MOD-CVM, and CHOICE, the MULTI-CVM has three parts: questions about the Clinch River Valley, questions concerning WTP, and questions regarding the background of respondents. Appendix 4 presents a sample MULTI-CVM. The questions on the Clinch River and questions on the background of respondents are the same as the TRAD-CVM, MOD-CVM, and CHOICE.

In the section concerning WTP, the MULT-CVM has eight valuation questions. This number is same as the number of choice sets in CHOICE, thus the two models are internationally similar. To test for the consistency of respondents, two out of the eight CVM questions are identical except for different bid amounts. Like the three other types of surveys, each question has four attributes: the condition of aquatic life, the amount of sport fishing, the level of water quality, and the cost of a policy to an individual per year. The eight statements are as follows:

---

[4] Shuman and Presser (1981) and Mitchell and Carson (1989) pointed out that the order of questions influence response patterns in a survey.

Q1. Water quality improved, but levels of aquatic life and sport fishing stayed the same.

Q2. The size and amount of sport fishing increased, but levels of water quality and aquatic life stayed the same.

Q3. The condition of aquatic life improved, but levels of water quality and sport fishing stayed the same (TRAD-CVM scenario).

Q4. Both the number of sport fish and water quality are improved, but level of aquatic life stayed the same.

Q5. Both the amount of sport fishing and condition of aquatic life are improved, but the level of water quality stayed the same.

Q6. Both the level of aquatic life and water quality are improved, but the amount of sport fishing stayed the same.

Q7. This question was the same as the Q4, but with a different bid amount.

Q8. All three attributes, water quality, aquatic life, and sport fishing, have improved, (MOD-CVM scenario).

In addition to the eight CVM questions, the MULT-CVM includes an individual's ideal willingness to pays and ideal policies.

For the MULT-CVM survey, 672 questionnaires were mailed to residents in Anderson, Campbell, Claiborne, Grainger, Hancock, and Union counties in Tennessee, the same targeted areas for the other surveys. In April, 2003, 420 surveys were mailed. The next month, 252 more were mailed to people who did not respond to the first 420.

3.5 Bid Design

The bid ranges for all four surveys were set between $0 and $100. The bid amounts in the CVM are $5, $10, $25, $50, $75, and $100. Since there are six bid amounts, six version of the CVM were created. The bid range and the distribution, which are based on pilot surveys, for both the TRAD-CVM and MOD-CVM are shown in Table 3.4. Nineteen percent faced $5 bid amount, 23 % faced $10 or $25, 15 % faced $50, 12 % faced $75, and 8 % faced $100.

The bid amounts for the MULT-CVM were also $5, $10, $25, $50, $75, and $100. The bid distribution is presented in Table 3.5. To keep constant bid distribution for each question and to avoid order bias, twelve versions for the MULT-CVM questionnaires were created. The orders of the bids were randomly selected by using EXCEL, which is presented in Table 3.6.

Table. 3.4. Bid Range and Distribution, TRAD-CVM & MOD-CVM

BID	TRAD-CVM	MOD-CVM	%
5	202	202	19
10	242	242	23
25	242	242	23
50	162	162	15
75	121	121	12
100	81	81	8
Total	1050	1050	100

Table 3.5. Bid Range and Distribution, MULT-CVM

BID	%	1st group	2nd group	Total
$5	17	70	42	112
$10	25	105	63	168
$25	25	105	63	168
$50	17	70	42	112
$75	8	35	21	56
$100	8	35	21	56
	100	420	252	672

Table 3.6. Bid Amount Orders, MULT-CVM

Version	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
1	50	50	75	25	5	25	10	100
2	10	50	25	25	75	10	5	5
3	5	25	25	25	50	10	5	25
4	25	75	5	10	10	100	25	10
5	5	25	10	75	10	50	25	25
6	10	100	5	10	50	25	10	10
7	100	10	50	5	10	5	75	10
8	25	10	10	5	5	50	100	50
9	50	25	100	10	25	75	25	5
10	10	5	10	50	25	25	50	50
11	75	5	25	50	100	10	50	25
12	25	10	50	100	25	5	10	75
Average	32.5	32.5	32.5	32.5	32.5	32.5	32.5	32.5

Chapter 4

Empirical Result: CHOICE Model

4.1 Descriptive Statistics in CHOICE

In CHOICE, 500 questionnaires were mailed. The response rate was 14.2 %. The descriptive statistics for the CHOICE sample are presented in Table 4.1. The average person is a 58 year old white male. He graduated from high school and has an associate degree. The average income is about $55,000. The typical respondent spend about 60 percent of his life in the Clinch Valley. The family size is 2.33, and the average number of children is 0.42. Forty percent of the sample claims Republican affiliation, and 24 percent claims to be Democratic. Political views are slightly conservative. Ninety-two percent are registered to vote. As for social issues, the economy is ranked at the first, with almost 60 percent of the people indicating it to be a concern. Other issues, such as the environment, public education, drugs, and public health issues are of concern to 10 percent or less of the sample. Only one percent of respondents are concerned about crime. The average number of visits to the Clinch River in the past 12 months was 2.85. Thirty-two percent of the people fished there, 13 percent boated and picnicked, 11 percent hiked, 7 percent camped, and 1 percent bicycled. Six percent of the entire sample belongs to environmental organizations. Thirty-three percent said that they heard, saw or read about water quality in the Clinch River in the past few months. Sixty percent of the people think that the most important uses of the river are recreation and animal/fish feeding, not industrial use or irrigation.

Table 4.1. Summary Statistics, CHOICE

	Mean	Std.Dev.	Skewness	Kurtosis	Minimum	Maximum	NumCases
EDUC	13.85	1.49	-0.29	2.05	11	16	1650
AGE	58.04	15.45	0.45	2.61	32	95	1650
MALE	0.71	0.45	-0.92	1.85	0	1	1650
INCOME	5.66	2.98	0.43	2.06	1	11	1482
BORN	0.26	0.44	1.08	2.17	0	1	1650
YEARS	34.57	21.22	0.25	2.42	0	87	1650
RLIFE	0.6	0.34	-0.22	1.67	0	1.02	1626
HHSIZE	2.33	1.06	1.06	4.28	1	6	1650
CHILD	0.42	0.72	1.38	3.34	0	2	1602
REPUB	0.4	0.49	0.42	1.17	0	1	1674
DEMOC	0.24	0.43	1.19	2.42	0	1	1674
POLVI	4.57	1.48	-0.42	2.78	1	7	1386
VOTE	0.92	0.27	-3.17	11.03	0	1	1554
FISHLIC	0.49	0.5	0.04	1	0	1	1602
ENVORG	0.06	0.24	3.71	14.74	0	1	1602
WHITE	0.89	0.32	-2.42	6.84	0	1	1674
ECONOMY	0.59	0.49	-0.36	1.13	0	1	1674
CRIME	0.01	0.12	8.17	67.72	0	1	1674
PEDU	0.09	0.28	2.95	9.71	0	1	1674
DRUG	0.09	0.28	2.95	9.71	0	1	1674
ENV	0.1	0.3	2.73	8.44	0	1	1674
HEALTH	0.09	0.28	2.95	9.71	0	1	1674
VISITR	0.7	0.9	4.74	34.35	0	7	1674
NUMV	2.85	3.29	1.06	3.05	0	11	1650
BOAT	0.13	0.34	2.21	5.89	0	1	1674
FISH	0.32	0.46	0.79	1.63	0	1	1674
HIKE	0.11	0.31	2.47	7.12	0	1	1674
CAMP	0.07	0.26	3.32	12.02	0	1	1674
WORK	0.03	0.17	5.65	32.88	0	1	1674
PICNIC	0.13	0.34	2.21	5.89	0	1	1674
BICYCLE	0.01	0.12	8.17	67.72	0	1	1674
MIMPOR	0.6	0.49	-0.41	1.17	0	1	1626
INFO	0.33	0.47	0.7	1.49	0	1	1650

4.2 Conditional Logit Model in CHOICE

The Conditional logit model has been used to estimate WTP in three different ways for the CHOICE data. The first estimate did not include social characteristics, the second includes these variables while the third includes a subset of them that leads to the best fit of the. The same set of social characteristics used here is also used across the CVM analysis. The results of the conditional logit models without social characteristics (Without SC), with social characteristics (With SC), and for the best fit regression (BEST) are presented in Tables 4.2, 4.3, and 4.4 respectively. Note that the effect codes (Section 3.6) are used for these models. Analysis using dummy variables is presented later.

The models include two alternative specific constants (ASC-1, ASC-2) for showing differences in the utility of one alternative (option 1 or 2) from the status quo (option 3). They reflect the mean of the error term, $\varepsilon^i - \varepsilon^j$ (Ben-Akiva and Lerman, 1985), which is the effect of unobserved factors on a respondent's choice (Morrison, et al., 2002).

The empirical indirect utility function of the first estimate (Without SC) includes attributes and alternative specific constants, as follows:

$$V1=\beta_1(COST)+ \beta_2(PRECOV)+ \beta_3(FRECOV)+ \beta_4(INCF)+ \beta_5(DECF)+ \beta_6(GOODWQ)+ \beta_7(POORWQ)+ ASC1+ ASC2,$$

where V1 is the indirect utility function for the first estimate.

Table 4.2. Conditional Logit Model ,CHOICE, Without SC, Using Effect Codes

Variable	Coeff		Std.Error	T-stat	P-val	ME
COST	-0.01	**	0	-2.55	0.01	
PRECOV	0.18	*	0.11	1.69	0.09	27.07
FRECOV	0.31	**	0.14	2.24	0.03	46.44
INCF	0.06		0.12	0.49	0.63	9.05
DECF	-0.19		0.13	-1.44	0.15	-27.99
GOODWQ	0.9	**	0.12	7.51	0	136.15
POORWQ	-0.97	**	0.13	-7.2	0	-146.23
ASC-01	0.09		0.32	0.27	0.79	13.09
ASC-02	-0.56	**	0.26	-2.13	0.03	-84.35
Number of Observation	558					
Log-likelihood	-506.94					
Chi-squared (7)	99.56					
R-square adjusted	0.08					

* Significant at the 0.10 level
** Significant at the 0.05 level

Table 4.3. Conditional Logit Model ,CHOICE, With SC, Using Effect Codes

Variable	Coeff.		Std.Err.	t-ratio	P-value	ME
COST	-0.01	**	0	-2.65	0.01	
PRECOV	0.22	**	0.12	1.86	0.06	28.07
FRECOV	0.38	**	0.15	2.48	0.01	49.1
INCF	0.07		0.14	0.52	0.6	9.27
DECF	-0.3	**	0.15	-2.07	0.04	-38.82
GOODWQ	1.03	**	0.14	7.59	0	132.56
POORWQ	-1.04	**	0.15	-6.84	0	-133.63
ASC-01	-1.21	**	0.5	-2.45	0.01	-156.15
ASC-02	-0.85	*	0.52	-1.63	0.1	-109.11
01xMAL	-0.15		0.27	-0.55	0.58	-19.37
01xINC	0.13	**	0.04	2.99	0	16.49
01xBOR	0.08		0.27	0.31	0.76	10.62
01xBOA	0.67	*	0.37	1.83	0.07	86.08
01xFIS	0.54	**	0.27	2.04	0.04	70.03
01xECO	0.3		0.25	1.18	0.24	38.02
01xENV	2.25	**	0.6	3.77	0	289.18
02xMAL	-0.16		0.35	-0.47	0.64	-21.12
02xINC	0.03		0.06	0.52	0.6	3.73
02xBOR	0.05		0.34	0.14	0.89	6.27
02xBOA	-0.42	*	0.56	-0.75	0.46	-54.01
02xFIS	0.75	**	0.33	2.26	0.02	96.47
02xECO	-0.02		0.32	-0.05	0.96	-2.07
02xENV	1.75	*	0.66	2.63	0.01	224.87
Number of Observation	558					
Log-likelihood	-409.4					
Chi-squared (21)	143.27					
R-squared adjusted	0.13					

* Significant at the 0.10 level
** Significant at the 0.05 level

Table 4.4. Conditional Logit Model, CHOICE, BEST, Using Effect Codes

	Coeff.		Std.Err.	t-ratio	P-value	ME
COST	-0.01	*	0.00	-1.80	0.07	
PRECOV	0.24	*	0.13	1.89	0.06	41.18
FRECOV	0.37	**	0.17	2.18	0.03	62.84
INCF	0.26	**	0.15	1.67	0.09	43.60
DECF	-0.40	**	0.15	-2.57	0.01	-67.74
GOODWQ	1.01	**	0.15	6.95	0.00	172.85
POORWQ	-1.08	**	0.17	-6.42	0.00	-184.28
ASC-01	-8.94	**	1.59	-5.62	0.00	-1522.74
ASC-02	-3.67	**	1.85	-1.99	0.05	-625.31
01xENV	2.27	**	0.59	3.82	0.00	386.51
01xEDUC	0.60	**	0.10	5.91	0.00	102.75
01xCAMP	1.19		0.85	1.40	0.16	202.56
01xMIMPOR	1.06	**	0.27	3.93	0.00	181.35
01xPOLVI	-0.16		0.10	-1.58	0.11	-27.22
01xFISHLIC	0.78	**	0.27	2.92	0.00	133.72
02xENV	2.05	**	0.67	3.04	0.00	349.29
02xEDUC	0.22	**	0.12	1.76	0.08	37.51
02xCAMP	2.41	**	0.86	2.81	0.00	410.61
02xMIMPOR	0.98	**	0.37	2.66	0.01	166.72
02xPOLVI	-0.25	**	0.13	-1.97	0.05	-43.21
02xFISHLIC	0.60	*	0.37	1.64	0.10	102.42
Number of Observation	558					
Log-likelihood	-341.99					
Chi-squared (7)	182.03					
R-squared adjusted	0.17					

* Significant at the 0.10 level
** Significant at the 0.05 level

The second estimate includes socio characteristics (MALE, INCOM, BORN, BOAT, FISH, ECON, and ENV) in the model (With SC). These coefficients cannot be estimated directly in the conditional logit model, because the variables are the same across all observations. They may be incorporated by interacting them with the alternative specific constant or with one of the attribute variables (Swallow, 1994). In thus study they are interacted with the alternative specific constants. The indirect utility function for the second estimation is:

$$V2=\beta_1(COST)+ \beta_2(PRECOV)+ \beta_3(FRECOV)+ \beta_4(INCF)+ \beta_5(DECF)+ \beta_6(GOODWQ)+ \beta_7(POORWQ)+ ASC1+ ASC2+ ASC1*MALE+ ASC1*INCOME+ ASC1*BORN+ ASC1*BOAT+ ASC1*FISHING+ ASC1*ECONOMY+ ASC1*ENV+ASC2*MALE+ ASC2*INCOME+ ASC2*BORN+ ASC2*BOAT+ ASC2*FISHING+ ASC2*ECONOMY+ ASC2*ENV,$$

where V2 is the indirect utility function for the second estimate.

In both models, PRECOV, FRECOV, GOODWQ, and POORWQ are significant at 0.05 or 0.10 level. Both PRECOV and FRECOV are positive, which leads to the interpretation that people are willing to pay for improved aquatic life. The results of positive GOODWQ and negative POORWQ, as expected, suggest that people are willing to pay for better water quality. INCF and DECF in the model without social characteristics and INCF in the model with social characteristics are insignificant, suggesting that improved sport fishing is not a strong influence. On the other hand, the

model with social characteristics gives the interpretation that people who fished the most in the river in the past year are more likely to choose policies that improve the environment because both ASC1*FISHING and ASC2*FISHING are positively significant at the 0.05 level. Similarly ASC1*ENV and ASC2*ENV are positive and significant at the 0.05 level, which implies that people concerned about environmental preferred to choose improving river policies. In addition, ASC1*INCOME and ASC1*BOAT are also positive and significant. This suggests that people who with higher incomes and who boated the most on the river were willing to choose a better river program. Other social characteristics variables, such as BORN and ECONOMY, are insignificant in each model.

The chi-square statistics leads to influences that each model is significant overall. The explanatory power of all models was satisfactory with an adjusted R-squared between 8 and 13 percent.

In the model BEST, all attributes are significant. DECF and POORWQ are negative, implying that individuals are less likely to choose a policy that leads to a decreases sport fishing or water quality. On the other hand, PRECOV, FRECOV, INCF, and GOODWQ, are positive, suggesting that people tend to choose a policy which improves aquatic life, water quality, and sport fishing. With respect to socio economic characteristics, ENV, EDUC, MIMPOR, and FISHLIC are positive and significant. The adjusted R-square increases to 17 percent.

4.3 Dummy Variable VS. Effect Codes in CHOICE

In the analysis presented above, the CHOICE data set has been analyzed with the conditional logit model using effects codes (Section 3.3) for attribute variables. In this section, the effects code approach is compared to a dummy variable approach; that is the traditional dummy variables (0,1) are substituted for the effects codes (1, 0, -1). Definitions of the dummy variables for attribute variables are presented in Table 4.5. Results of estimating CHOICE without social characteristics using the dummy variables are shown in Table 4.6. Comparing the result with the same model using effects codes notice that the signs of the significant variables at the 0.05 level are the same; however, interpreting these signs in the dummy variables case is slightly different than in the effects codes case. For dummy variables, a positive sign for an attribute shows that people are more likely to choose a policy with the option versus the status quo while a negative sign indicates the reverse. On the other hand, using effect codes a positive sign implies that people are more likely to choose a policy with the option compared to the other policies which a negative sign suggests that they are more likely to choose the status quo compared to other policies. For example, in Table 4.6, the sign of INCF is negative. This suggests that people were less likely to choose the policy for improving sport fishing compared to the current situation. In Table 4.2, the sing is positive in the effect codes case. It is interpreted that they preferred an improvement in sport fishing in comparison to another option, which might include a decrease amount of sport fishing. In short, signs in a model with dummy variables do not imply a person's tendency to choose other options; rather they directly suggest a comparison between one option and

Table 4.5. Definition of Attribute Variables, CHOICE, Using Dummy Variables

Variable	
COST	Cost to Household
PARTIALLY RECOV	1 if aquatic life is partially recovered; otherwise 0
FULLY RECOV	1 if aquatic life is fully recovered; otherwise 0
INCREASE FISH	1 if the number of sport fishing is increased by 20%; otherwise 0
DECREASE FISH	1 if the number of sport fishing is decreased by 20%; otherwise 0
GOOD WATER Q	1 if water is suitable for swimming and fish are edible, otherwise 0
POOR WATER Q	1 if water is suitable for neither swimming or fish consumption, otherwise 0

Table 4.6. Conditional Logit Model, CHOICE, Without SC, Using Dummy Variables

Variable	Coeff		Std.Error	T-stat	P-val	ME
COST	-0.01	**	0.00	-2.55	0.01	
PRECOV	0.67	**	0.21	3.12	0.00	100.58
FRECOV	0.79	**	0.26	3.03	0.00	119.95
INCF	-0.07		0.19	-0.34	0.73	-9.90
DECF	-0.31		0.20	-1.53	0.13	-46.93
GOODWQ	0.84	**	0.19	4.46	0.00	126.07
POORWQ	-1.04	**	0.21	-4.82	0.00	-156.31
A_01	0.09		0.32	0.27	0.79	13.09
A_02	-0.56	**	0.26	-2.13	0.03	-84.35
Number of Observation	558.00					
Log-likelihood	-613.74					
Chi-squared (7)	99.56					
R-squared adjusted	0.17					

* Significant at the 0.10 level
** Significant at the 0.05 level

the status quo. Signs in the case of effects codes reflect a person's comparison of one option withr another options.

These differences are clearly presented when "part-worths", sometimes are called marginal WTP or implicit prices, are estimated. Part-worths are estimated by the following equation:

$$\text{"Part-worth"} = \beta_A / - \beta_{COST},$$

where β_A is the coefficient of an attribute, and β_{COST} is the coefficient of the COST attribute.

The part-worth of INCF using dummy variables is $-9.90, whereas using effects codes it is $9.05. In the analysis using dummy variables, people accepted the policy by paying $-9.90 based on the current situation. The part-worth in effect codes case of

$9.05 is the difference between WTP for an option increasing sport fishing and another option for decreasing sport fishing. Therefore, to estimate the value for improving sport fishing, *ceteris paribus* from the status quo, the status quo situation must be calculated first. Then the value for the new situation must be subtracted from the value in the status quo. In the effects code case, finding the value for the status quo requires consideration of two variables (INCF and DNCF) since there are two options in the sportfishing question. For the status quo situation, two variables enter "-1" for each variable. The value in the status quo is:

$$= (9.05)*(-1) + (-27.99)* (-1) = 18.94$$

and the new value for improving sportfish:

$$= (9.05)*(1) + (27.99)*(0) = 9.05$$

and the WTP for improving sport fishing from the status quo:

$$= 9.05-18.94 = -9.90$$

Note that this result is the same as the part-worth for INCP using dummy variables. Thus, the estimation of WTP for each attribute should be the same. In the case of dummy variables, signs and part-worths for each attribute are based on the status quo. On the other hand, for effects codes, signs and part-worths reflect the differences between options. Currently researchers tend to use the effect codes for WTP estimates, even

though it is somehow difficult to compare the between the current situation and the new situation at glance. The reason is that the effect codes results provide more detail about the relationship among options.

4.4 Welfare Estimates Under CHOICE

The choice model allows us to estimate a variety of policy effect separately but simultaneously. In CHOICE, seven policies are examined with respect to their mean WTP.

Policy 1. Water quality improved, but levels of aquatic life and sport fishing stay the same.

Policy 2. The amount of sport fishingt increased, but levels of water quality and aquatic life stay the same.

Policy 3. The condition of aquatic life is improved, but levels of water quality and sport fishing stay the same (the TRAD-CVM scenario).

Policy 4. Both the amount of sport fishing and water quality improved, but level of aquatic life stays the same.

Policy 5. Both the amount of sport fishing and condition of aquatic life improved, but the level of water quality stays the same.

Policy 6. Both the level of aquatic life and water quality improved, but sport fishing stay the same.

Policy 7. All three attributes, water quality, aquatic life, and sport fishing, improved (the MOD-CVM scenario).

(Note that these seven policies are the equivalent of those defined for MULT-CVM (in section 3.4).)

The results are in Table 4.7 for all three models. Polices 1, 2, and 3 deal with individual attributes. Estimates without and with social characteristics yield a positive WTP for water quality and aquatic life, but not for sport fishing. In BEST, all three attributes are positive. Positive values may be influenced by the positive coefficients of the social characteristics included in the model, particularly CAMP and MIMOIR. Across the three individual policies, notice that people are much more interested in a policy for water quality and aquatic life improvement than one for sport fishing improvement. The welfare values for the combined policies are based on the corresponding three individual policies. Thus, the WTP for the combined policies are, in general, proportionally larger.

Table 4.7. Mean WTP, CHOICE

	Policy 1 (W)	Policy2 (S)	Policy 3 (A)	Policy 4 (W, S)	Policy 5 (S, A)	Policy 6 (W, A)	Policy 7 (W,S,A)
Without SC	48.97	-81.16	54.83	38.79	44.92	174.77	164.87
With SC	131.49	-20.27	126.26	111.22	105.99	257.74	237.48
BEST	161.42	19.45	166.86	180.88	186.31	328.28	347.74
			(TRAD-CVM)				(MOD-CVM)

W - questions asking for an improvement in river water quality
S - questions asking for an increase of sport fishing
A - questions asking for an improvement of aquatic life

Chapter 5

Empirical Results: CVM Model

5.1 Empirical Results of TRAD-CVM and MOD-CVM

5.1.1 Descriptive Statistics for TRAD-CVM and MOD-CVM

In the TRAD-CVM, 1,050 questionnaires were mailed. Nineteen were returned as undelivered, and there were 134 responses. The response rate was 14.6%. In the MOD-CVM, the same number of questionnaires were mailed. Twenty were returned, and 141 answered. The response rate was 15.3%.

Tables 5.1 and 5.2 show the summary statistics for the TRAD-CVM and MOD-CVM, receptively. The average person for the two groups is a white male, over 50 years old, who graduated from high school and had not finished a four-year-college. The mean income is $55,000. He has lived in the Clinch Valley for more than half of his life. Family size is between 2.5 and 2.8. The average number of children is between 0.6 and 0.8. He tends to be politically conservative. In these two groups, about 90 percent of the people are registered to vote, and about 55 percent of them have fishing licenses. In the TRAD-CVM, 43 percent of people identify themselves as Republicans, and 34 percent as Democratic, while in the MOD-CVM 36 percent of people are Republicans affliation, and 29 percent Democratic. As for social issues, in the TRAD-CVM, 51 percent of the people are concerned the most about economic issues including jobs, 13 percent about public education, 9 percent about environment, 9 percent about public health, 7 percent about drugs, and 2 percent about crime. Similarly, in the MOD-CVM, 58 percent of respondents cared about the economy the most, 16 percent about the public education, 9

Table 5.1. Summary Statistics, TRAD-CVM

	Mean	Std.Dev.	Skewness	Kurtosis	Minimum	Maximum	NumCases
EDUC	13.93	1.59	-0.37	1.97	11	16	127
AGE	54.44	15.1	0.22	2.57	23	94	130
MALE	0.74	0.44	-1.11	2.24	0	1	129
INCOME	5.87	3.29	0.25	1.79	0	11	121
BORN	0.34	0.48	0.68	1.45	0	1	130
YEARS	29.34	21.13	0.34	2.16	0	84	125
RLIFE	0.55	0.36	-0.07	1.51	0	1	124
HHSIZE	2.52	1.25	0.76	2.91	1	6	130
CHILD	0.59	0.99	2.16	9.32	0	6	130
REPUB	0.43	0.5	0.27	1.07	0	1	134
DEMOC	0.34	0.48	0.66	1.43	0	1	134
POLVI	4.44	1.69	-0.36	2.41	0	8	119
VOTE	0.91	0.28	-2.94	9.65	0	1	128
FISHLIC	0.53	0.5	-0.13	1.01	0	1	126
ENVORG	0.22	0.42	1.33	2.76	0	1	126
WHITE	0.87	0.34	-2.14	5.56	0	1	134
ECONOMY	0.51	0.5	-0.03	0.99	0	1	134
CRIME	0.02	0.15	6.43	42.37	0	1	134
PEDU	0.13	0.34	2.14	5.56	0	1	134
DRUG	0.07	0.25	3.45	12.86	0	1	134
ENV	0.09	0.29	2.86	9.2	0	1	134
HEALTH	0.09	0.29	2.86	9.2	0	1	134
VISITR	0.64	0.48	-0.6	1.35	0	1	129
NUMV	2.57	3.06	1.26	3.76	0	13	127
BOAT	0.13	0.34	2.14	5.56	0	1	134
FISH	0.2	0.4	1.48	3.19	0	1	134
HIKE	0.19	0.4	1.54	3.37	0	1	134
CAMP	0.04	0.19	4.86	24.65	0	1	134
WORK	0.03	0.17	5.5	31.3	0	1	134
PICNIC	0.19	0.4	1.54	3.37	0	1	134
BICYCLE	0.04	0.21	4.39	20.23	0	1	134
MIMPOR	0.71	0.8	3.19	20.27	0	6	128
INFO	0.27	0.45	1.02	2.04	0	1	129

Table 5.2. Summary Statistics, MOD-CVM

	Mean	Std.Dev.	Skewness	Kurtosis	Minimum	Maximum	NumCases
EDUC	13.73	1.59	-0.14	1.82	11	16	134
AGE	51.94	15.77	0.11	2.7	1	85	134
MALE	0.73	0.44	-1.04	2.07	0	1	134
INCOME	5.44	2.88	0.46	2.28	0	11	127
BORN	0.45	0.5	0.2	1.03	0	1	131
YEARS	30.56	20.62	0.29	2.16	0	81	126
RLIFE	0.62	0.37	-0.39	1.59	0	1	124
HHSIZE	2.78	1.23	0.8	3.28	1	6	131
CHILD	0.75	1.06	1.47	4.5	0	4	130
REPUB	0.36	0.48	0.57	1.32	0	1	141
DEMOC	0.29	0.46	0.92	1.84	0	1	141
POLVI	4.63	1.6	-0.38	2.81	0	8	117
VOTE	0.89	0.31	-2.48	7.14	0	1	127
FISHLIC	0.58	0.5	-0.32	1.09	0	1	126
ENVORG	0.11	0.31	2.49	7.21	0	1	128
WHITE	0.79	0.41	-1.4	2.95	0	1	141
ECONOMY	0.58	0.5	-0.33	1.1	0	1	141
CRIME	0.01	0.08	11.71	138.02	0	1	141
PEDU	0.16	0.36	1.89	4.56	0	1	141
DRUG	0.08	0.27	3.14	10.83	0	1	141
ENV	0.09	0.28	2.96	9.77	0	1	141
HEALTH	0.04	0.19	5.01	26.05	0	1	141
VISITR	0.63	0.49	-0.52	1.27	0	1	134
NUMV	3.22	3.29	0.93	2.99	0	13	119
BOAT	0.19	0.39	1.56	3.43	0	1	141
FISH	0.3	0.46	0.88	1.77	0	1	141
HIKE	0.22	0.43	1.61	4.3	0	2	141
CAMP	0.06	0.25	3.56	13.64	0	1	141
WORK	0.04	0.19	5.01	26.05	0	1	141
PICNIC	0.2	0.4	1.51	3.26	0	1	141
BICYCLE	0.02	0.14	6.61	44.7	0	1	141
MIMPOR	0.64	0.48	-0.58	1.33	0	1	125
INFO	0.33	0.47	0.73	1.52	0	1	125

percent about environment, 8 percent about drugs, 4 percent about public health, and only 1 percent about crime. In both groups, nearly 64 percent have visited the Clinch River in the past 12 months. The average number of visits was about 3. For the TRAD-CVM, 20 percent fished, 19 percent hiked, 19 percent picnicked, 13 percent boated, 4 percent camped, 4 percent bicycled, and 3 percent worked. In the MOD-CVM, 30 percent fished, 22 percent hiked, 20 percent picnicked, 19 percent boated, 6 percent camped, 4 percent worked, and 2 percent bicycled. The percentage belonging to environmental organizations also differs between the two groups. Twenty-two percent in the TRAD-CVM survey are members of these organizations. On the other hand, 11 percent in the MOD-CVM group belong to them. For the both groups, about 30 percent of respondents have formed opinions about water quality in the river through seeing, reading or hearing in the past few months. Nearly 70 percent of the samples believed that the most important use of the river from the perspective of the citizens was recreation (such as fishing, boating and hiking), or feeding fish/animals rather than industrial use or irrigation for faming.

5.1.2 "Yes" Response Rate in TRAD-CVM and MOD-CVM

The frequencies of WTP responses and the response rates for each range of bid, as well as the frequencies of the responses for "Yes" (would be willing to pay) and the response rates for each rage are presented in Table 5.3. The response rates in each bid range for both the TRAD-CVM and MOD-CVM groups are about 12 percent, except for the $5 bid in the MOD-CVM (18 percent). The "yes" response rates for both groups

Table 5.3. Response Rate, TRAD-CVM & MOD-CVM

	TRAD-CVM				MOD-CVM			
BID	Responses	%*	"Yes" Responses	%**	Responses	%*	"Yes" Responses	%**
5	26	0.13	16	0.62	36	0.18	23	0.64
10	25	0.1	10	0.4	24	0.1	11	0.46
25	27	0.11	12	0.44	22	0.09	6	0.27
50	22	0.14	7	0.32	18	0.11	7	0.39
75	11	0.09	5	0.45	17	0.14	4	0.24
100	11	0.14	3	0.27	8	0.1	2	0.25
Total	122	0.12	53	0.43	125	0.12	53	0.42

*The response rate is out of the total number mailed in each bid range.
**The "yes" response rate is out of the number of responses in each bid range

were slightly higher for the lower bid amounts, suggesting downward sloping demand curves for the both groups (See Figure 5.1).

5.1.3 Binomial Logit Model in TRAD-CVM and MOD-CVM

A binomial logit model was used to estimate the WTP for the TRAD-CVM and MOD-CVM. The first estimates do not include social characteristics; the second ones include social characteristics, such as MALE, INCOME, BORN, BOAT, FISH, ECONOMY, and ENVIRONMENT; the third include alternative social characteristics leading the model with the best fit (BEST).

The coefficients for the CVM model without social characteristics are presented in Table 5.4. Both COST variables are negative and significant at the 0.05 level, which indicates that people are less likely to choose a policy with a higher bid amount. For the model with social characteristics and BEST, results are shown in Tables 5.5 and 5.6. The

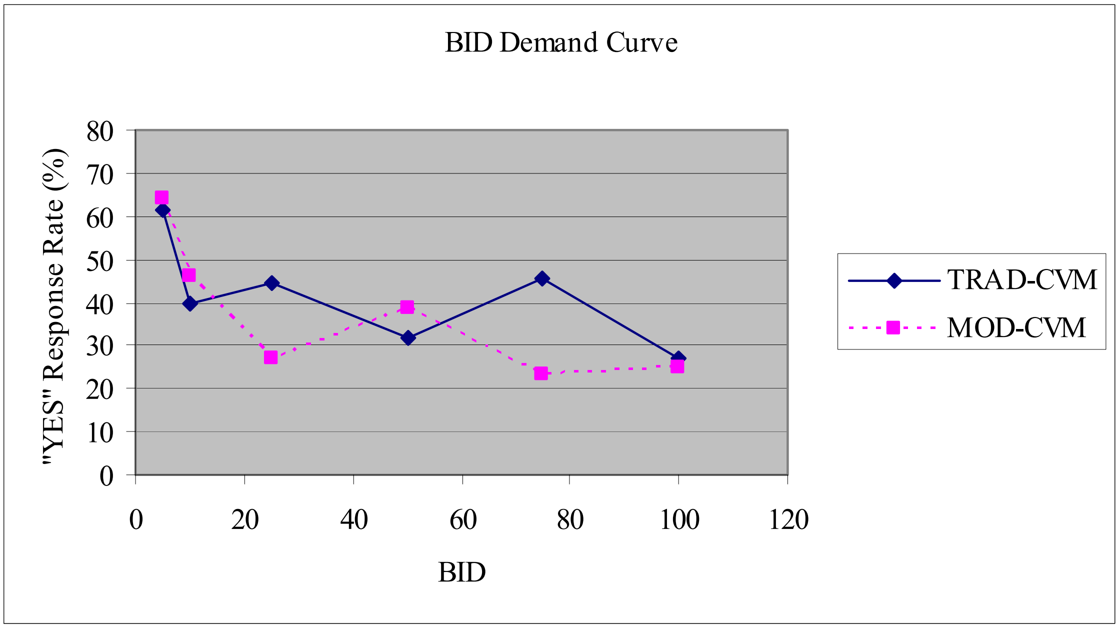

Figure 5.1. Bid Demand Curve, TRAD-CVM & MOD-CVM

Table 5.4. Binomial Logit Model, CVM, Without SC

	TRAD-CVM					MOD-CVM				
	Coeff.		Std.Error	T-stat	P-val	Coeff.		Std.Error	T-stat	P-val
CONSTANT	0.43		0.30	1.44	0.15	0.51	*	0.28	1.81	0.07
COST	-0.02	**	0.01	-2.23	0.03	-0.02	**	0.01	-2.80	0.01
Number of observation				111.00					111.00	
Log-likelihood				-74.16					-72.43	
Log-likelihood (0)				-76.83					-76.83	
Chi-squared				5.69					11.63	
Degree of freedom				1.00					1.00	
Significance level				0.02					0.06	
McFadden				0.04					0.07	
Ben./Lerman				0.53					0.55	
Akaike I.C.				1.37					1.32	

* Significant at the 0.10 level
** Significant at the 0.05 level

Table 5.5. Binomial Logit Model, CVM, With SC

	TRAD-CVM					MOD-CVM				
Variable	Coeff		Std.Error	T-stat	P-val	Coeff		Std.Error	T-stat	P-val
Constant	0.85		0.59	1.44	0.15	0.22		0.53	0.41	0.68
COST	-0.02	*	0.01	-2.13	0.03	-0.03	**	0.01	-3.43	0.00
MALE	0.24		0.40	0.60	0.55	0.00		0.00	-0.20	0.84
INCOME	0.00		0.00	1.47	0.14	0.00		0.00	1.22	0.22
BORN	0.04		0.10	0.37	0.71	1.16	**	0.48	2.44	0.01
BOAT	-0.12		0.61	-0.19	0.85	2.36	**	0.89	2.66	0.01
FISH	-0.47		0.51	-0.93	0.35	0.22		0.50	0.43	0.66
ECONOMY	-0.74		0.45	-1.64	0.10	-0.28		0.49	-0.58	0.56
ENV	-0.57		0.72	-0.79	0.43	1.67		1.29	1.29	0.20
Number of observation				111.00					111.00	
Log-likelihood				-69.94					-61.05	
Log-likelihood (0)				-76.82					-76.83	
Chi-squared				13.91					10.10	
Degree of freedom				8.00					8.00	
Significance level				0.08					0.00	
McFadden				0.09					0.18	
Ben./Lerman				0.56					0.61	
Akaike I.C.				1.42					1.27	

* Significant at the 0.10 level
** Significant at the 0.05 level

Table 5.6. Binomial Logit Model, CVM, BEST

	TRAD-CVM					MOD-CVM				
	Coeff.		Std.Err.	t-ratio	P-value	Coeff.		Std.Err.	t-ratio	P-value
ONE	0.79	**	0.34	2.3	0.02	0.16		0.33	0.48	0.63
BID	-0.02	**	0.01	-2.63	0.01	-0.02	**	0.01	-3.3	0
BORN	-0.88	**	0.43	-2.05	0.04	0.73	*	0.42	1.75	0.08
INCOME	0		0	1.53	0.12	0		0	1.57	0.12
PEDU	1.02	*	0.6	1.69	0.09					
DRUG						2.06	**	0.93	2.23	0.03
ENV						1.94	*	1.14	1.7	0.09
Number of observation				123					125	
Log-likelihood				-75					-70.48	
Log-likelihood (0)				-85.25					-86.45	
Chi-squared				20.51					31.94	
Degree of freedom				4					5	
Significance level				0					0	
McFadden				0.12					0.18	
Ben./Lerman				0.58					0.61	
Akaike I.C.				1.30					1.22	

* Significant at the 0.10 level

** Significant at the 0.05 level

coefficient of the COST variable are also negative and significant in these cases. In the TRAD-CVM model with social characteristics, none of the other variables are significant. This result might mean that sex, income, place of birth, leisure, and social interests do not influence people's decisions to choose a policy for improving aquatic life. On the other hand, BORN and BOAT are positive and significant at the 0.05 level in the MOD-CVM model; people who were born in the Clinch River Valley and boated there in the past year are more likely choose a policy improving aquatic life, sport fishing, and better water quality in the river.

In BEST, BORN is significant in both the TRAD-CVM and MOD-CVM. However, the signs are inconsistent in the models: negative in the TRAD-CVM and positive in the MOD-CVM. Thus, the influence of this variable is uncertain. PEDU is significant and positive in the BEST version of the TRAD-CVM model. DRUG and ENV are significant and positive in the BEST estimate for the MOD-CVM model

5.1.4 Welfare Estimates Under TRAD-CVM and MOD-CVM

The welfare values are estimated for the models without social characteristic by using both the standard procedure given the equation 2.44 and the Krinsky and Robb procedure. The results are presented in Table 5.7. The compensating surplus measure estimated from TRAD-CVM model is $24.89 per year. However, individuals may believe that a program that improves conditions for "aquatic life" may provide better habitat for sport fishing and better water quality as well. This issue is addressed directly with the MOD-CVM where the welfare measure obtained is $25.89 per year.

Table 5.7. WTP and Confidence Interval, TRAD-CVM & MOD-CVM, Without SC

		TRAD-CVM	MOD-CVM
Standard	Mean	24.89	25.89
K&R	Mean	23.91	29.13
	Median	24.38	29.11
	CI Upper	44.5	45.94
	CI Lower	13.33	12.33

K&R- the Krinsky and Robb procedure

The results of the Krinsky and Robb procedure are almost the same, except for the ninety percent of the confidence intervals in the TRAD-CVM. It is caused by the large standard error in the MOD-CVM. Without the exception, all willingness to pays in the MOD-CVM are larger than ones in the TRAD-CVM. In short, comparison of welfare estimates obtained from TRAD-CVM and MOD-CVM represents a test of embedding.[5] The results of the comparisons provide evidence that CVM may not be sensitive to embedding. The results indicate that individuals tend to value what we ask of them.

5.2 Empirical Results of MULT-CVM

5.2.1 Descriptive Statistics for MULT-CVM

For the MULT-CVM survey, 672 questionnaires were mailed. One hundred twenty five households responded, and 22 surveys were undelivered. The response rate

[5] Embedding is individuals' behaviors making the amount for several attributes together significantly less than the sum of the amount for the attributes separately. This problem is discussed by Diamond and Houseman (1994) and McFadden and Leonard (1993).

for the MULT-CVM is 21.9 %. This rate is somewhat higher than for the other surveys perhaps due to the follow-up procedure.

The descriptive statistics in MULT-CVM are presented in Table 5.8. The results are similar to those in other surveys. The average person is a white male whose age is about 59 years old. He graduated from high school and has an associate degree. The average income is about $55,000. He spent about 57 percent of his life in the Clinch River Valley. The average family size is 2.49, and the average number of children is 0.54. Thirty-six percent of respondents reported themselves to be Republican and 28 percent considered themselves Democratic. Their political views are slightly conservative. As for social issues, 51 percent of sample indicated that economic and employment issues are the most important. Between 10 and 13 percent of sample worried about other issues: environment, public education, and drugs. Crime is not reported as an important issue. About 62 percent of sample visited the Clinch River in the past 12 months, with the average number of visits being 2.92. The main purpose for visiting the river is fishing at 25 percent. Boating and picnicking are the next two most important reasons with 15 and 13 percent of sample, noting them respectively. Less than 10 percent visit the river for camping, bicycling, or working as main activities. Nearly 34 percent of the people are informed about water quality by hearing, seeing, or reading, during the preceding few months. About 60 percent of the people agreed that the most important uses of the river from the perspective of the citizens are recreation and feeding animals and fish, not industrial use or irrigation.

Table 5.8. Summary Statistics, MULT-CVM

	Mean	Std.Dev.	Skewness	Kurtosis	Minimum	Maximum	NumCases
EDUC	13.94	1.54	-0.21	1.84	11	16	123
AGE	59.24	14.1	-0.01	2.18	29	91	121
MALE	0.73	0.45	-1.02	2.02	0	1	121
INCOME	5.85	3.08	0.26	1.89	1	11	110
BORN	0.24	0.43	1.24	2.53	0	1	123
YEARS	34.23	20.26	0.01	1.92	0	79	121
RLIFE	0.57	0.32	-0.14	1.81	0	1	118
HHSIZE	2.49	1.3	1.28	4.62	1	7	124
CHILD	0.54	1.04	2.31	8.49	0	5	123
REPUB	0.36	0.48	0.56	1.31	0	1	129
DEMOC	0.28	0.45	0.98	1.96	0	1	129
POLVI	4.56	1.51	-0.56	2.66	1	7	107
VOTE	0.94	0.23	-3.83	15.65	0	1	124
FISHLIC	0.41	0.49	0.38	1.14	0	1	123
ENVORG	0.12	0.33	2.27	6.16	0	1	121
WHITE	0.91	0.28	-2.96	9.74	0	1	129
ECONOMY	0.51	0.5	-0.05	0.99	0	1	129
CRIME	0.01	0.09	11.18	126.02	0	1	129
PEDU	0.12	0.32	2.38	6.68	0	1	129
DRUG	0.1	0.3	2.64	7.97	0	1	129
ENV	0.13	0.34	2.17	5.7	0	1	129
HEALTH	0.05	0.21	4.29	19.4	0	1	129
VISITR	0.63	0.58	1.28	10.16	0	4	123
NUMV	2.92	3.62	1.04	2.7	0	11	121
BOAT	0.15	0.36	1.98	4.92	0	1	129
FISH	0.25	0.43	1.16	2.34	0	1	129
HIKE	0.22	0.41	1.37	2.86	0	1	129
CAMP	0.07	0.26	3.36	12.31	0	1	129
WORK	0.02	0.15	6.3	40.71	0	1	129
PICNIC	0.13	0.34	2.17	5.7	0	1	129
BICYCLE	0.04	0.19	4.76	23.66	0	1	129
MIMPOR	0.59	0.49	-0.38	1.14	0	1	116
INFO	0.34	0.48	0.68	1.45	0	1	124

5.2.2 "Yes" Response Rate in MULT-CVM

Table 5.9 describes response rates for each bid amount for each CVM question. A "0" stands for a "No" response, and a "1" indicates a "Yes" response. If the answer was missing, it was counted as "no." These results are visually summarized in Figure 5.2. The demand curves for all CVM questions are downward sloping. However, the demand curve for Q5 and Q6, in which both aquatic life and fishing are improved, does not show the same structure as the other demand curves. The response rate increase in some bid range. Another finding from the figure is that "yes" response rates for Q1, in which only water quality is improved, are higher than others. On the other hand, demand curves for Q2 and Q3 (about the improvement of sport fish and aquatic life) are relatively lower than others.

5.2.3 Binomial Logit Model in MULT-CVM

Table 5.10 presents coefficients of the MULT-CVM without social characteristics. In all eight scenarios, the coefficients of BID are negative and significant at the 0.01 level. It will be interpreted that the higher the bid amount, the fewer the number of individuals will choose policies for any improvements of the Clinch River. The results of the MULTI-CVM with social characteristics are presented in Table 5.11. All coefficients of BID are negative and significant at the 0.05 level. As a point of departure, the socio economic variables (MALE, INCOME, BORN, BOAT, FISH, ECONOMY, and ENV) are included as in the TRAD-CVM and MOD-CVM in the previous chapter. However, keeping the same socio economic characteristics causes a

Table 5.9. Response Rate, MULT-CVM

Q1 (WQ)			
Bid	Y/N*	Frequency	%
5	0	3	0.25
	1	9	**0.75**
	no	0	0.00
10	0	18	0.50
	1	17	**0.47**
	no	1	0.03
25	0	13	0.50
	1	12	**0.46**
	no	1	0.04
50	0	16	0.62
	1	8	**0.31**
	no	2	0.08
75	0	8	0.67
	1	3	**0.25**
	no	1	0.08
100	0	11	0.85
	1	1	**0.08**
	no	1	0.08

Q2 (FISH)			
	Y/N*	Frequency%	%
5	0	10	0.43
	1	11	**0.48**
	no	2	0.09
10	0	25	0.74
	1	7	**0.21**
	no	2	0.06
25	0	21	0.70
	1	4	**0.13**
	no	5	0.17
50	0	18	0.82
	1	3	**0.14**
	no	1	0.05
75	0	3	0.60
	1	0	**0.00**
	no	2	0.40
100	0	11	0.92
	1	1	**0.08**
	no	0	0.00

Q3 (AQ)			
Bid	Y/N*	Frequency	%
5	0	9	0.53
	1	7	**0.41**
	no	1	0.06
10	0	20	0.61
	1	10	**0.30**
	no	3	0.09
25	0	22	0.76
	1	6	**0.21**
	no	1	0.03
50	0	16	0.80
	1	2	**0.10**
	no	2	0.10
75	0	7	0.78
	1	1	**0.11**
	no	1	0.11
100	0	14	0.78
	1	2	**0.11**
	no	2	0.11

Q4 (FISH, WQ)			
Bid	Y/N*	Frequency	%
5	0	15	0.56
	1	10	**0.37**
	no	2	0.07
10	0	20	0.59
	1	12	**0.35**
	no	2	0.06
25	0	16	0.62
	1	9	**0.35**
	no	1	0.04
50	0	16	0.70
	1	5	**0.22**
	no	2	0.09
75	0	5	0.63
	1	1	**0.13**
	no	2	0.25
100	0	6	0.86
	1	0	**0.00**
	no	1	0.14

Table 5.9. Continued

Q5 (AQ, FISH) Bid	Y/N*	Frequency	%	Q6 (AQ, WQ) Bid	Y/N*	Frequency	%
5	0	12	0.52	5	0	9	0.45
	1	10	**0.43**		1	8	**0.40**
	no	1	0.04		no	3	0.15
10	0	16	0.64	10	0	11	0.38
	1	5	**0.20**		1	17	**0.59**
	no	4	0.16		no	1	0.03
25	0	22	0.61	25	0	19	0.61
	1	10	**0.28**		1	11	**0.35**
	no	4	0.11		no	1	0.03
50	0	13	0.81	50	0	14	0.64
	1	3	**0.19**		1	6	**0.27**
	no	0	0.00		no	2	0.09
75	0	13	1.00	75	0	13	0.72
	1	0	**0.00**		1	3	**0.17**
	no	0	0.00		no	2	0.11
100	0	8	0.73	100	0	3	0.60
	1	3	**0.27**		1	1	**0.20**
	no	0	0.00		no	1	0.20

Q7 (FISH, WQ) Bid	Y/N*	Frequency	%	Q8 (WQ, FISH, AL) Bid	Y/N*	Frequency	%
5	0	7	0.41	5	0	11	0.52
	1	10	**0.59**		1	9	**0.43**
	no	0	0.00		no	1	0.05
10	0	13	0.46	10	0	15	0.50
	1	12	**0.43**		1	11	**0.37**
	no	3	0.11		no	4	0.13
25	0	20	0.67	25	0	11	0.46
	1	7	**0.23**		1	11	**0.46**
	no	3	0.10		no	2	0.08
50	0	18	0.78	50	0	16	0.64
	1	3	**0.13**		1	8	**0.32**
	no	2	0.09		no	1	0.04
75	0	10	0.77	75	0	6	0.86
	1	2	**0.15**		1	1	**0.14**
	no	1	0.08		no	0	0.00
100	0	12	0.86	100	0	7	0.78
	1	1	**0.07**		1	0	**0.00**
	no	1	0.07		no	2	0.22

* Y="Yes"=1 and N="No"=0

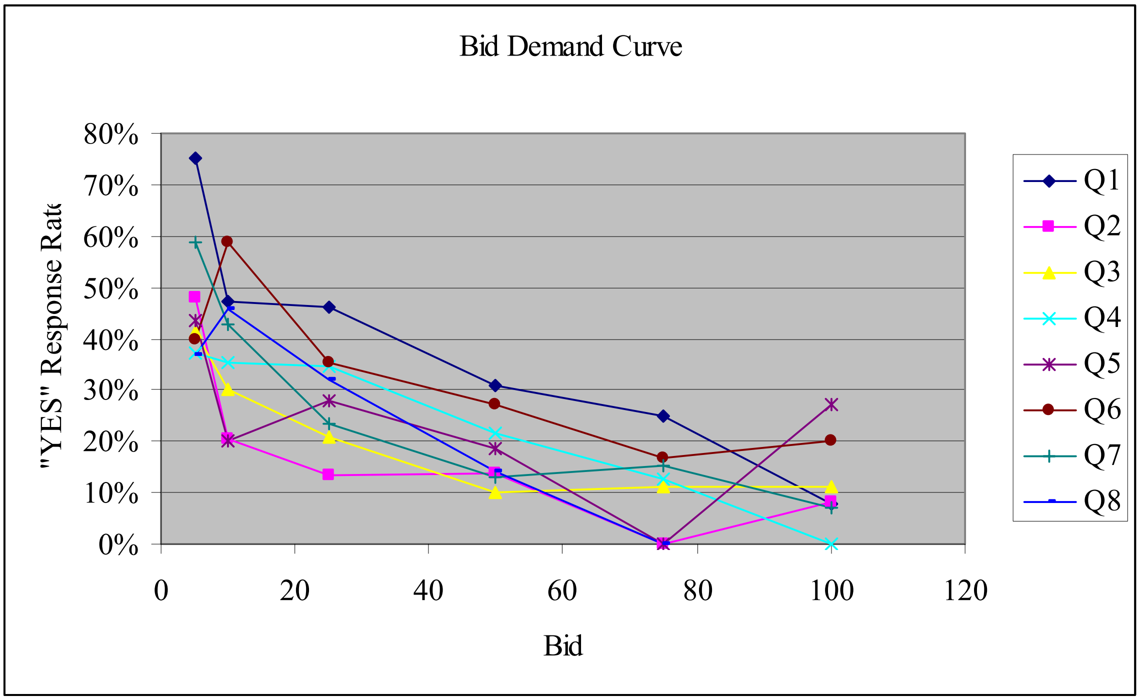

Figure 5.2. Bid Demand Curve, MULT-CVM

Table 5.10. Binomial Logit Model, MULT-CVM, Without SC

Q1 (Improvement of Water Quality)

	Coeff.		Std.Err.	t-ratio	P-value	WTP
ONE	0.48	*	0.30	1.62	0.10	21.00
BID1	-0.02	**	0.01	-3.13	0.00	
Number of observation	119.00					
Log-likelihood	-75.48					
Log-likelihood (0)	-81.27					
Chi-squared	11.58					
Degree of freedom	1.00					
Significance level	0.00					
McFadden	0.07					
Ben./Lerman	0.55					
Akaike I.C.	0.16					

Q2 (Improvement of Sportfish)

	Coeff.		Std.Err.	t-ratio	P-value	WTP
ONE	-0.55	*	0.33	-1.68	0.09	-20.82
BID2	-0.03	**	0.01	-2.28	0.02	
Number of observation	113.00					
Log-likelihood	-57.28					
Log-likelihood (0)	-60.95					
Chi-squared	7.35					
Degree of freedom	1.00					
Significance level	0.01					
McFadden	0.06					
Ben./Lerman	0.67					
Akaike I.C.	1.05					

Q3 (Improvement of Aquatic Life)

	Coeff.		Std.Err.	t-ratio	P-value	WTP
ONE	-0.54	*	0.32	-1.69	0.09	-27.93
BID3	-0.02	**	0.01	-2.20	0.03	
Number of observation	115.00					
Log-likelihood	-60.83					
Log-likelihood (0)	-63.83					
Chi-squared	5.99					
Degree of freedom	1.00					
Significance level	0.01					
McFadden	0.05					
Ben./Lerman	0.65					
Akaike I.C.	1.09					

Table 5.10. Continued

Q4 (Improvement of Water Quality and Sportfish)

	Coeff.		Std.Err.	t-ratio	P-value	WTP
ONE	-0.20	*	0.31	-0.67	0.51	-9.00
BID4	-0.02	**	0.01	-2.19	0.03	
Number of observation	114.00					
Log-likelihood	-98.89					
Log-likelihood (0)	-71.85					
Chi-squared	5.91					
Degree of freedom	1.00					
Significance level	0.02					
McFadden	0.04					
Ben./Lerman	0.58					
Akaike I.C.	1.24					

Q5 (Improvement of Sportfish and Aquatic Life)

	Coeff.		Std.Err.	t-ratio	P-value	WTP
ONE	-0.49		0.31	-1.56	0.12	-31.45
BID5	-0.02	*	0.01	-1.92	0.06	
Number of observation	114.00					
Log-likelihood	-64.61					
Log-likelihood (0)	-66.71					
Chi-squared	4.21					
Degree of freedom	1.00					
Significance level	0.04					
McFadden	0.03					
Ben./Lerman	0.62					
Akaike I.C.	1.17					

Q6 (Improvement of Water Quality and Aquatic Life)

	Coeff.		Std.Err.	t-ratio	P-value	WTP
ONE	0.26		0.30	0.86	0.39	12.24
BID6	-0.02	**	0.01	-2.61	0.01	
Number of observation	114.00					
Log-likelihood	-73.01					
Log-likelihood (0)	-76.88					
Chi-squared	7.75					
Degree of freedom	1.00					
Significance level	0.01					
McFadden	0.05					
Ben./Lerman	0.11					
Akaike I.C.	1.32					

Table 5.10. Continued

Q7 (Improvement of Water Quality and Sportfish)						
	Coeff.		Std.Err.	t-ratio	P-value	WTP
ONE	0.13	*	0.32	0.42	0.68	4.29
BID7	-0.03	**	0.01	-3.30	0.00	
Number of observation	115.00					
Log-likelihood	6.00					
Log-likelihood (0)	-63.15					
Chi-squared	-70.67					
Degree of freedom	15.04					
Significance level	0.00					
McFadden	0.11					
Ben./Lerman	0.63					
Akaike I.C.	1.13					

Q8 (Improvement of Water Quality, Sportfish, Aquatic Life)						
	Coeff.		Std.Err.	t-ratio	P-value	WTP
ONE	0.48	*	0.29	1.67	0.09	16.93
BID8	-0.03	**	0.01	-3.22	0.00	
Number of observation	115.00					
Log-likelihood	-72.20					
Log-likelihood (0)	-78.45					
Chi-squared	12.49					
Degree of freedom	1.00					
Significance level	0.00					
McFadden						
Ben./Lerman						

*Significant at the 0.10 level
** Significant at the 0.05 level

multicolinearity problem. In all eight scenarios, the socio economic characteristics are not significantly different from zero. The results are presented in Table 5.11.

To eliminate the problem of colinearlity, some socio economic variables are dropped, and new variables are added, as shown in Table 5.12. All coefficients of BID are again negative and significant at the 0.01 level. For Q1, where individuals are asked about only water improvement, the coefficients of BOAT, CAMP, PEDU, and ENV are positive and significant, and the coefficient of DRUG is negative and significant. These results reveal that individuals who boated and camped in the past and are concerned about public education and the environment are more likely to choose a policy for improvement in water quality, but individuals who are concerned about drug issues are less likely to choose this policy. Q2 asks about improvement in only sport fishing. The coefficients of MINPOR, INFO, and BORN are positive and significant, indicating that people who are originally from the Clinch Valley, have the information about river quality in the past three months, and believe that the major use of the river is recreation, feeding fish, or providing water for use in homes are more likely to choose the policy of improving sport fishing. Q3 deals with improving aquatic life only. The coefficient of ENVRG is positive and significant, while the coefficient of WHITE is negative and significant, which suggests that members of environmental organization tends to choose a policy of improvement of aquatic life, while Caucasians are less likely to do so. In Q4, in which people are asked about improvement of both water quality and sport fishing, the result is positive and significant for REPUB and ENV, indicating that people who are Republicans and concerned about the environment are more likely to choose a policy of improvement. In Q5, dealing with improvement of both sport fishing and aquatic life,

Table 5.11. Binomial Logit Model, MULT-CVM, With SC

Q1 (Improvement of Water Quality)

	Coeff.		Std.Err.	t-ratio	P-value	WTP
ONE	0.35		0.48	0.74	0.46	9.80
BID1	-0.02	**	0.01	-2.76	0.01	
MALE	0.00		0.00	-0.91	0.36	
INCOME	0.00		0.00	2.09	0.04	
BORN	0.00		0.00	-1.10	0.27	
BOAT	0.87		0.61	1.42	0.16	
FISH	0.06		0.48	0.12	0.90	
ECONOMY	-0.16		0.46	-0.35	0.73	
ENV	0.98		0.70	1.39	0.16	
Number of observation	119.00					
Log-likelihood	-68.67					
Log-likelihood (0)	-81.27					
Chi-squared	25.20					
Degree of freedom	8.00					
Significance level	0.00					
McFadden	0.16					
Ben./Lerman	0.60					
Akaike I.C.	1.31					

Q2 (Improvement of Sportfish)

	Coeff.		Std.Err.	t-ratio	P-value	WTP
ONE	-0.76		0.50	-1.51	0.13	11.96
BID2	-0.03	**	0.01	-2.51	0.01	
MALE	0.01		0.02	0.28	0.78	
INCOME	0.00		0.00	-0.03	0.98	
BORN	0.82		0.56	1.45	0.15	
BOAT	0.05		0.69	0.07	0.94	
FISH	0.10		0.58	0.17	0.86	
ECONOMY	0.13		0.55	0.23	0.81	
ENV	0.35		0.77	0.45	0.65	
Number of observation	113.00					
Log-likelihood	-54.05					
Log-likelihood (0)	-60.95					
Chi-squared	13.80					
Degree of freedom	8.00					
Significance level	0.09					
McFadden	0.11					
Ben./Lerman	0.69					
Akaike I.C.	1.12					

Table 5.11. Continued

Q3 (Improvement of Aquatic Life)						
	Coeff.		Std.Err.	t-ratio	P-value	WTP
ONE	-0.83		0.53	-1.55	0.12	0.27
BID3	-0.02	**	0.01	-2.00	0.05	
MALE	0.00		0.00	-0.99	0.32	
INCOME	0.00		0.00	1.24	0.22	
BORN	0.00		0.02	0.26	0.80	
BOAT	1.03	**	0.61	1.69	0.09	
FISH	0.00		0.55	-0.01	0.99	
ECONOMY	0.11		0.53	0.21	0.84	
ENV	0.44		0.69	0.64	0.52	
Number of observation	115.00					
Log-likelihood	-57.40					
Log-likelihood (0)	-63.83					
Chi-squared	12.86					
Degree of freedom	8.00					
Significance level	0.12					
McFadden	0.10					
Ben./Lerman	0.67					
Akaike I.C.	1.15					

Q4 (Improvement of Water Quality and Sportfish)						
	Coeff.		Std.Err.	t-ratio	P-value	WTP
ONE	-0.36		0.49	-0.73	0.46	0.32
BID4	-0.02	*	0.01	-1.88	0.06	
MALE	0.00		0.00	-1.08	0.28	
INCOME	0.00	*	0.00	1.64	0.10	
BORN	0.25		0.51	0.48	0.63	
BOAT	0.13		0.62	0.21	0.84	
FISH	0.51		0.49	1.03	0.30	
ECONOMY	-0.20		0.49	-0.42	0.68	
ENV	0.46		0.67	0.68	0.49	
Number of observation	114.00					
Log-likelihood	-64.47					
Log-likelihood (0)	-71.85					
Chi-squared	14.76					
Degree of freedom	8.00					
Significance level	0.06					
McFadden	0.10					
Ben./Lerman	0.61					
Akaike I.C.	1.29					

Table 5.11. Continued

Q5 (Improvement of Sportfish and Aquatic Life)	Coeff.		Std.Err.	t-ratio	P-value	WTP
ONE	-0.63		0.46	-1.37	0.17	12.97
BID5	-0.02	**	0.01	-1.94	0.05	
MALE	0.00		0.00	0.25	0.80	
INCOME	0.00		0.00	0.49	0.63	
BORN	0.01		0.03	0.21	0.84	
BOAT	0.55		0.60	0.91	0.36	
FISH	0.19		0.50	0.38	0.71	
ECONOMY	0.26		0.49	0.53	0.60	
ENV	-0.44		0.75	-0.58	0.56	
Number of observation	114.00					
Log-likelihood	-62.95					
Log-likelihood (0)	-66.71					
Chi-squared	7.51					
Degree of freedom	8.00					
Significance level	0.48					
McFadden	0.06					
Ben./Lerman	0.63					
Akaike I.C.	1.26					

Q6 (Improvement of Water Quality and Aquatic Life)	Coeff.		Std.Err.	t-ratio	P-value	WTP
ONE	0.29		0.47	0.62	0.54	1.18
BID6	-0.02	**	0.01	-2.51	0.01	
MALE	0.00		0.00	0.89	0.37	
INCOME	0.00		0.00	0.29	0.77	
BORN	0.01		0.02	0.27	0.79	
BOAT	0.16		0.59	0.27	0.79	
FISH	-0.40		0.49	-0.81	0.42	
ECONOMY	0.04		0.46	0.08	0.94	
ENV	0.57		0.63	0.91	0.36	
Number of observation	114.00					
Log-likelihood	-71.27					
Log-likelihood (0)	-76.88					
Chi-squared	11.22					
Degree of freedom	8.00					
Significance level	0.19					
McFadden	0.07					
Ben./Lerman	0.56					
Akaike I.C.	1.41					

Table 5.11. Continued

Q7 (Improvements of Water Quality and Sportfish)						
	Coeff.		Std.Err.	t-ratio	P-value	WTP
ONE	0.43		0.52	0.83	0.41	-7.59
BID7	-0.03	**	0.01	-3.40	0.00	
MALE	0.00		0.00	-0.57	0.57	
INCOME	0.00		0.00	0.69	0.49	
BORN	0.47		0.52	0.91	0.36	
BOAT	0.03		0.64	0.05	0.96	
FISH	0.15		0.51	0.28	0.78	
ECONOMY	-0.62		0.51	-1.22	0.22	
ENV	-0.52		0.69	-0.76	0.45	
Number of observation	115.00					
Log-likelihood	-61.02					
Log-likelihood (0)	-70.34					
Chi-squared	19.31					
Degree of freedom	8.00					
Significance level	0.01					
McFadden	0.14					
Ben./Lerman	0.64					
Akaike I.C.	1.22					

Q8 (Improvements of Water Quality, Sportfish, Aquatic Life)						
	Coeff.		Std.Err.	t-ratio	P-value	WTP
ONE	0.08		0.50	0.16	0.87	19.46
BID8	-0.03	**	0.01	-3.15	0.00	
MALE	0.00		0.00	-0.87	0.39	
INCOME	0.00		0.00	2.06	0.04	
BORN	0.01		0.02	0.23	0.82	
BOAT	0.75		0.65	1.15	0.25	
FISH	0.00		0.50	0.00	1.00	
ECONOMY	0.59		0.49	1.22	0.22	
ENV	0.99		0.68	1.46	0.15	
Number of observation	116.00					
Log-likelihood	-66.90					
Log-likelihood (0)	-79.30					
Chi-squared	-79.30					
Degree of freedom	24.79					
Significance level	8.00					
McFadden	0.00					
Ben./Lerman						
Akaike I.C.						

*Significant at the 0.10 level
** Significant at the 0.05 level

Table 5.12. Binomial Logit Model, MULT-CVM, BEST

Q1 (Improvement of Water Quality)	Q1 (W)		Q2 (S)		Q3 (A)		Q4 (W, S)		Q5 (S, A)		Q6 (W, A)		Q7 (W, S)		Q8 (W,S,A)	
ONE	0.015		-1.366	**	1.389		-0.654	*	-1.079	**	0.165		0.132		0.764	
BID1	-0.017	**	-0.038	**	-0.021	**	-0.025	**	-0.014	*	-0.018	**	-0.034	**	-0.035	**
BOAT	1.360	**														
CAMP	2.335	**									2.468	*				
POLVI	0.002	**											0.002	*		
PEDU	1.522	**									1.052		1.274	*	1.355	*
DRUG	-2.974	**									-2.395	*			-2.021	*
ENV	1.586	**					1.128	*								
MIMPOR			0.895	**							0.002	*				
INFO			0.956	*												
BORN			1.052	*												
REPUB							1.137	**	0.883	**						
INCOME							0.002	*							0.001	*
ENVORG					1.323	**			1.087	*						
WHITE					-2.193	*										
Number of observation	120.00		114.00		116.00		115.00		115.00		115.00		114.00		115.00	
Log-likelihood	-59.30		-48.85		-55.51		-63.42		-60.87		-64.13		-56.55		-64.17	
Log-likelihood (0)	-81.82		-61.21		-64.11		-72.24		-67.02		-77.40		-69.47		-78.45	
Chi-squared	45.04		24.73		17.20		17.64		12.31		26.53		25.84		28.57	
Degree of freedom	7.00		4.00		3.00		4.00		3.00		5.00		3.00		4.00	
Significance level	0.00		0.00		0.00		0.00		0.01		0.00		0.00		0.00	
McFadden	0.28		0.20		0.13		0.12		0.09		0.17		0.19		0.18	
Ben./Lerman	0.67		0.72		0.72		0.62		0.64		0.61		0.67		0.62	
WTP	25.57		-15.19		-24.99		-0.02		-0.05		10.56		8.69		20.53	

*Significant at the 0.10 level
** Significant at the 0.05 level

W - questions asking an improvement of river water quality
S - questions asking an increase of sportfish
A - questions asking an improvement of aquatic life

REPUB and ENVORG are significant and positive, which implies that Republicans and members of an environmental organization tend to choose the policy for improving sport fishing and aquatic life. In Q6, asking about improvement of water quality and aquatic life, CAMP is positive and significant, and DRUG is negative and significant. The result shows that those who camped favor a program of improvement, but people concerned about drug issues are less likely to do so.

The results from the question dealing with improvements to all three attributes (aquatic life, sport fishing, and water quality) reveal that INCOME and PEDU are positive and significant, and DRUG is negative and significant. Here it can be said that people who have higher incomes and are concerned about public education are more likely to choose the policy of improvement, while people who are concerned about drug issues are less like to choose this policy.

Throughout the eight questions, it is possible to see that individuals who are concerned about public education favor policies of improvement in water quality, and people who are concerned about drug issues are less likely to choose the favorable environmental policies.

5.2.4 Welfare Estimates Under MULT-CVM

Welfare estimates under the MULT-CVM are shown in Table 5.13. The WTP for the improvement of only water quality is $21.00. Surprisingly, the WTP for both the improvement of only aquatic life and the increase of only sport fishing are. It suggests that individuals are not willing to pay anything when policies for improving aquatic life or sportfish are offered. For the policies of aquatic life & sport fishing taken together, the

Table 5.13. Mean WTP, MULT-CVM, Without SC

Q1 (W)	Q2 (S)	Q3 (A)	Q4 (W, S)	Q5 (S, A)	Q6 (W, A)	Q7 (W, S)	Q8 (W,S,A)
21	-20.82	-27.93	-9	-31.45	12.24	4.29	16.93

W - questions asking an improvement of river water quality

S - questions asking an increase of sportfish

A - questions asking an improvement of aquatic life

WTP is also negative. The WTP for the other combinations, water quality & aquatic life and water quality & sportfish, are lower than the WTP for only water quality improvement. The WTP for the improvement of all three attributes is also less than the WTP for only water quality improvement at $16.93.

5.2.5 Confidence Interval for Mean WTP Under MULT-CVM

The Krinsky and Robb procedure is used to estimate a 90 percent confidence interval on willingness to pay. Table 5.14 shows the results of the mean, lower, upper, and median points of the willingness to pay for the Krinsky and Robb procedure.

Regarding the Krinsky and Robb procedure, in case of models the signs of the all mean, median, confidence interval on the WTP for improving water quality (Q1) are positive, while ones for improving aquatic life (Q3) are negative. The signs are negative for increasing sport fish (Q2), except for the upper bound of the confidence interval, due to the large standard errors. The combined policy of drinking water quality and aquatic life improvements (Q6) has signs that are all positive. However, welfare values for the

Table 5.14. Mean WTP and Confidence Interval, MULT-CVM, Without SC

	Q1 (W)	Q2 (S)	Q3 (A)	Q4 (W, S)	Q5 (S, A)	Q6 (W, A)	Q7 (W, S)	Q8 (W,S,A)
Mean WTP	21.00	-20.82	-27.93	-9.00	-31.45	12.24	4.29	16.93
Krinsky and Robb Procedure								
Mean	17.38	-12.94	-45.77	-23.57	-25.24	5.33	0.03	15.27
Standard Error	0.41	38.03	8.87	4.81	40.28	1.25	0.84	0.28
Median	19.1	-20.05	-25.71	-9.40	-33.89	11.12	3.39	16.44
Confidence Interval (90.0%)								
Upper	18.06	49.66	-31.17	-15.64	41.06	7.39	1.42	15.73
Lower	16.70	-75.55	-60.37	-31.49	-91.55	3.27	-1.35	14.82
Skewness	-22.57	-16.14	17.24	-3.45	14.09	12.22	0.40	-0.90

W - questions asking an improvement of river water quality
S - questions asking an increase of sportfish
A - questions asking an improvement of aquatic life

joint policy about aquatic life and sport fish improvements (Q5) are negative except for the upper bound of the confidence interval due to the large standard error. The policy for combined sport fish and water quality improvements resulted in both a positive and a negative WTP in two same questions (Q4 and Q7) (discussed below). The WTP for combined the three attribute improvements (Q8) is positive. The results may imply that some people will not pay anything for a policy of improving the river, and they rather prefer to accept some money for changing river quality, especially for the policies to improve sport fishing and aquatic life.

Not all the welfare mean values estimated in the standard way are similar to the ones estimated by the Krinsky and Robb procedure. Rather, the median willingness-to-pay calculated by the Krinsky and Robb procedure, which is estimated by the order of

rank from 1000 draws, is close to them. This is consistent with the Mitchell and Caron finding, in which using median rather than mean willingness to pay is more appropriate because a mean willingness to pay is more likely to affect a bias caused from the skewed distribution.

5.2.6 Consistency Test for MULT-CVM

For the purpose of testing consistency of individual choice, the MULT-CVM survey has the same question in Q4 and Q7, which is asking about a policy for combined drinking water and sport fish improvements. In the Krinsky and Robb procedure, the mean WTP is $-23.57 in Q4. On the other hand, they are $0.03 in Q7. The same results, in which the willingness to pay in Q4 are negative and positive in Q7, are shown in the mean willingness to pay estimation by the standard procedure.

The hypothesis test for the differences of the welfare values between the two questions can be exhibited of whether or not the consistency of the individual's behavior exists (Bateman et al., forthcoming; Mitchell and Carson, 1989; McFadden and Leonard, 1993) in the MULT-CVM. This test is examined for both Without SC and BEST in the Krinsky and Robb Procedure, using a Chi-Squared test (Conover 1980; Poe, et al. 2002) at a ninety percent confidence level. The null hypothesis is that the mean WTP in Q4 and Q7 are identical.

The test is failed; the probabilities are 1.575E-6. This result suggests that the mean WTP in Q4 are different from the ones in Q7 at the ninety percent confidence level, which implies that individuals are not consistent in their behaviors for choosing a policy on water and sportfish improvements.

5.2.7 Scope for MULT-CVM

Willingness to pay results estimated by the standard and Krinsky and Robb procedures in Table 5.14 present individuals' preferences for three attributes. The results of the first three questions (Q1,Q2, and Q3) reveals that individuals prefer a policy for improving drinking water quality the most, a policy for increasing a number of sport fish second, and one for improving aquatic life third. The result can be shown:

WTP (W) > WTP(S) > WTP (A),

which W is a policy asking for water quality improvement, S is a policy asking for increasing sport fish, and A is a policy asking for improving aquatic life. The order of their preferences is constant across the three policy questions for single attribute in both the standard and Krinsky and Robb procedures. According to this result, we could expect the individuals' preferences for policies for combined attributes; a policy for combining water quality and sport fish improvements in the first preference. The second preference would be a policy for combining water quality and aquatic life improvements, and the third one would be a policy for combining sport fish and aquatic life improvements. What we expect is:

WTP (W, S) > WTP (W, A) > WTP (S, A),

where W,S is a policy asking for combined water quality and sport fish improvements, W,A is a policy asking for combined water quality and quality life improvements, and

S,A is a policy asking for sport fish and aquatic life improvements. However, Table 5.14 willingness to pay estimates indicate a policy for combined water quality and aquatic life is in the individuals' first preferences among the three combined policies, a policy for water quality and sport fish improvements is in the second, and a policy for combined sport fish and aquatic life improvements is third, or:

$$WTP\ (W, A) > WTP\ (W, S) > WTP\ (S, A)$$

Although the third preference is the same as what we could expect, the order of the first and second is not identical from the result of the preference for policies of single attribute.

The reasons must depend on a statistical problem and the psychology of the responders. The high standard errors, especially in a question for sport fish improvement, cause wide confidence intervals for the willingness to pay. It might affect to the change in the order of preferences on combined policies. An individual's choice behaviors also would be a significant reason. Individuals might react differently when they faced with a policy for single attribute and a policy with combined attributes. This issue will be discussed in the following section.

5.2.8 Embedding Test in MULT-CVM

Kahneman and Knetsch (1992), Diamond, et al. (1992) and Desvouges, et al. (1992) pointed out that individuals were insensitive about each attributes. In their studies, if three attributes are contained in each CVM question, and if individuals are

asked about their welfare values for one of the attributes among the three, then the welfare values become identical with the welfare value for the total three attributes. It implies that individuals tend to overestimate for a sub-sample question and are insensitive on each attribute.

To see whether or not this problem exists, two types of welfare value in the Krinsky and Robb procedure are estimated; one is the sum of welfare values for two or three policies in which each policy contains improvement of only a single attribute, and the other is welfare values for policies containing the improvement of two or three attributes together. These two types of welfare values are compared in case of both the Without SC and the BEST. Table 5.14 shows the results. Based on the sum of welfare estimates for individual policies of water quality and sport fish, one cannot determine whether or not it is larger than the welfare value for a policy of combined the corresponding two attributes, because the combined policy question is asked twice in a survey, and the two results are significantly different each other in both the Without SC and BEST cases. The other three welfare values for combined policies, such as a policy combined water quality and aquatic life, a policy combined support fish and aquatic life, and a policy combined three attributes together, are larger than the sums of welfare estimates for single attributes relative to the combined attributes in the Without SC case. In case of the BEST, the result is the same except that the sum of willingness to pay for the single sport fishing attribute and aquatic life attribute is not different from the willingness to pay for the combined policy. The result implies that individuals are insensitive about attributes in most cases in MULT-CVM.

To see whether or not the embedding issues exist, the embedding effects have been tested (McFadden and Leonard, 1993). Five hypotheses were created and tested with a Chi-squared test at the ninety percent confidence level. The hypotheses are as follows:

Hypothesis1: WTP (W+S) = WTP (W, S)^{4}

Hypothesis2: WTP (W+S) = WTP (W, S)^{7}

Hypothesis3: WTP (W+A) = WTP (W, A)

Hypothesis4: WTP (A+S) = WTP (A, S)

Hypothesis5: WTP (W+S+A) = WTP (W, S, A),

which WTP (W+S) is the sum of the individual willingness to pay for water quality and sportfish; WTP (W+A) is the sum of the individual willingness to pay for water quality and aquatic life; WTP (A+S) is the sum of individual willingness to pay for aquatic life and sport fish; and WTP (W+S+A) is the sum of individual willingness to pay for water quality, sport fish, and aquatic life. WTP (W, S)^{4} and WTP (W, S)^{7} indicate the willingness to pay of combined policies for water quality and sport fish in Q4 and Q7 respectively.

The results of the hypothesis tests are shown in Table 5.15. In the Without SC case, the hypothesis 3 and 5 failed at the ninety percent confidence level, and in the BEST case the hypothesis 2, 3, and 5 failed. In all failed hypotheses the sums of willingness to pay for single attributes were negative while the willingness to pay for

Table 5.15. Hypotheses for Embedding Test and the Result,
MULT-CVM , Using Mean WTP

		Sum of WTP for a Policy			WTP for a Combined Policy		
			WTP			WTP	p-value
Without SC	Hypothesis 1:	WTP(W)+WTP(S)	4.44	=	WTP (W,S)[4]	-23.57	0.465
	Hypothesis 2:	WTP(W)+WTP(S)	4.44	=	WTP (W,S)[7]	0.03	0.908
	Hypothesis 3:	WTP(W)+WTP(A)	-28.39	=	WTP(W,A)	5.33	**0.000**
	Hypothesis 4:	WTP(S)+WTP(A)	-58.71	=	WTP(S,A)	-25.24	0.551
	Hypothesis 5:	WTP(W)+WTP(S)+WTP(A)	-52.47	=	WTP(W, S, A)	15.30	**8.03E-35**
BEST	Hypothesis 1:	WTP(W)+WTP(S)	-8.13	=	WTP (W,S)[4]	-15.61	0.277
	Hypothesis 2:	WTP(W)+WTP(S)	-7.13	=	WTP (W,S)[7]	9.39	**0.006**
	Hypothesis 3:	WTP(W)+WTP(A)	-11.50	=	WTP(W,A)	32.23	**0.001**
	Hypothesis 4:	WTP(S)+WTP(A)	-46.46	=	WTP(S,A)	-46.44	0.999
	Hypothesis 5:	WTP(W)+WTP(S)+WTP(A)	-33.05	=	WTP(W, S, A)	28.62	**9.90E-08**

W - questions asking an improvement of river water quality
S - questions asking an increase of sportfish
A - questions asking an improvement of aquatic life

*A question for combined W & S is asked twice

policies of the combined attributes were positive. For example, in the result of the hypothesis 3 test in the Without SC case, the sum of willingness to pay of individual water quality and aquatic life attributes, which is \$-28.39, is significantly different from the willingness to pay of the combined attribute, which is \$5.53. In hypothesis 5, in which the test failed, the sum of individual water quality, sport fish, and aquatic life attributes is \$-52.47, and the WTP for the policy of the combined attributes is \$15.30. The same things happened to the BEST case. For hypothesis 2 the sum of WTP for single water quality and sport fish attributes is \$-7.13, and the willingness to pay for a policy of the combined attributes is \$9.39. For hypothesis 3 the sum of single water quality and aquatic life attribute is \$-11.50, while the WTP the combined attributes is \$32.23. For hypothesis 5 the WTP for individual three attributes and the combined three attributes are \$-33.05 and \$28.62 respectively. All failed hypotheses contain a water quality attribute in the policies, and the sums of WTP for individual water quality and other attributes are negative, however when the policies are combined with the water quality and other attributes together, the WTP turns out to be positive. Because of the positive welfare values for single water quality attributes and negative welfare values for other single attributes resulted in Table 5.15, a finding can be addressed; a water quality attribute is weighted more than other attributes when a policy is combined with water quality and other attributes. In other words, the WTP for water quality is less valued as a single attribute. Thus, we could infer that there are the embedding problems in the MULT-CVM. This finding is different from the concept of embedding effect addressed by Kahneman and Knetsch (1992), Diamond et al. (1992) and Desvouges et al. (1992). They suggested that individuals would tend to overestimate for a sub-sample question.

My study found that individuals would tend to overestimate for a combined question (policy) if the attributes are their favorite.

Another finding of the embedding tests is that the willingness to pay for individual sport fish and aquatic life attributes are not significantly different from the one with combined attributes. It can be said that people are sensitive about sport fishing and aquatic life attributes. A conclusion is that people are insensitive on water quality attribute and estimate the single water quality attribute less than a policy for the combined attributes, although they are sensitive on aquatic life and sport fishing attributes.

5.2.9 Ideal WTP and Policy Under MULT-CVM

In the TRAD-CVM, an individual's ideal willingness-to-pay and his/her ideal levels of the policy were asked after the eight referendum questions. The mean ideal willingness-to-pay was $34.44, which was much lower than the estimated willingness-to-pay used by the logit model. Table 5.16 presents the results.

As for the water quality attributes, 80 percent of the respondents chose better water quality, 3 percent chose worse water quality, and 18 percent chose the status-quo. For the question about sport fishing, 50 percent preferred an increase in the number of sport fish, 1 percent chose a decrease in the number, and 49 percent chose to stay the constant. As for the aquatic life, 55 percent preferred to improve it in the river, while 19 and 27 percents preferred not to improve and to have no-changes respectively. These results imply that people are like to choose e a policy, which leads to improvement in water quality and aquatic life. For the level of sport fish, half of them preferred to

Table 5.16. Ideal WTP and Policy, MULT-CVM

	Mean	Std.Dev.	Skewness	Kurtosis	Minimum	Maximum	NumCases
IDEALCOST	34.44	79.1	5.11	30.12	0	500	640
IDEALWG	0.8	0.4	-1.48	3.19	0	1	628
IDEALWP	0.03	0.16	6.02	37.22	0	1	628
IDEALWC	0.18	0.38	1.69	3.87	0	1	628
IDEALSI	0.5	0.5	-0.02	1	0	1	593
IDEALSD	0.01	0.07	13.94	195.34	0	1	593
IDEALSC	0.49	0.5	0.04	1	0	1	593
IDEALAF	0.55	0.5	-0.2	1.04	0	1	610
IDEALAP	0.19	0.39	1.62	3.62	0	1	610
IDEALAC	0.27	0.44	1.05	2.1	0	1	610

WG - good water quality
WP - poor water quality
WC - constant water quality
SI- a increase in the number of sport fish
SD - a decrease in the number of sport fish
SC - the constant number of sport fish
AF - Full recovered aquatic life
AP - Partial recovered aquatic life
AC - constant level of the aquatic life

increase the number of sport fishing, while another half of them was not interested in increasing them.

5.3 Empirical Results of POOLED CVM

5.3.1 Descriptive Statistics in POOLED CVM

Table 5.17 and Table 5.18 show the summary statistics for the POOLED TRAD-CVM and POOLED MOD-CVM respectively. The total observation in the POOLED TRAD-CVM is 257, and the one in the POOLED MOD-CVM is 253. Since there are some missed values, the observation number for each variable is less than the total observation number in the both data sets.

The summary statistics for both data sets are similar. The average person for the two data sets is white male, about 55 years old, who graduated high school and had some college degree/associated degree. The mean income is $55,000. He has lived in the Clinch River Valley for more than half of his life. The family size is between 2.5 and 2.7. The average number of children is 0.6. He tends to be politically conservative. About 92 percent of people are registered to vote in both data sets, and around 48 percent of them have fish licenses. In POOLED TRAD-CVM, 42 percent of the respondents identify themselves as the Republican Party, and 31 percent people are Democrats, while in the POOLED MOD-CVM, 37 percent of people are Republican, and 30 percent are Democratic. With respect to social issues, for both data sets more than half of people were concerned about the economy and unemployment, 3 percent of people were concerned about public education, about 10 percent on environment issues, 7 percent on drugs, about 5 percent on public health, and about 1 percent on crime. For both data sets

Table 5.17. Summary Statistics, POOLED TRAD-CVM

	Mean	Std.Dev.	Skewness	Kurtosis	Minimum	Maximum	NumCases
EDUC	13.97	1.55	-0.32	1.95	11	16	237
AGE	56.81	14.83	0.07	2.37	23	94	241
MALE	0.75	0.44	-1.14	2.29	0	1	238
INCOME	5.92	3.15	0.21	1.89	0	11	208
BORN	0.4	1.96	13.76	200.49	0	29	226
YEARS	30.59	20.86	0.21	1.96	0	84	221
RLIFE	0.54	0.35	-0.06	1.6	0	1	217
HHSIZE	2.55	1.29	1.01	3.76	1	7	226
CHILD	0.56	1.03	2.23	8.83	0	6	241
REPUB	0.42	0.49	0.33	1.1	0	1	227
DEMOC	0.31	0.46	0.83	1.68	0	1	227
POLVI	4.48	1.61	-0.52	2.57	0	7	205
VOTE	0.92	0.27	-3.2	11.21	0	1	224
FISHLIC	0.47	0.5	0.13	1.01	0	1	222
ENVORG	0.2	0.5	4.67	39.48	0	5	221
WHITE	0.91	0.28	-2.9	9.41	0	1	227
ECONOMY	0.52	0.5	-0.06	1	0	1	227
CRIME	0.01	0.11	8.51	73.36	0	1	227
PEDU	0.13	0.34	2.17	5.69	0	1	227
DRUG	0.07	0.26	3.35	12.21	0	1	227
ENV	0.12	0.32	2.35	6.51	0	1	227
HEALTH	0.06	0.23	3.8	15.45	0	1	227
VISITR	0.64	0.53	0.67	7.91	0	4	224
NUMV	3.1	3.39	0.95	2.67	0	11	197
BOAT	0.12	0.33	2.29	6.22	0	1	227
FISH	0.22	0.42	1.32	2.73	0	1	227
HIKE	0.19	0.39	1.58	3.5	0	1	227
CAMP	0.04	0.18	5.03	26.3	0	1	227
WORK	0.03	0.16	5.89	35.7	0	1	227
PICNIC	0.11	0.32	2.42	6.83	0	1	227
BICYCLE	0.03	0.16	5.89	35.7	0	1	227
MIMPOR	0.67	0.73	2.92	19.83	0	6	215
INFO	0.31	0.46	0.83	1.68	0	1	224

Table 5.18. Summary Statistics, POOLED MOD-CVM

	Mean	Std.Dev.	Skewness	Kurtosis	Minimum	Maximum	NumCases
EDUC	13.95	1.54	-0.19	1.8	11	16	220
AGE	54.86	14.17	0.2	2.14	29	91	220
MALE	0.74	0.44	-1.09	2.18	0	1	219
INCOME	5.67	2.95	0.37	2.11	0	11	208
BORN	0.33	0.47	0.7	1.48	0	1	224
YEARS	32.21	20.47	0.08	1.93	0	81	219
RLIFE	0.59	0.35	-0.25	1.64	0	1	212
HHSIZE	2.66	1.26	0.98	3.66	1	7	225
CHILD	0.6	1.14	0.75	9.53	0	5	239
REPUB	0.37	0.48	0.54	1.28	0	1	227
DEMOC	0.3	0.46	0.9	1.8	0	1	227
POLVI	4.55	1.55	-0.51	2.77	0	8	199
VOTE	0.92	0.27	-3.05	10.32	0	1	221
FISHLIC	0.49	0.5	0.04	1	0	1	222
ENVORG	0.14	0.46	6.07	57.58	0	5	220
WHITE	0.9	0.3	-2.64	7.95	0	1	227
ECONOMY	0.57	0.5	-0.28	1.07	0	1	227
CRIME	0	0.07	14.93	224.01	0	1	227
PEDU	0.13	0.34	2.17	5.69	0	1	227
DRUG	0.07	0.26	3.35	12.21	0	1	227
ENV	0.1	0.3	2.64	7.95	0	1	227
HEALTH	0.04	0.18	5.03	26.3	0	1	227
VISITR	0.62	0.54	0.71	7.82	0	4	223
NUMV	3.2	3.45	0.94	2.75	0	13	194
BOAT	0.12	0.33	2.29	6.22	0	1	227
FISH	0.28	0.45	0.97	1.93	0	1	227
HIKE	0.18	0.38	1.7	3.87	0	1	227
CAMP	0.04	0.18	5.03	26.3	0	1	227
WORK	0.03	0.17	5.42	30.33	0	1	227
PICNIC	0.07	0.26	3.22	11.38	0	1	227
BICYCLE	0.02	0.13	7.32	54.53	0	1	227
MIMPOR	0.74	1.34	8.18	79.05	0	14	213
INFO	0.34	0.48	0.67	1.44	0	1	217

approximately 63 percent of people visited the Clinch River in a past year. The average number of visits was about 3. For the POOLED TRAD-CVM, 22 percent of people fished in the Clinch River in the past year, while in the POOLED MOD-CVM, 28 percent of them did. In the both data, about 18 percent of them hiked, 4 percent camped, 3 percent worked, 10 percent picnicked, and 3 percent bicycled in the river in the past year. The percentage belonging to environmental organizations was 20 percent in the POOLED TRAD-CVM. On the other hand, it was 14 percent in the POOLED MOD-CVM. In the POOLED TRAD-CVM, 31 percent of people had learned about water quality in the river through seeing, reading or hearing in the past few months. While in the POOLED MOD-CVM, 34 percent of people did. In the POOLED TRAD-CVM, nearly 67 percent believed that the most important use of the river form the perspective of the citizens was recreation, such as fishing, boating, and hiking, or feeding fish or animals rather than industrial use of irrigation for farming. On the other hand, 74 percent did in the POOLED MOD-CVM.

5.3.2 Bid Distribution in POOLED TRAD-CVM and POOLED MOD-CVM

Table 5.19 shows the number of responses and the response rates for each bid level in both the POOLED TRAD-CVM and POOLEDMOD-CVM. The bid demand curves for both data sets are presented in Figure 5.3. For both pooled data sets, the demand curves, which are the "Yes" response rate in each bid level, are almost downward sloping, except for the $80 bid level in the POOLED TRAD-CVM. It leads to the conclusion that individuals are more likely to choose a policy if the bid amount is lower in both TRAD-CVM and MOD-CVM. The graph reveals that the "Yes" respons

Table 5.19. Response Rate, POOLED TRAD-CVM & POOLED MOD-CVM

	POOLED TRAD-CVM					POOLED MOD-CVM				
BID	Number of Responses	"Yes" Response	"No" Responses	No Answer	% (Yes)	Number of Responses	"Yes" Response	"No" Responses	No Answer	% (Yes)
5	41	23	15	3	56.10	66	42	21	3	63.64
10	52	20	28	4	38.46	52	22	24	6	42.31
25	58	18	37	3	31.03	44	17	26	3	38.64
50	45	9	31	5	20.00	44	15	26	3	34.09
75	19	6	12	1	31.58	22	5	16	1	22.73
100	29	5	22	2	17.24	17	2	13	2	11.76

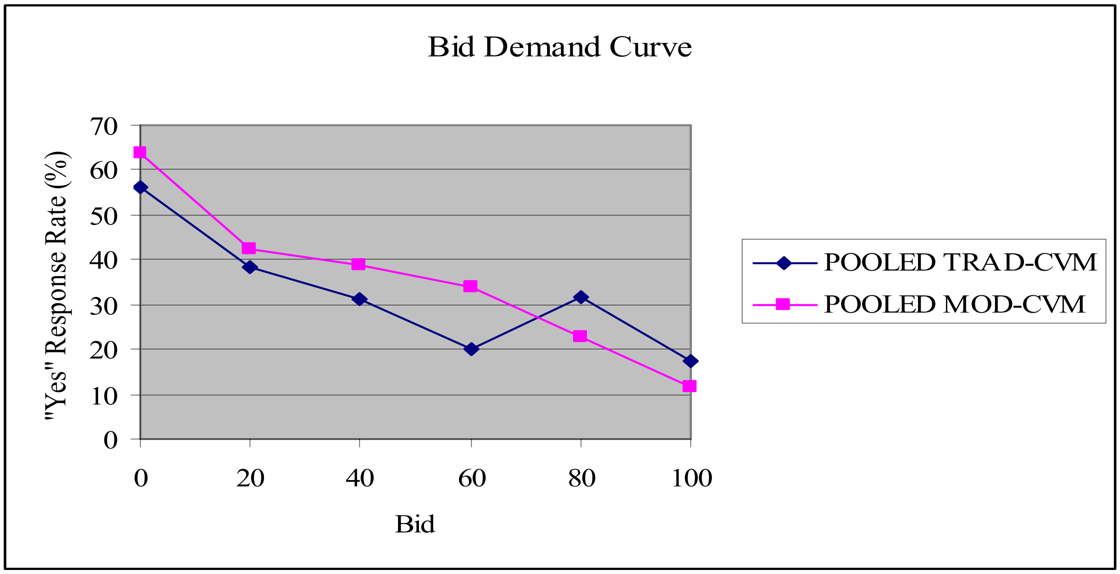

Figure 5.3. Bid Demand Curve, POOLED CVM

rate between \$0 to \$60 bid amount ranges in the POOLED MOD-CVM is higher than the one in the POOLED TRAD-CVM. It implies that people prefer the POOLED MOD-CVM to the POOLED TRAD-CVM. On the other hand, the rate between \$60 and \$80 bid range in the POOLED MOD-CVM is lower than the one in the POOLED TRAD-CVM. One of the reasons must be in the small numbers of responses in the \$75 and \$100 bid amounts. The number of responses for the \$5, \$10, \$25, and \$50 bid amounts is more than 40; however the number for \$75 and \$100 bid amounts is around 20. The small number of responses easily brings high "Yes" repose rates in the both POOLED TRAD CVM and POOLED MOD CVM. It suggests that the POOLED TRAD-CVM is a better sample than the POOLED MOD CVM in terms of the number of observations at the high bid ranges.

5.3.3 Binomial Logit Model in POOLED TRAD-CVM and POOLED MOD-CVM

Three models are estimated using the binominal logit model in both POOLED TRAD-CVM and POOLED MOD-CVM. The first one does not include socio economic variables (Without SC), the second one includes the variables (With SC), and the third one is regressed with variables, which will lead the best fit regression in the logit model (BEST). Table 5.20, Table5.21, and Table 5.22 present the results of the binominal logit model for the Without SC, With SC, and BEST respectively.

Cost variables in all cases are significantly negative at the 95 percent confidence level. Higher bid amounts lead individuals to be less likely to choose a policy across all cases. In the With SC, POOLED TRAD-CVM presents that INCOME is significant and positive at the 95 percent confidence level, but the coefficient is nearly 0. Other

Table 5.20. Binomial Logit Model, POOLED CVM, Without SC

	POOLED TRAD-CVM					POOLED MOD-CVM				
	Coeff.		Std.Error	T-stat	P-val	Coeff.		Std.Error	T-stat	P-val
CONSTANT	-0.06		0.21	-0.31	0.76	0.48	**	0.20	2.38	0.02
COST	-0.02	**	0.01	-3.12	0.00	-0.02	**	0.01	-4.21	0.00
Number of observation				227.00					227.00	
Log-likelihood				-142.44					-145.93	
Log-likelihood (0)				-147.91					-156.37	
Chi-squared				10.93					0.07	
Degree of freedom				1.00					1.00	
Significance level				0.00					0.00	
McFadden				0.04					0.67	
Ben./Lerman				0.56					0.55	
Akaike I.C.				1.27					1.30	

*Significant at the 0.10 level
** Significant at the 0.05 level

Table 5.21. Binomial Logit Model, POOLED CVM, With SC

	POOLED TRAD-CVM					POOLED MOD-CVM				
Variable	Coeff		Std.Error	T-stat	P-val	Coeff		Std.Error	T-stat	P-val
Constant	0.22		0.32	0.68	0.50	0.25		0.59	1.44	0.15
COST	-0.02	**	0.01	-3.00	0.00	-0.03	**	0.01	-2.13	0.03
MALE	0.00		0.00	-0.12	0.91	0.00		0.40	0.60	0.55
INCOME	0.00	**	0.00	2.16	0.03	0.00		0.00	1.47	0.14
BORN	0.04		0.08	0.48	0.63	0.48		0.10	0.37	0.71
BOAT	0.34		0.44	0.76	0.44	1.11		0.61	-0.19	0.85
FISH	-0.11		0.35	-0.31	0.75	0.06		0.51	-0.93	0.35
ECONOMY	-0.41		0.32	-1.28	0.20	0.10	*	0.45	-1.64	0.10
ENV	-0.19		0.47	-0.39	0.69	0.87		0.72	-0.79	0.43
Number of observation				227.00					227.00	
Log-likelihood				-137.33					-133.82	
Log-likelihood (0)				-147.91					-156.37	
Chi-squared				21.16					45.11	
Degree of freedom				8.00					8.00	
Significance level				0.01					0.00	
McFadden				0.08					0.14	
Ben./Lerman				0.58					0.59	
Akaike I.C.				1.28					1.26	

*Significant at the 0.10 level
** Significant at the 0.05 level

Table 5.22. Binomial Logit Model, POOLED CVM, BEST

	POOLED TRAD-CVM					POOLED MOD-CVM				
Variable	Coeff		Std.Error	T-stat	P-val	Coeff		Std.Error	T-stat	P-val
Constant	0.92		0.57	1.62	0.11	0.28		0.25	1.13	0.26
COST	-0.02	**	0.01	-3.13	0	-0.03	**	0.01	-4.68	0
WORK	3.58	**	1.54	2.32	0.02					
WHITE	-1.08	**	0.56	-1.92	0.05					
INCOME	0	*	0	1.71	0.09	0	**	0.49	2.05	0.04
PEDU	0.91	**	0.43	2.14	0.03	0.77		0.32	1.62	0.11
DRUG	-2.36	**	1.11	-2.12	0.03					
ENV						0.91	**	0	2.57	0.01
BOAT						1	*	0.45	1.72	0.08
BORN						0.52	*	0.52	1.75	0.08
Number of observation				227					227	
Log-likelihood				-128.35					-132.68	
Log-likelihood (0)				-147.91					-156.37	
Chi-squared				39.12					47.38	
Degree of freedom				6					6	
Significance level				0					0	
McFadden				0.13					0.16	
Ben./Lerman				0.64					0.6	
Akaike I.C.				1.19					1.24	

*Significant at the 0.10 level

** Significant at the 0.05 level

variables, such as MALE, BORN, BOAT, FISH, ECONOMY, and ENV are insignificant, which implies that these valuables do not affect individual decisions to choose a policy for improving aquatic life in the Clinch River. In the POOLED MOD-CM with SC, ECONOMY is significantly positive at the 90 percent confidence level, which implies individuals who concerns about economy and unemployment are more likely to choose a policy for improving aquatic life, water quality, and sport fish, while other variables show to be insignificant on the MOD-CVM policy.

The BEST model shows that WORK, INCOME, and PEDUC are significantly positive, and COST, WHITE, DRUG are significantly negative in the POOLED TRAD-CVM. On the other hand, INCOME, ENV, BOAT, and BORN are significantly positive, and COST is negative. Both data set results show INCOME to be significantly positive, which implies that people who have higher income tend to choose a policy for improving the Clinch River.

5.3.4 Welfare Estimates Under POOLED TRAD-CVM and POOLED MOD-CVM

Table 5.23 shows the willingness to pay for POOLED TRAD-CVM and POOLED MOD-CVM estimated by the traditional procedure in the Without SC. In addition, the willingness to pay and a ninety percent confidence interval estimated by the Krinsky and Robb procedure are displayed for the Without SC. In the POOLED TRAD-CVM, the mean welfare values estimated by the traditional procedure are $-4.10. These welfare values, $-9.67, are higher than the ones estimated by the Krinsky and Robb procedure. Since the distributions are significantly skewed to the left tail, the differences in the welfare values between the standard and the Krinsky and Robb procedures might

Table 5.23. Mean WTP and Confidence Interval, POOLED-CVM, Without SC

	POOLED TRAD-CVM	POOLED MOD-CVM
Mean WTP	-4.1	20.08
Krinsky and Robb Procedure		
Mean	-9.67	20.36
Standard Error	2.41	0.23
Median	-3.94	20.88
Confidence Interval (90.0%)		
Upper	-5.7	20.74
Lower	-13.64	19.98
Skewness	-9.01	-0.99

occur. This inference is supported by the median welfare values estimated by the Krinsky and Robb Procedure, which is close to the welfare values for the traditional procedures. The median welfare values estimated the Krinsky and Robb procedure are $-3.94, while the ones estimated by the traditional way are $-4.10. These results imply that the median WTP must be a less biased estimator than the mean WTP.

In the MOD-CVM, there are not large differences in the welfare values between the traditional and Krinsky and Robb Procedure. These are due to the small standard errors and skewnesses in both Without SC. In the model without SC, the mean WTP derived by the traditional procedure as well as the mean and median WTPs derived by the Krinsky and Robb Procedure are $20.08, $20.36, and $20.88, respectively.

Chapter 6

Comparisons Between CVM and CHOICE

This chapter compares the results of the regressions and the WTP estimates for the CVM and CHOICE models. The results reveal the differences in the causality of WTP in each case.

6.1 Descriptive Statistics

The summary statistics for all samples are displayed in Table 6.1. The choice data sets are similar to the other CVM data sets. Across the all data sets, the average education is nearly 14 years, which implies that the average person had already a high school diploma. The mean age is in a range between 51 and 59. The mean annual income is nearly $55,000. Around 90 percent of the combined sample is white. There are slight differences between the CHOICE and CVM samples in terms of ENVORG, FISH, HIKE, and BICYCLE. The percent of individuals who belong an environmental organization in the CHOICE sample is lower than the ones in other CVM samples. Also the average numbers of activities for hiking and bicycling are similar. On the other hand, individuals in the CHOICE sample fished more than ones in the CVM samples. Even though these differences exist in the several variables between the two models, those surveys are comparable because the characteristics of the sample groups resembles in mind of the average income higher than the actual data according to county data.

Table 6.1. Summary Statistics for All Data

	TRAD-CVM						MOD-CVM					
	Mean	Std.Dev.	Skewness	Minimum	Maximum	NumCases	Mean	Std.Dev.	Skewness	Minimum	Maximum	NumCases
EDUC	13.93	1.59	-0.37	11	16	127	13.73	1.59	-0.14	11	16	134
AGE	54.44	15.10	0.22	23	94	130	51.94	15.77	0.11	1	85	134
MALE	0.74	0.44	-1.11	0	1	129	0.73	0.44	-1.04	0	1	134
INCOME	5.87	3.29	0.25	0	11	121	5.44	2.88	0.46	0	11	127
BORN	0.34	0.48	0.68	0	1	130	0.45	0.50	0.20	0	1	131
YEARS	29.34	21.13	0.34	0	84	125	30.56	20.62	0.29	0	81	126
RLIFE	0.55	0.36	-0.07	0	1	124	0.62	0.37	-0.39	0	1	124
HHSIZE	2.52	1.25	0.76	1	6	130	2.78	1.23	0.80	1	6	131
CHILD	0.59	0.99	2.16	0	6	130	0.75	1.06	1.47	0	4	130
REPUB	0.43	0.50	0.27	0	1	134	0.36	0.48	0.57	0	1	141
DEMOC	0.34	0.48	0.66	0	1	134	0.29	0.46	0.92	0	1	141
POLVI	4.44	1.69	-0.36	0	8	119	4.63	1.60	-0.38	0	8	117
VOTE	0.91	0.28	-2.94	0	1	128	0.89	0.31	-2.48	0	1	127
FISHLIC	0.53	0.50	-0.13	0	1	126	0.58	0.50	-0.32	0	1	126
ENVORG	0.22	0.42	1.33	0	1	126	0.11	0.31	2.49	0	1	128
WHITE	0.87	0.34	-2.14	0	1	134	0.79	0.41	-1.40	0	1	141
ECONOMY	0.51	0.50	-0.03	0	1	134	0.58	0.50	-0.33	0	1	141
CRIME	0.02	0.15	6.43	0	1	134	0.01	0.08	11.71	0	1	141
PEDU	0.13	0.34	2.14	0	1	134	0.16	0.36	1.89	0	1	141
DRUG	0.07	0.25	3.45	0	1	134	0.08	0.27	3.14	0	1	141
ENV	0.09	0.29	2.86	0	1	134	0.09	0.28	2.96	0	1	141
HEALTH	0.09	0.29	2.86	0	1	134	0.04	0.19	5.01	0	1	141
VISITR	0.64	0.48	-0.60	0	1	129	0.63	0.49	-0.52	0	1	134
NUMV	2.57	3.06	1.26	0	13	127	3.22	3.29	0.93	0	13	119
BOAT	0.13	0.34	2.14	0	1	134	0.19	0.39	1.56	0	1	141
FISH	0.20	0.40	1.48	0	1	134	0.30	0.46	0.88	0	1	141
HIKE	0.19	0.40	1.54	0	1	134	0.22	0.43	1.61	0	2	141
CAMP	0.04	0.19	4.86	0	1	134	0.06	0.25	3.56	0	1	141
WORK	0.03	0.17	5.50	0	1	134	0.04	0.19	5.01	0	1	141
PICNIC	0.19	0.40	1.54	0	1	134	0.20	0.40	1.51	0	1	141
BICYCLE	0.04	0.21	4.39	0	1	134	0.02	0.14	6.61	0	1	141
MIMPOR	0.71	0.80	3.19	0	6	128	0.64	0.48	-0.58	0	1	125
INFO	0.27	0.45	1.02	0	1	129	0.33	0.47	0.73	0	1	125

Table 6.1. Continued

	CHOICE						MULT-CVM					
	Mean	Std.Dev.	Skewness	Minimum	Maximum	NumCases	Mean	Std.Dev.	Skewness	Minimum	Maximum	NumCases
EDUC	13.85	1.49	-0.29	11	16	1650	13.94	1.54	-0.21	11	16	123
AGE	58.04	15.45	0.45	32	95	1650	59.24	14.10	-0.01	29	91	121
MALE	0.71	0.45	-0.92	0	1	1650	0.73	0.45	-1.02	0	1	121
INCOME	5.66	2.98	0.43	1	11	1482	5.85	3.08	0.26	1	11	110
BORN	0.26	0.44	1.08	0	1	1650	0.24	0.43	1.24	0	1	123
YEARS	34.57	21.22	0.25	0	87	1650	34.23	20.26	0.01	0	79	121
RLIFE	0.60	0.34	-0.22	0	1	1626	0.57	0.32	-0.14	0	1	118
HHSIZE	2.33	1.06	1.06	1	6	1650	2.49	1.30	1.28	1	7	124
CHILD	0.42	0.72	1.38	0	2	1602	0.54	1.04	2.31	0	5	123
REPUB	0.40	0.49	0.42	0	1	1674	0.36	0.48	0.56	0	1	129
DEMOC	0.24	0.43	1.19	0	1	1674	0.28	0.45	0.98	0	1	129
POLVI	4.57	1.48	-0.42	1	7	1386	4.56	1.51	-0.56	1	7	107
VOTE	0.92	0.27	-3.17	0	1	1554	0.94	0.23	-3.83	0	1	124
FISHLIC	0.49	0.50	0.04	0	1	1602	0.41	0.49	0.38	0	1	123
ENVORG	0.06	0.24	3.71	0	1	1602	0.12	0.33	2.27	0	1	121
WHITE	0.89	0.32	-2.42	0	1	1674	0.91	0.28	-2.96	0	1	129
ECONOMY	0.59	0.49	-0.36	0	1	1674	0.51	0.50	-0.05	0	1	129
CRIME	0.01	0.12	8.17	0	1	1674	0.01	0.09	11.18	0	1	129
PEDU	0.09	0.28	2.95	0	1	1674	0.12	0.32	2.38	0	1	129
DRUG	0.09	0.28	2.95	0	1	1674	0.10	0.30	2.64	0	1	129
ENV	0.10	0.30	2.73	0	1	1674	0.13	0.34	2.17	0	1	129
HEALTH	0.09	0.28	2.95	0	1	1674	0.05	0.21	4.29	0	1	129
VISITR	0.70	0.90	4.74	0	7	1674	0.63	0.58	1.28	0	4	123
NUMV	2.85	3.29	1.06	0	11	1650	2.92	3.62	1.04	0	11	121
BOAT	0.13	0.34	2.21	0	1	1674	0.15	0.36	1.98	0	1	129
FISH	0.32	0.46	0.79	0	1	1674	0.25	0.43	1.16	0	1	129
HIKE	0.11	0.31	2.47	0	1	1674	0.22	0.41	1.37	0	1	129
CAMP	0.07	0.26	3.32	0	1	1674	0.07	0.26	3.36	0	1	129
WORK	0.03	0.17	5.65	0	1	1674	0.02	0.15	6.30	0	1	129
PICNIC	0.13	0.34	2.21	0	1	1674	0.13	0.34	2.17	0	1	129
BICYCLE	0.01	0.12	8.17	0	1	1674	0.04	0.19	4.76	0	1	129
MIMPOR	0.60	0.49	-0.41	0	1	1626	0.59	0.49	-0.38	0	1	116
INFO	0.33	0.47	0.70	0	1	1650	0.34	0.48	0.68	0	1	124

6.2. Estimation Results

6.2.1 Without Socioeconomic Variables

Table 6.2 and Table 6.3 present the results for the CVM and CHOICE samples respectively, without social characteristics. Results of the TRAD-CVM and MOD-CVM are included in the Table 6.2. All COST variables are negative and significant at the 0.05 level, the coefficients are nearly -0.02, which leads to the inference that COST (bid amount) has the same impact on policy decisions across the CVM policies. The CONSTANT terms are insignificant in the TRAD-CVM and (TRAD) MULT-CVM, and the terms show negative signs in the POOLED TRAD-CVM and corresponding MULT-CVM.

In the CHOICE results, sport fishing variables (INCF and DECF) are insignificant, while other variables are significant. This suggests that a larger amount and size of sport fishing does not influence the individuals' decisions for a policy of improving the Clinch River.

6.2.2 With Socioeconomic Variables

Table 6.4 presents that coefficients of the COST variables are negative and significant, when social characteristics, such as MALE, INCOME, BORN, BOAT, FISH, ECONOMY, and ENV, are included in the CVM and CHOICE models. However, most of socio economic variables are insignificant cross the all results. BOAT is positive and significant in the (TRAD) MULT-CVM and MOD-CVM. In the result of CHOICE, which is presented in Table 6.3, the variable is negative and significant for the interaction

Table 6.2. Binomial Logit Model, ALL CVM, Without SC

	TRAD-CVM						MOD-CVM					
Variable	CVM		MULT		POOLED		CVM		MULT		POOLED	
CONSTANT	0.43		-0.54	*	-0.06		0.51	*	0.48	*	0.48	**
COST	-0.02	**	-0.02	**	-0.02	**	-0.02	**	-0.03	**	-0.02	**
Number of observation	111.00		115.00		227.00		111.00		115.00		227.00	
Log-likelihood	-74.16		-60.83		-142.44		-72.43		-72.20		-145.93	
Log-likelihood (0)	-76.83		-63.83		-147.91		-76.83		-78.45		-156.37	
Chi-squared	5.69		5.99		10.93		11.63		12.49		0.07	
Degree of freedom	1.00		1.00		1.00		1.00		1.00		1.00	
Significance level	0.00		0.01		0.00		0.00		0.00		0.00	
McFadden	0.03		0.05		0.04		0.06		0.08		0.67	
Ben./Lerman	0.53		0.65		0.56		0.53		0.56		0.55	
Akaike I.C.	1.37		1.09		1.30		1.32		1.29		1.30	

*Significant at the 0.10 level
** Significant at the 0.05 level

Table 6.3. Conditional Logit Model, CHOICE

Variable	Without SC		With SC		BEST	
COST	-0.01	**	-0.01	**	-0.01	*
PRECOV	0.18	*	0.22	**	0.24	*
FRECOV	0.31	**	0.38	**	0.37	**
INCF	0.06		0.07		0.26	**
DECF	-0.19		-0.3	**	-0.40	**
GOODWQ	0.9	**	1.03	**	1.01	**
POORWQ	-0.97	**	-1.04	**	-1.08	**
ASC-01	0.09		-1.21	**	-8.94	**
ASC-02	-0.56	**	-0.85	*	-3.67	**
01xMAL			-0.15			
01xINC			0.13	**		
01xBOR			0.08			
01xBOA			0.67	*		
01xFIS			0.54	**		
01xECO			0.3			
01xENV			2.25	**	2.27	**
01xEDUC					0.60	**
01xCAMP					1.19	
01xMIMPOR					1.06	**
01xPOLVI					-0.16	
01xFISHLIC					0.78	**
02xMAL			-0.16			
02xINC			0.03			
02xBOR			0.05			
02xBOA			-0.42	*		
02xFIS			0.75	**		
02xECO			-0.02			
02xENV			1.75	*	2.05	**
02xEDUC					0.22	**
02xCAMP					2.41	**
02xMIMPOR					0.98	**
02xPOLVI					-0.25	**
02xFISHLIC					0.60	*
Chi-squared	558		558		558	
Log-likelihood	-506.94		-409.4		-341.99	
Chi-squared	99.56		143.27		182.03	
R-squared Adj.	0.08		0.13		0.27	

*Significant at the 0.10 level
** Significant at the 0.05 level

Table 6.4. Binomial Logit Model, ALL CVM, With SC

	TRAD-CVM						MOD-CVM					
variable	CVM		MULT		POOLED		CVM		MULT		POOLED	
CONSTANT	0.85		-0.83		0.22		0.22		0.08		0.25	
COST	-0.02	*	-0.02	**	-0.02	**	-0.03	**	-0.03	**	-0.03	**
MALE	0.24		0.00		0.00		0.00		0.00		0.00	
INCOME	0.00		0.00		0.00	**	0.00		0.00		0.00	
BORN	0.04		0.00		0.04		1.16	**	0.01		0.48	
BOAT	-0.12		1.03	**	0.34		2.36	**	0.75		1.11	
FISH	-0.47		0.00		-0.11		0.22		0.00		0.06	
ECONOMY	-0.74		0.11		-0.41		-0.28		0.59		0.10	*
ENV	-0.57		0.44		-0.19		1.67		0.99		0.87	
Number of observation	111		115		227		111		116		227	
Log-likelihood	-69.94		-57.40		-137.33		-61.05		-66.90		-133.82	
Log-likelihood (0)	-76.82		-63.83		-147.91		-76.83		-79.30		-156.37	
Chi-squared	13.91		12.86		21.16		31.67		27.49		45.11	
Degree of freedom	8.00		8.00		8.00		8.00		8.00		8.00	
Significance level	0.08		0.12		0.01		0.00		0.00		0.00	
McFadden	0.09		0.10		0.08		0.21		0.15		0.14	
Ben./Lerman	0.56		0.67		0.58		0.61		0.60		0.59	
Akaike I.C.	1.42		1.15		1.26		1.27		1.31		1.26	

*Significant at the 0.10 level
** Significant at the 0.05 level

with ASC2, although it is positively significant in the interaction with ASC1. Thus, it hardly be said that BOAT affects an individual's decision to choose a policy for the Clinch River.

Several other results have inconsistent impacts on the individuals' decisions. For instance, BORN is positive and significant only in the MOD-CVM. ENV and FISH are positive and significant in CHOICE but not elsewhere.

6.2.3 BEST

Table 6.5 shows the results for BEST. In the BEST model, COST variables are again all negative and significant in both CVM and CHOICE. The INCOME variables are positive and significant, but nearly zero across the CVM results. PEDUC, WORK, ENVORG, BOAT variables are positive and significant, and WHITE is negative and significant in some CVM results, but not in CHOICE. In CHOICE, EDUC, MIMPOR, and FISHLIC variables are positive and significant. Only the ENV variable is significantly positive across the CVM and CHOICE.

6.3 Welfare Estimates

A comparison of welfare estimates is shown in Table 6.6. The first finding from this comparison is that the welfare values derived from CHOICE are much higher than the ones derived from the corresponding CVM. The welfare values for CHOICE for the TRAD-CVM (Q3) scenario are the about twice as much as ones for TRAD-CVM. In the MOD-CVM (Q8) scenario, which is asking individuals about the improvement of three attributes (aquatic life, drinking water quality, and sport fish) together, the welfare values

Table 6.5. Binomial Logit Model, ALL CVM, BEST

	TRAD-CVM						MOD-CVM					
variable	CVM		MULT		POOLED		CVM		MULT		POOLED	
Constant	0.79	**	1.39		0.92		0.16		0.76		0.28	
COST	-0.02	**	-0.02	**	-0.02	**	-0.02	**	-0.04	**	-0.03	**
BORN	-0.88	**										
INCOME	0.00				0.00	*	0.00		0.00	*	0.00	**
PEDU	1.02	*			0.91	**			1.36	*	0.77	
WORK					3.58	**						
WHITE			-2.19	*	-1.08	**						
DRUG					-2.36	**	2.06	**	-2.02	*		
ENV							1.94	*			0.91	**
BOAT											1.00	*
BORN											0.52	*
ENVORG			1.32	**			0.73	*				
Number of observation	123.00		116.00		227.00		125.00		115.00		227.00	
Log-likelihood	-75.00		-55.51		-128.35		-70.48		-64.17		-132.68	
Log-likelihood (0)	-85.25		-64.11		-147.91		-86.45		-78.45		-156.37	
Chi-squared	20.51		17.20		39.12		31.94		28.57		47.38	
Degree of freedom	4.00		3.00		6.00		5.00		4.00		6.00	
Significance level	0.00		0.00		0.00		0.00		0.00		0.00	
McFadden	0.13		0.13		0.15		0.18		0.18		0.16	
Ben./Lerman	0.58		0.72		0.60		0.61		0.62		0.60	
Akaike I.C.	1.30		1.03		1.24		1.22		1.20		1.24	

*Significant at the 0.10 level
** Significant at the 0.05 level

Table 6.6. WTP, All Surveys, Without CVM

					TRAD-CVM					MOD-CVM
			Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
	Procedure		(W)	(S)	(A)	(W, S)	(S, A)	(W, A)	(W, S)	(W,S,A)
CVM	Standard	Mean			24.89					25.89
	K&R	Mean			23.91					29.13
	K&R	Median			24.38					29.11
MULT-CVM	Standard	Mean	21.00	-20.82	-27.93	-9.00	-31.45	12.24	4.29	16.93
	K&R	Mean	17.38	-12.94	-45.77	-23.57	-25.24	5.33	0.03	15.27
	K&R	Median	19.10	-20.05	-25.71	-9.40	-33.89	11.12	3.39	16.44
POOLED CVM	Standard	Mean			-4.10					20.08
	K&R	Mean			-9.67					20.36
	K&R	Median			-3.94					20.88
CHOICE	Standard	Mean	48.97	-81.16	54.83	38.79	44.92	174.77	38.79	164.87

W - questions asking an improvement of river water quality

S - questions asking an increase of sportfish

A - questions asking an improvement of aquatic life

K&R-Krinsky and Robb Procedure

from CHOICE are six times larger than the ones for the MOD-CVM. These results imply that differences in welfare values between CVM and CHOICE still exist even after equalizing the number of the substitutes between the two models.

Another finding from the comparisons is that the willingness to pay for aquatic life improvement in the TRAD-CVM and CHOICE are positive, while the ones in the MULT-CVM and POOLED TRAD-CVM are negative. The implication is that individuals respond differently when they are faced with a single policy outcome versus multiple questions. Moreover, this result suggests that the multiple CVM questions do not lead to the same welfare values as the choice models.

Chapter 7

Conclusion

This dissertation has examined differences in valuation of environmental attributes for residents of the Clinch River Valley derived from CVM and choice models. The focus has been on the survey design, in particular, the number of substitutes offered respondents and their experimental aspects. Three surveys were created for the substitute test: TRAD-CVM, which contained single "aquatic life" attribute improvement; MOD-CVM, which contained three attributes, "aquatic life, water quality, sport fishing," improvements; CHOICE, which has the same number of attributes as the MOD-CVM but in different format.

A finding from the substitute test is that welfare values for MOD-CVM are higher than the those derived from the TRAD-CVM, which implies that individuals recognize differences of attributes and complements within a protection regime. The second findings is that welfare values for CHOICE are much larger than for CVM alternatives even after equalizing the number of substitutes between the choice model and CVM.

The existence of experimental aspects in the choice model was suspected to be another cause of differences in the welfare estimates. Generally, the choice model presents an iterative question format; however, the CVM does not. To investigate this problem, a fourth survey was created, termed the MULT-CVM. In the MULT-CVM, individuals are asked the CVM questions repeatedly, thus mirroring the iterative nature of CHOICE. Both the TRAD-CVM and MULT-CVM are estimated for the same policy choice. The results exhibited that when individuals face multiple CVM questions, they

will respond differently from when they face only one question, inferring that experimental aspect leas to change individual decision behaviors. However, the role of experiment aspect does not play to reduce differences between CVM and choice models. The examination for the experimental aspect revealed that the welfare values in TRAD-CVM and MOD-CVM are higher than the corresponding MULT-CVM. Thus, it seems the compensating surplus measures estimated from the CHOICE are the largest, those from the TRAD-CVM and MOD-CVM are smaller, and those from MULT-CVM are the smallest.

Another finding from the MULT-CVM is embedding issues. Although the comparison between the TRAD-CVM and MOD-CVM suggested that individuals were sensitive about the attributes, the examination focused on only a policy for a single attribute (aquatic life) versus a combined policy for the tree attributes (aquatic life, water quality, sport fish). The MULT-CVM allowed us to compare welfare values for a variety of policies and test embedding for all three attributes in the survey. The results of the embedding test suggest that the welfare values for a combined policy for two individual attributes (aquatic life and sport fishing) are equivalent to the sum of the values of those individual attributes. However, once the water quality attribute is included, equivalence does not appear to be present. When water quality attributes are combined with the other attributes, the welfare values for the combined policy turns out to be much higher than the sum of the values of the corresponding individual attributes. This result suggests that when people face multinomial CVM questions, they are sensitive to the attributes, and they tend to overestimate if a combined policy includes an attribute which is their favorite.

The goal of this dissertation is to examine welfare values derived by the two models, focusing on substitute and experimental issues. This study revealed that the values derived by the two models differ even after eliminating the substitute and experimental setting problems. Causes of the dispersion need to be examined. Policy makers need appropriate techniques to estimate non-market values and provide individual true welfare values, to identify optimal policies.

For future studies, there are several suggestions. First, psychological aspects should be carefully examined for the significant dispersion between two models. Stevens, et al. (2000) and Alberini, et al. (2003) suggested that uncertain responses would bias the individual's welfare values upward. Ready, et al. (1998) noted that the choice model had a much higher "yes" rate than CVM. Indeed, in the choice model, because the policy never explicitly appears as an alternative in the survey, individuals might easily choose any options without careful consideration. Because of the complex choice format, the problem should be dealt with for the comparisons.

The second suggestion is statistical analysis. CVM estimates are derived by binominal logit model, while the CHOICE estimates are questioned by the conditional logit model. Affect of the different estimation techniques impact on welfare estimations needs to be studied. Also large standard errors in the choice model need to be dealt with.

The third suggestion is to sustain to the consistency in MULT-CVM. This study revealed that the question order bias exists in the model. Creating the different versions of the question order may reduce the problem.

The fifth suggestion concerns collecting data. The sample averages of bored on data collected by mail were biased upward in terms of income. Alternative survey

techniques, such as telephone or web surveys, should be used to see if they reduce this bias.

The last concern is reliability of the valuations. Because of hypothetical questions and large gap between the two models, examining reliability for the two models is one of the most significant concerns. Comparing WTP elicited by the two models with ones elicited by experimental laboratory tests should be explored to gather in formations about reliability of the models.

.

References

References

Adams, R. M., O. Bergland, W.N. Musser, S.L.Johnson, and M. Musser. "User Fees and Equity Issues in Public Hunting Expenditures: The Case of Ring-Necked Pheasant in Oregon." *Land Economics* 65 (1989): 376-385.

Adamowicz, Wictor,, J. Louviere, and M. Williams. "Combining Revealed and Stated Preference Methods for Valuing Environmental Amenities." *Journal of Environmental Economics and Management* 26 (1994): 271-292.

Adamowicz, Wictor., Peter Boxall, Michael Williams, and Jordan Louviere. "Stated Preference Approaches for Measuring Passive Use Values: Choice Experiments and Contingent Valuation." *American Journal of Agricultural Economics* 80 (1998): 64-75.

Alberini, Ann., Kevin Boyle, and Michael Welsh. "Using Multiple Bounded Question to Incorporate Preference Uncertainty in Non-market Valuation." Tenth Interim Report, W-133 Benefits and Costs Transfer in Natural Resource Planning, University of Reno, Reno, NV. (1997).

Alberni, Ann., Kevin Boyle, and Michael Welsh. "Analysis of Contingent Valuation data with Multiple bids and Response Options Allowing Respondents to Express Uncertainty." *Journal of Environmental Economics and Management* 25 (2003) 40-62.

Bateman, Ian J., Matthew Cole, Philip Cooper, Stavors Georgiou, David Hadley, and Gregory L. Poe. "On Visible Choice Sets and Scope Sensitivity." *Journal of Environmental Economics and Management* (Forthcoming).

Barrett, C., T. H. Stevens, and J. Willis. "Comparison of CV and Conjoint Analysis in Groundwater Valuation." Ninth Interim Report, W-133 Benefits and Costs Transfer in Natural Resource Planning, Department of Economics, Iowa State University, Ames, IA. (1996).

Ben-Akiva, Moshe, and Steven R. Lerman. *Discrete Choice Analysis*. MIT. Cambridge, MA. (1985).

Bergland, Olvar., Kristin Magnussen, and Stale Navrud. "Benefit Transfer: Testing for Accuracy and Reliability." *The Methodology of Comparative Environmental Economic Assessment* (2002): 117-132.

Bishop, Richard C. and Thomas A. Heberlein. "Measuring Values of Extramarket Goods: Are Indirect Measures Biased?" *American Journal of Agricultural Economics* 61 (1979): 220-225.

Boxall, P., W. Adamowicz, J Swait, M Williams, J. Louviere. "A Comparison of Stated Preference methods for environmental valuation." *Ecological Economics* 18 (1996): 243-253.

Cameron, Trudy Ann. "Combining Contingent Valuation and Travel Cost Data for the Valuation of Nonmarket Goods." *Land Economics* 68 (1992): 302-317.

Carlsson, Fedrik. and Peter Martinsson. "Do Hypothetical and Actual Marginal Willingness to Pay Differ in Choice Experiments?" *Journal of Environmental Economics and Management* 41 (2001): 179-192.

Carson, Richard T. and Robert C. Mitchell. "The Issue of Scope in Contingent Valuation Studies." *American Journal of Agricultural Economics* 75 (1993): 1263-1267.

Cooper. Joseph C. "A Comparison of Approaches to Calculating Confidence Intervals for Benefit Measures from Dichotomous Choice Contingent Valuation Surveys." *Land Economics* 70 (1994): 111-122.

Conover. W. J. *Practical Non-Parametric Statistics*. John Wiley and Sons. New York, NY. (1980).

Champ, P, R. Bishop, T. Brown, and D. McCollum. "Using Donation Mechanisms to Value Nonuse Benefits from Public Goods." *Journal of Environmental Economics Management* 32 (1997): 151-162.

Cramer. S. J. *The Logit Model*. Edward Arnold. New York. NY. (1990).

Deacon, Robert T., David S. Brookshire, Anthony C. Fisher, Allen V. Kneese, Charles D. Kolstad, David Scrogin, V. Kerry Smith, Michael Ward, and James Wilen. "Research Trends and Opportunities in Environmental natural Resource Economics." *Environmental and Resource Economics* 11 (1998): 383-397.

Desvousges, W.H., V. K. Smith, and A. Fisher. "Option Price Estimates for Water Quality Improvements: A Contingent Valuation Study for the Monogahela River."*Journal of Environmental Economics Management* 14 (1987): 248-267.

Diamond, P, and J. Hausman. "Contingent Valuation: Is Some Number Better Than No Number?" *Journal of Economic Perspectives* 8 (1994): 45-64.

Elkstrand, E., and J. Loomis. "Estimated Willingness to Pay for Protecting Critical habitat for Threatened and Endangered Fish with Respondent Uncertainty." Tenth Interim Report, W-133 Benefits and Costs Transfer in natural Resource Planning, University of Reno, Reno, NV. (1997).

Freeman, A. Myrick. *The Measurement of Environmental and Resource Values: Theory and Methods*. Resource for the Future. Washington D.C. (1993).

Garrod, Guy and Kenneth G. Willis. *Economic Valuation of the Environment: Methods and Case Study*. Edward Elgar. Northampton, MA. (1999).

Gan, C., and E. J. Luzar. "A Conjoint Analysis of Waterfowl Hunting in Louisiana." *Journal of Agricultural and Applied Economics* 25 (1993): 36-45.

Green, P. E. and V. Srinivasan. "Conjoint Analysis of Marketing: New Development With Implications for Research and Practice." *Journal of Marketing* 54 (1990): 1-19.

Greene, William H. *Econometric Analysis*. Prentice Hall. Upper Saddle River, NJ. (1997).

Greene, William H. *Limedep: Version 7.0 User's Manual*. Econometric Software Inc. Plainview, NY. (1998).

Haab, Timothy C. and Kenneth E. McConnell. *Valuing Environmental and Natural Resources*. Edward Elgar. Northampton, MA. (2003).

Haefele, Michelle A., and John B. Loomis. "Improving Statistical Efficiency and Testing Robustness of Conjoint Marginal Valuations.' *American Journal of Agricultural Economics* 2001: 1321-1327.

Hausman, A. J. Contributions to Economic Analysis. North-Holland. Elsevier Science. Amsterdam, Netherlands. (1993).

Hanemann, W. Michael. "Applied Welfare Analysis With Qualitative Response Models." Department of Agricultural and Resource Economics. Working Paper No. 241, *University of California, Berkeley*. Nov. (1982).

Hanemann, W. Michael. "Welfare Evaluation in Contingent Valuation Experiments with discrete Responses." *American Journal of Agricultural Economics* 66 (1984): 332-341.

Hanemann, W. Michael. "Valuing the Environment Thought Contingent Valuation." *Journal of Economic Perspectives* 8 (1994): 19-43.

Hanley, Nick, Jason F. Shorgren, and Ben White. *Environmental Economics: In Theory and Practice*. Oxford. New York, NY. (1997).

Irwin, J. R., P. Slovic, S. Lichtenstein, and G. McClelland. “Preference Reversals and the Management of Environmental Values.” *Journal of Risk Uncertain* 6 (1993): 5-18.

Kahneman, D. and J. L. Knetsch. “Valuing Public Goods: the Purchase of Moral Satisfaction.” *Journal of Environmental Economics and Management* 22 (1992): 57-70.

Krinsky, Itzhak. and A. Leslie Robb. “On Approximating the Statistics Properties of Elasticities.” *The Review of Economics and Statistics* 68 (1986): 715-719.

Long, J. Scott. *Regression Models for Categorical and Limited Dependent Variables.* SAGE. Thousand Oaks, CA. (1997).

Louviere, Jordan J. ”Conjoint Analysis Modeling of Stated Preferences: A Review of Theory, Methods, Recent Development and External Validity.” *Journal of Transportation Economic Policy* 10 (1988): 93-119.

Louviere, Jordan J. “Relating Stated Preference Measures and Models to Choices in Real Markets.” DOE/EPA Workshop on Using Contingent Valuation to Measure Nonmarket Values. Herdon, VA. May (1994).

Louviere, Jordan J., David A. Hensher, and Joffre D. Swait. *Stated Choice Methods: Analysis and Application.* Cambridge University (2000). Cambridge, UK.

Louviere, Jordan J., and H. Timmermans. ” Stated Preference and Choice Models Applies to Recreation Research” *Leisure Science* 12: 9-32.

Mitchell. Robert Cameron. and Richard T. Carson. Using Surveys to Value Public Goods. Resource for the Future. Washington D.C. (1989).

MaCkenzie, John. “A Comparison of Contingent Preference Models.” American Journal of Agricultural Economics 75 (1993): 593-603.

Maddala, G. S. Limited Dependent and Qualitative Variables in Econometrics. Cambridge. New York, NY. 1983.

Magat, W. A., W. K. Viscusi, and J. Huber. “Paired Comparison and Contingent Valuation Approach to Morbidity Risk Valuation. *Journal of Environmental Economics and Management* 15 (1988): 395-411.

McFadden, Daniel. “The Choice Theory Approach to Market Research.” *Marketing Science* 5 (1986): 275-297.

McFadden, Daniel. and Gregory K. Leonard. "Issues in the Contingent Valuation of Environmental Goods: Methodologies for Data Collection and Analysis." J.A. Hausman. (Ed). *Contingent Valuation: A Critical Assessment*. North-Holland. Amsterdam, Netherlands. (1993).

McIntosh, E. and M. Ryan. "Using Discrete Choice Experiments to Derive Welfare Estimates for the Provision of Elective Surgery: Implications of Discontinuous Preferences." *Journal of Economic Psychology* 23 (2002): 367-382.

McKenzie, J. "Comparison of Contingent Preference Models." *American Journal of Agricultural Economics* 75 (1993): 593-603.

McLean, David G. and Bill Mundy. "The Addition of Contingent Valuation and Conjoint Analysis to the Required Body of Knowledge for the Estimation of Environmental Damages to Real Property." *Journal of Real Estate Practice and Education* 1 (1998): 1-19.

Morrison, Mark., Jeff Bennett, and Russell Blamey. "Valuing Improved Wetland Quality Using Choice Modeling" *Water Resources Research* 35 (1999): 2805-2814.

Morrison, Mark., and Jeff Bennett. "Choice Modeling, Non-Use Values and Benefit Transfer." *Economic Analysis & Policy* 30 (2000): 13-32.

Park, Timothy., John B. Loomis, and Michael Creel. "Confidence Intervals for Evaluating Benefits Estimates From Dichotomous Choice Contingent Valuation Studies." *Land Economics* 37 (1991): 67-73.

Poe, Gregory L., Jeremy E. Clark, Daniel Rondeau, and William D. Schulze. "Provision Point Mechanisms and Field Validity Tests o Contingent Valuation." *Environmental and Resource Economics* 23 (2002): 105-131.

Pundney, Stepen. *Modeling Individual Choice*. Basil Blackwell. New York, NY. (1989).

Randall, Alan and John Stoll. "Existence Value in a Total Valuation Framework." *In Managing Air Quality and Science Resources at National Parks and Wildness Areas,* eds. R. D. Rowe and L.G. Chestnut. Westview Press. Boulder, CO. (1983).

Ready, R. J. Whitehead, and G. Blomquist. "Contingent Valuation when Respondents are Ambivalent." Journal of Environmental Economic Management 29 (1995): 181-197.

Roe, B., K. Boyle, and M. Teisl. “Using Conjoint Analysis to Derive Estimates of Compensating Variation.” *Journal of Environmental Economic Management* 31 (1996): 145-159.

Rolfe, J.C. and J.W. Bennett. “Testing for Framing Effects in Environmental Choice Modeling.” Choice Modeling Research Reports, Research Report 13 (2000), ISSN 1327-810. Australian National University, Canberra

San Miguel, Fernando., Mandy Ryan, and Anthony Scott. “Are Preferences Stable? The Case of Health Care.” *Journal of Economic Behavior & Organization* 48 (2002): 1-14.

Shuman, H. and S. Presser. *Questions and Answers in Attitude Surveys Experiments on Question From, Wording, and Context*. Academic Press. San Diego, CA. (1981).

Stevens, T. H., R. Belkner, D. Dennis, D. Kittredge, and C. Willis. "Comparison of Contingent Valuation and Conjoint Analysis in Ecosystem." *Ecological Economics* 32 (2000): 63-74.

Swallow, Stephen K., Thomas Weaver, James J. Opaluch, and Thomas S. Michelman. “Heterogeneous Preferences and Aggregation in Environmental Policy Analysis: A Landfill Sitting Case.” American Journal of Agricultural Economics 76 (1994): 431-443.

Thomas, L. R. *Introductory Econometrics*. Longman. New York, NY. (1993).

Wang, H. “Treatment of Don’t Know? Responses in Contingent Valuation Survey: A Random Valuation Model.” *Journal of Environmental Economic Management* 32 (1997): 219-232.

Wittink, D.R., and P. Cattin. “Commercial Use of Conjoint Analysis: An update.” *Journal of Marketing* 53 (1989): 91-96.

Appendixes

Appendix 1

CHOICE Survey

Clinch River Valley Survey

University of Tennessee/Washington and Lee University

CHOICE

Clinch/Powell Survey

Introduction: The University of Tennessee and Washington and Lee University are engaged in a research project to help us understand the value of environmental quality to people who live in the Clinch and Powell River Valleys of Virginia and Tennessee and explore alternative development options for the Valley. We would like your advice on issues in the Clinch River Valley. We have two major goals in this study. The first goal is to provide better information upon which decisions can be made about the future of the Clinch and Powell River Valleys. The second goal is to improve the methods that analysts use to assess peoples' preferences for environmental quality and alternative means of obtaining economic growth.

We would be grateful if you would take about 10-15 minutes to complete the attached survey that asks you to compare different options for the Clinch and Powell River Valleys. Your address was chosen at random. Your participation in this survey is completely voluntary. Should you choose to participate in our survey, your answers to all of our questions will remain confidential. The University of Tennessee releases no information as to how any particular individual answers surveys.

Please return in the enclosed envelope by November 15, 2002. First class postage is provided.

If you would like us to send you a copy of the study after it's completed, or if you have questions or comments contact:

Professor Steve Stewart
Department of Economics
University of Tennessee
505-A Stokeley Management Center
University of Tennessee
Knoxville, TN
37996-0550
(865) 974-1710
sstewar6@utk.edu

First, we would like to ask you some background questions.

1. What is the highest level of education you have completed?

☐ Elementary or some high school
☐ High school graduate/GED
☐ Trade or vocational certification
☐ Some college/Associates degree
☐ College graduate, or
☐ Post-graduate degree

2. How old are you? _______

3. Are you male or female? ______

4. If you had to choose from the following categories, what would you say is the single, biggest problem facing people in the Clinch River Valley today? Please check one.

Is it:
☐ Jobs and the economy
☐ Crime
☐ Public education
☐ Drug abuse
☐ Environmental quality
☐ Public health care
☐ Other - Please list__________________
☐ Don't know

Now, we would like to ask you several questions about water issues in the Clinch River Valley. These questions concern the approximately 175 mile stretch of river that runs from near the headwaters at Tazewell county in southwestern Virginia down to Norris Lake in northeastern Tennessee.

5. In the past year, have you spent any time on or along the Clinch River anywhere from the headwaters down to Norris Lake?

- ☐ Yes
- ☐ No

6. If you answered YES to question 5, approximately how many times did you go to the river in the past year? If you answered NO to question 5, skip to question 8.

- ☐ 1-2 Visits
- ☐ 3-5 Visits
- ☐ 6-10 Visits
- ☐ 11-20 Visits
- ☐ 21-50 Visits
- ☐ More than 50 visits

7. Which of the following activities did you participate in when you were there?

Please check one.

Did you:

- ☐ Fish
- ☐ Boat
- ☐ Hike
- ☐ Camp
- ☐ Work
- ☐ Picnic
- ☐ Bicycle
- ☐ Don't know/No answer
- ☐ Anything else? Please list ________________

8. Along the 175 mile stretch of river from the headwaters down to Norris Lake, the river provides many uses. Of the following uses, which do you think is the most important use of the river from the perspective of the citizens (including yourself) of the valley?
Please check one.

- ☐ Irrigation for farming
- ☐ Recreation, such as fishing, boating and hiking
- ☐ Industrial use, such as manufacturing processes
- ☐ Providing water for use in homes and yards
- ☐ Creating wetlands and woods along the banks
- ☐ Providing food and refuge for fish, birds and other animals
- ☐ Cultural and religious uses
- ☐ Other. Please list___________________
- ☐ Don't know

9. Do you recall seeing, reading, or hearing anything about water quality in the Clinch River in the past few months?

- ☐ Yes
- ☐ No

Background information on the Clinch River Valley

The upper Clinch and Powell Rivers represent some of the last free-flowing river segments in the Tennessee River system. Together, they drain approximately 3800 square miles of land area. The Clinch and Powell Valley has one of the most diverse concentrations of freshwater mussels and fish species of any river in North America. Many of the valley's mussel and fish species are on the decline. Twenty-two mussels and eleven fish species are listed as endangered or threatened. Moreover, the Clinch River Valley has many species that are found nowhere else. Of the 50 mussel species that are listed by the U.S. Fish and Wildlife Service as "Threatened" or "Endangered", 16 are found in the Clinch River Valley.

Ecologists believe that biodiversity is important for a number of reasons, including its contribution to the health of the ecosystem (diverse ecosystems can better withstand and recover from stressors such as drought). Mussel species are good indicators of the health of the ecosystem. Because mussels are very sensitive to pollution, poor water quality will often affect mussels before it has an impact on other species in the river and before it has a direct impact on human health.

Although employment in the region is increasingly migrating to the manufacturing, service, and tourism sectors, the economy of the valley has historically been based on coal mining and agriculture. More than 40% of coal production in Virginia occurs within the Clinch/Powell Valley and much of the discharge of pollutants in the region is not regulated.

The combined effects of raising livestock, pesticide runoff and soil erosion from farming, forest clearing for development, coal mining and processing, discharge from sewage treatment facilities and septic tanks, chemical spills, runoff from roads, parking lots, and chemically treated lawns decrease water quality and reduce mussel and fish abundance and diversity.

Evaluating Changes in Agriculture to Protect the Environment

One cause of reduced water quality in the river is that livestock get into the river, crushing mussels, eroding river banks, and muddying the water. Intensive cultivation of crops near the river allows fertilizers, pesticides, soil and other substances to contaminate the river as well.

These problems could be lessened by the development of an “agricultural free zone” in the immediate proximity of the river. This zone, where crop planting and grazing would be restricted, could be of different widths.

Farmers who keep cattle would need to construct fences to keep the livestock out of the exclusion zones. Fences would keep the cattle from trampling the mussels, reduce erosion and sedimentation of the river. Trees would shade the river water, reducing its summertime temperature and increasing the dissolved oxygen level, which would benefit aquatic life. As the pastures revert to more naturally occurring types of vegetation, songbird and wildlife populations could increase. The construction of fences and substitute watering facilities for the cattle, and the loss of the use of the land are costly for farmers. Farmers who grow crops would not be able to plant in the zones, which may be among their most fertile (and flattest) land holdings.

However, the farmers need not bear the full cost of the policy. A pilot project has been underway where non-profit organizations such as The Nature Conservancy have been compensating farmers who construct fences and take lands near the river out of production. This type of project could be expanded and funded through a small increase in taxes for everyone in the Clinch Valley. The questions below ask you to compare possible alternative policies. Another set of differences involve the levels of the environmental characteristics. These changes in agricultural practices may have effects on aquatic life, sportfish, and water quality. The ranges of these effects that we would like you to consider are as follows:

Aquatic life: includes all non-game fish and mussels. Changes are in terms of diversity, abundance and distribution throughout the watershed.

Continued Decline = continued decreases in diversity, abundance and distribution in the Clinch River and its tributaries.
Partial Recovery = some improvement in the Clinch River, but no improvement in tributaries
Full Recovery = improvement in the Clinch River and its tributaries

Sportfish: Includes smallmouth bass, trout, etc. Changes are in terms of number and average size.

No change = current numbers and distribution of sizes
Increase = 20% increase in Clinch and tributaries
Decrease = 20% decrease in Clinch and tributaries

General water quality: Changes are in terms of concentrations of selected toxic pollutants (copper, chromium, nickel, and zinc) and conventional ones (ammonia, phosphorous, pH**,** and dissolved oxygen).

Good = Water is suitable for primary contact such as swimming, and fish are edible.

Fair = Water is suitable for primary contact, but fish are not edible.

Poor = Water is suitable for neither primary contact nor fish consumption.

Cost to household: One way of financing improvements to the quality of the Clinch River is to ask residents of the valley to share in the costs of protection. Households could make voluntary contributions to a trust fund to be a non-profit agency. The proceeds of the trust fund would be used solely for the purpose of improving water quality in the Clinch River and its tributaries.

The questions that follow ask you to compare possible future conditions in the Clinch River Valley.

Question: 10
Which option for the future of agriculture and the environment in the Clinch Valley do you prefer the most, Option A, Option B, or Option C? Option C is the status quo, or what is currently happening and will continue to happen with no further environmental or agricultural policies. *Note that some of these options might not seem completely realistic in real life. We ask that you do your best to assume that each option is possible and then choose your most preferred option.*

	Option A	**Option B**	**Option C: No New Action**
Aquatic Life	full recovery	continued decline	continued decline
Sportfish	no change	no change	no change
Water quality	fair	poor	fair
Cost to Household ($ per year)	$100	$50	$0

Please check the option that you most prefer:

☐ Option A ☐ Option B ☐ Option C

Questions 11-17 are similar to question 10 , but the options that you are presented with have been altered. In all instances, Option C is the current situation in the valley. Options A and B change from question to question.

Question: 11
Which option for the future of agriculture and the environment in the Clinch Valley do you prefer the most, Option A, Option B, or Option C?

	Option A	**Option B**	**Option C: No New Action**
Aquatic Life	full recovery	partial recovery	continued decline
Sportfish	decrease	decrease	no change
Water quality	good	good	fair
Cost to Household ($ per year)	$25	$10	$0

Please check the option that you most prefer:

☐ Option A ☐ Option B ☐ Option C

Question: 12
Which option for the future of agriculture and the environment in the Clinch Valley do you prefer the most, Option A, Option B, or Option C?

	Option A	**Option B**	**Option C: No New Action**
Aquatic Life	partial recovery	continued recovery	continued decline
Sportfish	no change	increase	no change
Water quality	good	good	fair
Cost to Household ($ per year)	$5	$10	$0

Please check the option that you most prefer:

☐ Option A ☐ Option B ☐ Option C

Question: 13
Which option for the future of agriculture and the environment in the Clinch Valley do you prefer the most, Option A, Option B, or Option C?

	Option A	**Option B**	**Option C: No New Action**
Aquatic Life	full recovery	continued recovery	continued decline
Sportfish	increase	decrease	no change
Water quality	poor	fair	fair
Cost to Household ($ per year)	$5	$5	$0

Please check the option that you most prefer:

☐ Option A ☐ Option B ☐ Option C

Question: 14
Which option for the future of agriculture and the environment in the Clinch Valley do you prefer the most, Option A, Option B, or Option C?

	Option A	**Option B**	**Option C: No New Action**
Aquatic Life	partial recovery	continued recovery	continued decline
Sportfish	increase	increase	no change
Water quality	fair	good	fair
Cost to Household ($ per year)	$75	$100	$0

Please check the option that you most prefer:

☐ Option A ☐ Option B ☐ Option C

Question: 15
Which option for the future of agriculture and the environment in the Clinch Valley do you prefer the most, Option A, Option B, or Option C?

	Option A	**Option B**	**Option C: No New Action**
Aquatic Life	full recovery	full recovery	continued decline
Sportfish	increase	No change	no change
Water quality	good	fair	fair
Cost to Household ($ per year)	$50	$10	$0

Please check the option that you most prefer:

☐ Option A ☐ Option B ☐ Option C

Question: 16
Which option for the future of agriculture and the environment in the Clinch Valley do you prefer the most, Option A, Option B, or Option C?

	Option A	**Option B**	**Option C: No New Action**
Aquatic Life	full recovery	partial recovery	continued decline
Sportfish	decrease	No change	no change
Water quality	poor	poor	fair
Cost to Household ($ per year)	$75	$25	$0

Please check the option that you most prefer:

☐ Option A ☐ Option B ☐ Option C

Question: 17
Which option for the future of agriculture and the environment in the Clinch Valley do you prefer the most, Option A, Option B, or Option C?

	Option A	**Option B**	**Option C: No New Action**
Aquatic Life	**continued decline**	**partial recovery**	**continued decline**
Sportfish	**no change**	**decrease**	**no change**
Water quality	**good**	**poor**	**fair**
Cost to Household ($ per year)	**$75**	**$100**	**$0**

Please check the option that you most prefer:

☐ Option A ☐ Option B ☐ Option C

Finally, we need some basic background information about you.

18. What is the zip code at your primary residence? ________

19. Were you born in the Clinch River Valley?

- ☐ Yes
- ☐ No

20. What is the total number of years you have lived in the Clinch River Valley? ______

21. Including yourself, how many people currently live at your residence? _______

22. How many of those people are 18 or older? ______

23. With which political party do you identify?

- ☐ Republican party (or GOP)
- ☐ Democratic party
- ☐ Other party
- ☐ No party affiliation
- ☐ Green party
- ☐ Reform party
- ☐ Don't know/no answer
- ☐ Other___________

24. Do you completely, somewhat, or slightly identify with the party you identified above?

- ☐ Completely
- ☐ Somewhat
- ☐ Slightly
- ☐ Don't know/no answer

25. Which of the following categories best describes your political views?

- ☐ Strongly liberal
- ☐ Liberal
- ☐ Slightly liberal
- ☐ Middle of the road
- ☐ Slightly conservative
- ☐ Conservative
- ☐ Strongly conservative
- ☐ Don't know/no answer

26. Are you currently registered to vote?

- ☐ Yes
- ☐ No
- ☐ Don't know

27. Has anyone in your household purchased a Virginia or Tennessee fishing license within the last three years?

- ☐ Yes
- ☐ No
- ☐ Don't know

28. Does anyone in your household belong to any environmental organizations?

- ☐ Yes
- ☐ No
- ☐ Don't know

29. From the following options, do you consider yourself to be:

- ☐ American Indian
- ☐ Asian
- ☐ Black
- ☐ Hispanic
- ☐ White
- ☐ Refuse to answer
- ☐ Other

30. From the following broad income categories, please indicate the one that includes the estimated annual income for your household for .

- ☐ Less than $10,000
- ☐ $10 to $20,000
- ☐ $20 to $30,000
- ☐ $30 to $40,000
- ☐ $40 to $50,000
- ☐ $50 to $60,000
- ☐ $60 to $70,000
- ☐ $70 to $80,000
- ☐ $80 to $90,000
- ☐ $90 to $100,000
- ☐ More than $100,000
- ☐ Don't know

31. What is your profession or major source of income, i.e., school teacher, farmer, rancher, lawyer, retired, etc ? _______________

Thank you very much for taking the time to complete this survey! Your help is very much appreciated. The answers you provided to us will remain confidential.

Appendix 2

TRAD-CVM survey

Clinch River Valley Survey

University of Tennessee/Washington and Lee University

TRAD-CVM-A5-2

Clinch/Powell Survey

Introduction: The University of Tennessee and Washington and Lee University are engaged in a research project to help us understand the value of environmental quality to people who live in the Clinch and Powell River Valleys of Virginia and Tennessee and explore alternative development options for the Valley. We would like your advice on issues in the Clinch River Valley. We have two major goals in this study. The first goal is to provide better information upon which decisions can be made about the future of the Clinch and Powell River Valleys. The second goal is to improve the methods that analysts use to assess peoples' preferences for environmental quality and alternative means of obtaining economic growth.

We would be grateful if you would take about 10-15 minutes to complete the attached survey that asks you to compare different options for the Clinch and Powell River Valleys. Your address was chosen at random. Your participation in this survey is completely voluntary. Should you choose to participate in our survey, your answers to all of our questions will remain confidential. The University of Tennessee releases no information as to how any particular individual answers surveys.

Please return in the enclosed envelope by November 15, 2002. First class postage is provided.

If you would like us to send you a copy of the study after it's completed, or if you have questions or comments contact:

Professor Steve Stewart
Department of Economics
University of Tennessee
505-A Stokeley Management Center
University of Tennessee
Knoxville, TN
37996-0550
(865) 974-1710
sstewar6@utk.edu

First, we would like to ask you some background questions.

1. What is the highest level of education you have completed?

- ☐ Elementary or some high school
- ☐ High school graduate/GED
- ☐ Trade or vocational certification
- ☐ Some college/Associates degree
- ☐ College graduate, or
- ☐ Post-graduate degree

2. How old are you? _______

3. Are you male or female? ______

4. If you had to choose from the following categories, what would you say is the single, biggest problem facing people in the Clinch River Valley today? Please check one.

Is it:

- ☐ Jobs and the economy
- ☐ Crime
- ☐ Public education
- ☐ Drug abuse
- ☐ Environmental quality
- ☐ Public health care
- ☐ Other - Please list___________________
- ☐ Don't know

Now, we would like to ask you several questions about water issues in the Clinch River Valley. These questions concern the approximately 175 mile stretch of river that runs from near the headwaters at Tazewell county in southwestern Virginia down to Norris Lake in northeastern Tennessee.

5. In the past year, have you spent any time on or along the Clinch River anywhere from the headwaters down to Norris Lake?

☐ Yes
☐ No

6. If you answered YES to question 5, approximately how many times did you go to the river in the past year? If you answered NO to question 5, skip to question 8.

☐ 1-2 Visits
☐ 3-5 Visits
☐ 6-10 Visits
☐ 11-20 Visits
☐ 21-50 Visits
☐ More than 50 visits

7. Which of the following activities did you participate in when you were there?

Please check one.

Did you:

☐ Fish
☐ Boat
☐ Hike
☐ Camp
☐ Work
☐ Picnic
☐ Bicycle
☐ Don't know/No answer
☐ Anything else? Please list ________________

8. Along the 175 mile stretch of river from the headwaters down to Norris Lake, the river provides many uses. Of the following uses, which do you think is the most important use of the river from the perspective of the citizens (including yourself) of the valley? Please check one.

- ☐ Irrigation for farming
- ☐ Recreation, such as fishing, boating and hiking
- ☐ Industrial use, such as manufacturing processes
- ☐ Providing water for use in homes and yards
- ☐ Creating wetlands and woods along the banks
- ☐ Providing food and refuge for fish, birds and other animals
- ☐ Cultural and religious uses
- ☐ Other. Please list__________________
- ☐ Don't know

9. Do you recall seeing, reading, or hearing anything about water quality in the Clinch River in the past few months?

- ☐ Yes
- ☐ No

Background information on the Clinch River Valley

The upper Clinch and Powell Rivers represent some of the last free-flowing river segments in the Tennessee River system. Together, they drain approximately 3800 square miles of land area. The Clinch and Powell Valley has one of the most diverse concentrations of freshwater mussels and fish species of any river in North America. Many of the valley's mussel and fish species are on the decline. Twenty-two mussels and eleven fish species are listed as endangered or threatened. Moreover, the Clinch River Valley has many species that are found nowhere else. Of the 50 mussel species that are listed by the U.S. Fish and Wildlife Service as "Threatened" or "Endangered", 16 are found in the Clinch River Valley.

Ecologists believe that biodiversity is important for a number of reasons, including its contribution to the health of the ecosystem (diverse ecosystems can better withstand and recover from stressors such as drought). Mussel species are good indicators of the health of the ecosystem. Because mussels are very sensitive to pollution, poor water quality will often affect mussels before it has an impact on other species in the river and before it has a direct impact on human health.

Although employment in the region is increasingly migrating to the manufacturing, service, and tourism sectors, the economy of the valley has historically been based on coal mining and agriculture. More than 40% of coal production in Virginia occurs within the Clinch/Powell Valley and much of the discharge of pollutants in the region is not regulated.

The combined effects of raising livestock, pesticide runoff and soil erosion from farming, forest clearing for development, coal mining and processing, discharge from sewage treatment facilities and septic tanks, chemical spills, runoff from roads, parking lots, and chemically treated lawns decrease water quality and reduce mussel and fish abundance and diversity.

Evaluating Changes in Agriculture to Protect the Environment

One cause of reduced water quality in the river is that livestock get into the river, crushing mussels, eroding river banks, and muddying the water. Intensive cultivation of crops near the river allows fertilizers, pesticides, soil and other substances to contaminate the river as well.

These problems could be lessened by the development of an "agricultural free zone" in the immediate proximity of the river. This zone, where crop planting and grazing would be restricted, could be of different widths.

Farmers who keep cattle would need to construct fences to keep the livestock out of the exclusion zones. Fences would keep the cattle from trampling the mussels, reduce erosion and sedimentation of the river. Trees would shade the river water, reducing its summertime temperature and increasing the dissolved oxygen level, which would benefit aquatic life. As the pastures revert to more naturally occurring types of vegetation, songbird and wildlife populations could increase. The construction of

vegetation, songbird and wildlife populations could increase. The construction of fences and substitute watering facilities for the cattle, and the loss of the use of the land are costly for farmers. Farmers who grow crops would not be able to plant in the zones, which may be among their most fertile (and flattest) land holdings.

However, the farmers need not bear the full cost of the policy. A pilot project has been underway where non-profit organizations such as The Nature Conservancy have been compensating farmers who construct fences and take lands near the river out of production. This type of project could be expanded and funded through voluntary contributions to a non-profit agency to provide funding for these changes in agricultural operations.

Question: 10

Now, we would like to ask you a question about the dollar value your household would place on a project to provide funding for farmers to create an agriculture free zone. This project would create a special trust fund operated by a non-profit foundation. Such a foundation would accept voluntary contributions to be used for the purchase of rights to construct agricultural free zones. Keep in mind that we are asking a hypothetical question only. We are not requesting any money from you, we only want to get an idea of what kind of value you place on this program.

The project would lead to the recovery of habitat for non-game fish and mussels in the Clinch River and its tributaries. We would like you to *assume that water quality for purposes other than recovery of non-game fish species and sportfish would not change nor would the number of sportfish*. $5.00 each year from each household will be needed to implement the program . Please consider the program and then indicate if you would contribute to such a trust fund. The proceeds of the trust fund would be used solely for the purpose of improving water quality River and its tributaries.

Aquatic Life	full recovery
Sportfish	no change
Water quality	fair
Cost to Household ($ per year)	$5.00

Would you contribute the requested amount for the habitat improvements?

☐ Yes ☐ No

Question: 11
What is the maximum you wound contribute to the trust fund on a yearly basis to provide habitat improvements on the Clinch River and its tributaries?

$

If your answer to Question 11 was zero, please tell us
Why____

Finally, we need some basic background information about you.

12. What is the zip code at your primary residence? ________

13. Were you born in the Clinch River Valley?
- ☐ Yes
- ☐ No

14. What is the total number of years you have lived in the Clinch River Valley? ______

15. Including yourself, how many people currently live at your residence? _______

16. How many of those people are 18 or older? ______

17. With which political party do you identify?

- ☐ Republican party (or GOP)
- ☐ Democratic party
- ☐ Other party
- ☐ No party affiliation
- ☐ Green party
- ☐ Reform party
- ☐ Don't know/no answer
- ☐ Other___________

18. Do you completely, somewhat, or slightly identify with the party you identified above?

- ☐ Completely
- ☐ Somewhat
- ☐ Slightly
- ☐ Don't know/no answer

19. Which of the following categories best describes your political views?

- ☐ Strongly liberal
- ☐ Liberal
- ☐ Slightly liberal
- ☐ Middle of the road
- ☐ Slightly conservative
- ☐ Conservative
- ☐ Strongly conservative
- ☐ Don't know/no answer

20. Are you currently registered to vote?

- ☐ Yes
- ☐ No
- ☐ Don't know

21. Has anyone in your household purchased a Virginia or Tennessee fishing license within the last three years?

- ☐ Yes
- ☐ No
- ☐ Don't know

22. Does anyone in your household belong to any environmental organizations?

- ☐ Yes
- ☐ No
- ☐ Don't know

23. From the following options, do you consider yourself to be:

- ☐ American Indian
- ☐ Asian
- ☐ Black
- ☐ Hispanic
- ☐ White
- ☐ Refuse to answer
- ☐ Other

Please continue to next page

24. From the following broad income categories, please indicate the one that includes the estimated annual income for your household for 1999.

☐ Less than $10,000
☐ $10 to $20,000
☐ $20 to $30,000
☐ $30 to $40,000
☐ $40 to $50,000
☐ $50 to $60,000
☐ $60 to $70,000
☐ $70 to $80,000
☐ $80 to $90,000
☐ $90 to $100,000
☐ More than $100,000
☐ Don't know

25. What is your profession or major source of income, i.e., school teacher, farmer, rancher, lawyer, retired, etc ? _______________

Thank you very much for taking the time to complete this survey! Your help is very much appreciated. The answers you provided to us will remain confidential.

Appendix 3

MOD-CVM Survey

Clinch River Valley Survey

University of Tennessee/Washington and Lee University

MOD-CVM-A5-2

Clinch/Powell Survey

Introduction: The University of Tennessee and Washington and Lee University are engaged in a research project to help us understand the value of environmental quality to people who live in the Clinch and Powell River Valleys of Virginia and Tennessee and explore alternative development options for the Valley. We would like your advice on issues in the Clinch River Valley. We have two major goals in this study. The first goal is to provide better information upon which decisions can be made about the future of the Clinch and Powell River Valleys. The second goal is to improve the methods that analysts use to assess peoples' preferences for environmental quality and alternative means of obtaining economic growth.

We would be grateful if you would take about 10-15 minutes to complete the attached survey that asks you to compare different options for the Clinch and Powell River Valleys. Your address was chosen at random. Your participation in this survey is completely voluntary. Should you choose to participate in our survey, your answers to all of our questions will remain confidential. The University of Tennessee releases no information as to how any particular individual answers surveys.

Please return in the enclosed envelope by November 15, 2002. First class postage is provided.

If you would like us to send you a copy of the study after it's completed, or if you have questions or comments contact:

Professor Steve Stewart
Department of Economics
University of Tennessee
505-A Stokeley Management Center
University of Tennessee
Knoxville, TN
37996-0550
(865) 974-1710
sstewar6@utk.edu

First, we would like to ask you some background questions.

1. What is the highest level of education you have completed?

- ☐ Elementary or some high school
- ☐ High school graduate/GED
- ☐ Trade or vocational certification
- ☐ Some college/Associates degree
- ☐ College graduate, or
- ☐ Post-graduate degree

2. How old are you? _______

3. Are you male or female? ______

4. If you had to choose from the following categories, what would you say is the single, biggest problem facing people in the Clinch River Valley today? Please check one.

Is it:

- ☐ Jobs and the economy
- ☐ Crime
- ☐ Public education
- ☐ Drug abuse
- ☐ Environmental quality
- ☐ Public health care
- ☐ Other - Please list__________________
- ☐ Don't know

Now, we would like to ask you several questions about water issues in the Clinch River Valley. These questions concern the approximately 175 mile stretch of river that runs from near the headwaters at Tazewell county in southwestern Virginia down to Norris Lake in northeastern Tennessee.

5. In the past year, have you spent any time on or along the Clinch River anywhere from the headwaters down to Norris Lake?

- ☐ Yes
- ☐ No

6. If you answered YES to question 5, approximately how many times did you go to the river in the past year? If you answered NO to question 5, skip to question 8.

- ☐ 1-2 Visits
- ☐ 3-5 Visits
- ☐ 6-10 Visits
- ☐ 11-20 Visits
- ☐ 21-50 Visits
- ☐ More than 50 visits

7. Which of the following activities did you participate in when you were there?

Please check one.

Did you:

- ☐ Fish
- ☐ Boat
- ☐ Hike
- ☐ Camp
- ☐ Work
- ☐ Picnic
- ☐ Bicycle
- ☐ Don't know/No answer
- ☐ Anything else? Please list ________________

8. Along the 175 mile stretch of river from the headwaters down to Norris Lake, the river provides many uses. Of the following uses, which do you think is the most important use of the river from the perspective of the citizens (including yourself) of the valley?

Please check one.

- ☐ Irrigation for farming
- ☐ Recreation, such as fishing, boating and hiking
- ☐ Industrial use, such as manufacturing processes
- ☐ Providing water for use in homes and yards
- ☐ Creating wetlands and woods along the banks
- ☐ Providing food and refuge for fish, birds and other animals
- ☐ Cultural and religious uses
- ☐ Other. Please list__________________
- ☐ Don't know

9. Do you recall seeing, reading, or hearing anything about water quality in the Clinch River in the past few months?

- ☐ Yes
- ☐ No

Background information on the Clinch River Valley

The upper Clinch and Powell Rivers represent some of the last free-flowing river segments in the Tennessee River system. Together, they drain approximately 3800 square miles of land area. The Clinch and Powell Valley has one of the most diverse concentrations of freshwater mussels and fish species of any river in North America. Many of the valley's mussel and fish species are on the decline. Twenty-two mussels and eleven fish species are listed as endangered or threatened. Moreover, the Clinch River Valley has many species that are found nowhere else. Of the 50 mussel species that are listed by the U.S. Fish and Wildlife Service as "Threatened" or "Endangered", 16 are found in the Clinch River Valley.

Ecologists believe that biodiversity is important for a number of reasons, including its contribution to the health of the ecosystem (diverse ecosystems can better withstand and recover from stressors such as drought). Mussel species are good indicators of the health of the ecosystem. Because mussels are very sensitive to pollution, poor water quality will often affect mussels before it has an impact on other species in the river and before it has a direct impact on human health.

Although employment in the region is increasingly migrating to the manufacturing, service, and tourism sectors, the economy of the valley has historically been based on coal mining and agriculture. More than 40% of coal production in Virginia occurs within the Clinch/Powell Valley and much of the discharge of pollutants in the region is not regulated.

The combined effects of raising livestock, pesticide runoff and soil erosion from farming, forest clearing for development, coal mining and processing, discharge from sewage treatment facilities and septic tanks, chemical spills, runoff from roads, parking lots, and chemically treated lawns decrease water quality and reduce mussel and fish abundance and diversity.

Evaluating Changes in Agriculture to Protect the Environment

One cause of reduced water quality in the river is that livestock get into the river, crushing mussels, eroding river banks, and muddying the water. Intensive cultivation of crops near the river allows fertilizers, pesticides, soil and other substances to contaminate the river as well.

These problems could be lessened by the development of an "agricultural free zone" in the immediate proximity of the river. This zone, where crop planting and grazing would be restricted, could be of different widths.

Farmers who keep cattle would need to construct fences to keep the livestock out of the exclusion zones. Fences would keep the cattle from trampling the mussels, reduce erosion and sedimentation of the river. Trees would shade the river water, reducing its summertime temperature and increasing the dissolved oxygen level, which would benefit aquatic life. As the pastures revert to more naturally occurring types of vegetation, songbird and wildlife populations could increase. The construction of

vegetation, songbird and wildlife populations could increase. The construction of fences and substitute watering facilities for the cattle, and the loss of the use of the land are costly for farmers. Farmers who grow crops would not be able to plant in the zones, which may be among their most fertile (and flattest) land holdings.

However, the farmers need not bear the full cost of the policy. A pilot project has been underway where non-profit organizations such as The Nature Conservancy have been compensating farmers who construct fences and take lands near the river out of production. This type of project could be expanded and funded through voluntary contributions to a non-profit agency to provide funding for these changes in agricultural operations.

Question: 10

Now, we would like to ask you a question about the dollar value your household would place on a project to provide funding for farmers to create an agriculture free zone. This project would create a special trust fund operated by a non-profit foundation. Such a foundation would accept voluntary contributions to be used for the purchase of rights to construct agricultural free zones. Keep in mind that we are asking a hypothetical question only. We are not requesting any money from you, we only want to get an idea of what kind of value you place on this program.

The project would lead to the recovery of habitat for non-game fish and mussels in the Clinch River and its tributaries. *Habitat for sportfish species and general water quality would most likely increase as well*. $5.00 each year from each household will be needed to implement the program. Please consider the program and then indicate if you would contribute to such a trust fund. The proceeds of the trust fund would be used solely for the purpose of improving water quality River and its tributaries.

Aquatic Life	Full recovery
Sportfish	Increase
Water quality	Good
Cost to Household ($ per year)	$5.00

Would you contribute the requested amount for the habitat improvements?

☐ Yes ☐ No

Question: 11
What is the maximum you wound contribute to the trust fund on a yearly basis to provide habitat improvements on the Clinch River and its tributaries?

$

If your answer to Question 11 was zero, please tell us
Why____

Finally, we need some basic background information about you.

12. What is the zip code at your primary residence? ________

13. Were you born in the Clinch River Valley?
- ☐ Yes
- ☐ No

14. What is the total number of years you have lived in the Clinch River Valley? ______

15. Including yourself, how many people currently live at your residence? _______

16. How many of those people are 18 or older? ______

17. With which political party do you identify?

- ☐ Republican party (or GOP)
- ☐ Democratic party
- ☐ Other party
- ☐ No party affiliation
- ☐ Green party
- ☐ Reform party
- ☐ Don't know/no answer
- ☐ Other___________

18. Do you completely, somewhat, or slightly identify with the party you identified above?

- ☐ Completely
- ☐ Somewhat
- ☐ Slightly
- ☐ Don't know/no answer

19. Which of the following categories best describes your political views?

- ☐ Strongly liberal
- ☐ Liberal
- ☐ Slightly liberal
- ☐ Middle of the road
- ☐ Slightly conservative
- ☐ Conservative
- ☐ Strongly conservative
- ☐ Don't know/no answer

20. Are you currently registered to vote?

- ☐ Yes
- ☐ No
- ☐ Don't know

21. Has anyone in your household purchased a Virginia or Tennessee fishing license within the last three years?

☐ Yes
☐ No
☐ Don't know

22. Does anyone in your household belong to any environmental organizations?

☐ Yes
☐ No
☐ Don't know

23. From the following options, do you consider yourself to be:

☐ American Indian
☐ Asian
☐ Black
☐ Hispanic
☐ White
☐ Refuse to answer
☐ Other

Please continue to next page

24. From the following broad income categories, please indicate the one that includes the estimated annual income for your household for 1999.

- ☐ Less than $10,000
- ☐ $10 to $20,000
- ☐ $20 to $30,000
- ☐ $30 to $40,000
- ☐ $40 to $50,000
- ☐ $50 to $60,000
- ☐ $60 to $70,000
- ☐ $70 to $80,000
- ☐ $80 to $90,000
- ☐ $90 to $100,000
- ☐ More than $100,000
- ☐ Don't know

25. What is your profession or major source of income, i.e., school teacher, farmer, rancher, lawyer, retired, etc ? _______________

Thank you very much for taking the time to complete this survey! Your help is very much appreciated. The answers you provided to us will remain confidential.

Appendix 4

MULT-CVM Survey

Clinch River Valley Survey

University of Tennessee/Washington and Lee University/University of Arizona

Introduction: The University of Tennessee, Washington and Lee University, and the University of Arizona are engaged in a research project to help us understand the value of environmental quality to people who live in the Clinch and Powell River Valleys of Virginia and Tennessee and explore alternative development options for the Valley. We would like your advice on issues in the Clinch River Valley. We have two major goals in this study. The first goal is to provide better information upon which decisions can be made about the future of the Clinch and Powell River Valleys. The second goal is to improve the methods that analysts use to assess peoples' preferences for environmental quality and alternative means of obtaining economic growth.

We would be grateful if you would take about 10-15 minutes to complete the attached survey that asks you to compare different options for the Clinch and Powell River Valleys. Your address was chosen at random. Your participation in this survey is completely voluntary. Should you choose to participate in our survey, your answers to all of our questions will remain confidential. The University of Tennessee releases no information as to how any particular individual answers surveys.

Please return in the enclosed envelope by March 20, 2003. First class postage is provided.

If you would like us to send you a copy of the study after it's completed, or if you have questions or comments contact:

Yuki Takatsuka
Department of Economics
University of Tennessee
505-A Stokeley Management Center
University of Tennessee
Knoxville, TN
37996-0550
(865) 974-3303
ytakatsu@utk.edu

Professor Jim Kahn
Director, Department of Environmental Studies
Washington and Lee University

Professor Steven Stewart
Department of Hydrology and Water Resources
University of Arizona

First, we would like to ask you some background questions.

1. What is the highest level of education you have completed?

1. ☐ Elementary or some high school
2. ☐ High school graduate/GED
3. ☐ Trade or vocational certification
4. ☐ Some college/Associates degree
5. ☐ College graduate, or
6. ☐ Post-graduate degree

2. How old are you?_____________

3. Are you male or female?

4. If you had to choose from the following categories, what would you say is the single, biggest problem facing people in the Clinch River Valley today? *Please check **one**.*

Is it:

1. ☐ Jobs and the economy
2. ☐ Crime
3. ☐ Public education
4. ☐ Drug abuse
5. ☐ Environmental quality
6. ☐ Public health care
7. ☐ Other - Please list__________________
8. ☐ Don't know

Now, we would like to ask you several questions about water issues in the Clinch River Valley. These questions concern the approximately 175 mile stretch of river that runs from near the headwaters at Tazewell county in southwestern Virginia down to Norris Lake in northeastern Tennessee.

5. In the past year, have you spent any time on or along the Clinch River anywhere from the headwaters down to Norris Lake?

☐ Yes ☐ No

6. If you answered YES to question 5, approximately how many times did you go to the river in the past year? If you answered NO to question 5, skip to question 8.

☐ 1-2 Visits
☐ 3-5 Visits
☐ 6-10 Visits
☐ 11-20 Visits
☐ 21-50 Visits
☐ More than 50 visits

7. Which of the following activities did you participate in when you were there?

Please check **one** you did most.

Did you:

1. ☐ Fish
2. ☐ Boat
3. ☐ Hike
4. ☐ Camp
5. ☐ Work
6. ☐ Picnic
7. ☐ Bicycle
8. ☐ Don't know/No answer
9. ☐ Anything else? Please list ________________

8 Along the 175 mile stretch of river from the headwaters down to Norris Lake, the river provides many uses. Of the following uses, which do you think is the most important use of the river from the perspective of the citizens (including yourself) of the valley?

Please check **one.**

☐ Irrigation for farming
☐ Recreation, such as fishing, boating and hiking
☐ Industrial use, such as manufacturing processes
☐ Providing water for use in homes and yards
☐ Creating wetlands and woods along the banks
☐ Providing food and refuge for fish, birds and other animals
☐ Cultural and religious uses
☐ Other. Please list____________________
☐ Don't know

9. Do you recall seeing, reading, or hearing anything about water quality in the Clinch River in the past few months?

☐ Yes ☐ No

Background information on the Clinch River Valley

The upper Clinch and Powell Rivers represent some of the last free-flowing river segments in the Tennessee River system. Together, they drain approximately 3800 square miles of land area. The Clinch and Powell Valley has one of the most diverse concentrations of freshwater mussels and fish species of any river in North America. Many of the valley's mussel and fish species are on the decline. Twenty-two mussels and eleven fish species are listed as endangered or threatened. Moreover, the Clinch River Valley has many species that are found nowhere else. Of the 50 mussel species that are listed by the U.S. Fish and Wildlife Service as "Threatened" or "Endangered", 16 are found in the Clinch River Valley.
Ecologists believe that biodiversity is important for a number of reasons, including its contribution to the health of the ecosystem (diverse ecosystems can better withstand and recover from stressors such as drought). Mussel species are good indicators of the health of the ecosystem. Because mussels are very sensitive to pollution, poor water quality will often affect mussels before it has an impact on other species in the river and before it has a direct impact on human health.

Although employment in the region is increasingly migrating to the manufacturing, service, and tourism sectors, the economy of the valley has historically been based on coal mining and agriculture. More than 40% of coal production in Virginia occurs within the Clinch/Powell Valley and much of the discharge of pollutants in the region is not regulated.

The combined effects of raising livestock, pesticide runoff and soil erosion from farming, forest clearing for development, coal mining and processing, discharge from sewage treatment facilities and septic tanks, chemical spills, runoff from roads, parking lots, and chemically treated lawns decrease water quality and reduce mussel and fish abundance and diversity.

Evaluating Changes in Agriculture to Protect the Environment

One cause of reduced water quality in the river is that livestock get into the river, crushing mussels, eroding river banks, and muddying the water. Intensive cultivation of crops near the river allows fertilizers, pesticides, soil and other substances to contaminate the river as well.

These problems could be partially addressed by the development of an "agricultural free zone" in the immediate proximity of the river. This zone, where crop planting and grazing would be restricted, could be of different widths.

Farmers who keep cattle would need to construct fences to keep the livestock out of the exclusion zones. Fences would keep the cattle from trampling the mussels, reduce erosion and sedimentation of the river. Trees would shade the river water, reducing its summertime temperature and increasing the dissolved oxygen level, which would benefit aquatic life. As the pastures revert to more naturally occurring types of vegetation, songbird and wildlife populations could increase. The construction of fences and substitute watering facilities for the cattle, and the loss of the use of the land are costly for farmers. Farmers who grow crops would not be able to plant in the zones, which may be among their most fertile (and flattest) land holdings.

However, farmers need not bear the full cost of the policy. A pilot project is underway where non-profit organizations such as The Nature Conservancy have been compensating farmers who construct fences and take lands near the river out of production. This type of project could be expanded and funded through voluntary contributions by those living in the Clinch Valley. The questions below ask you to compare possible alternative policies. Another set of differences involve the levels of the environmental characteristics. These changes in agricultural practices may have effects on aquatic life, sportfish, and water quality. The ranges of these effects that we would like you to consider are as follows:

Aquatic life: includes all non-game fish and mussels. Changes are in terms of diversity, abundance and distribution throughout the watershed.

Continued Decline = continued decreases in diversity, abundance and distribution in the Clinch River and its tributaries.

Partial Recovery = some improvement in the Clinch River, but no improvement in tributaries

Full Recovery = improvement in the Clinch River and its tributaries

Sportfish: Includes smallmouth bass, trout, etc. Changes are in terms of number and average size.

No change = current numbers and distribution of sizes

Increase = 20% increase in Clinch and tributaries

Decrease = 20% decrease in Clinch and tributaries

General water quality: Changes are in terms of concentrations of selected toxic pollutants (copper, chromium, nickel, and zinc) and conventional ones (ammonia, phosphorous, pH, and dissolved oxygen).

Good = Water is suitable for primary contact such as swimming, and fish are edible.

Fair = Water is suitable for primary contact, but fish are not edible. Current level of quality.

Poor = Water is suitable for neither primary contact nor fish consumption.

Cost to household: One way of financing improvements to the quality of the Clinch River is to ask residents of the valley to share in the costs of protection. Households could make voluntary contributions to a trust fund administered by a non-profit agency. The proceeds of the trust fund would be used solely for the purpose of improving water quality in the Clinch River and its tributaries.

The questions that follow ask you to compare possible future conditions in the Clinch River Valley. We will present several different policies, each having differing costs and combinations of aquatic life, sportfish, and water quality. There is no relationship between Questions 10 through 17 and we would like for you to consider them independently.

Question: 10

Now, we would like to ask you a question about the dollar value your household would place on a project to provide funding for farmers to create an agriculture free zone. This project would create a special trust fund operated by a non-profit foundation. Such a foundation would accept voluntary contributions to be used for the purchase of rights to construct agricultural free zones. Keep in mind that we are asking a hypothetical question only. We are not requesting any money from you, we only want to get an idea of what kind of value you place on this program.

The project would lead to the following conditions. $75.00 each year from each household will be needed to implement the program . Please consider the program and then indicate if you would contribute to such a trust fund. The proceeds of the trust fund would be used solely for the purpose of improving water quality for non-sportfish aquatic life, sportfish, or general water quality in the Clinch River and its tributaries.

Aquatic Life	**partial recovery**
Sportfish	**increase**
Water quality	**current conditions**
Cost to Household ($ per year)	**$75**

Would you contribute the requested amount for the program?

☐ **Yes** ☐ **No**

Questions 11-17 are similar to question 10 , but the <u>projects that you are presented with have been altered.</u> There is no relationship between Questions 11 through 17 and we would like for you to consider them independently.

Question: 11

The project would lead to the following condition. $100.00 each year from each household will be needed to implement the program . Please consider the program and then indicate if you would contribute to such a trust fund.

Aquatic Life	**current conditions**
Sportfish	**increase**
Water quality	**good**
Cost to Household ($ per year)	**$100**

Would you contribute the requested amount for the program?

☐ **Yes** ☐ **No**

Question: 12

The project would lead to the following condition. $5.00 each year from each household will be needed to implement the program . Please consider the program and then indicate if you would contribute to such a trust fund.

Aquatic Life	**full recovery**
Sportfish	**increase**
Water quality	**poor**
Cost to Household ($ per year)	**$5**

Would you contribute the requested amount for the program?
☐ **Yes** ☐ **No**

Question: 13

The project would lead to the following condition. $5.00 each year from each household will be needed to implement the program . Please consider the program and then indicate if you would contribute to such a trust fund.

Aquatic Life	**current conditions**
Sportfish	**decrease**
Water quality	**current conditions**
Cost to Household ($ per year)	**$5**

Would you contribute the requested amount for the program?
☐ **Yes** ☐ **No**

Question: 14

The project would lead to the following condition. $75.00 each year from each household will be needed to implement the program . Please consider the program and then indicate if you would contribute to such a trust fund.

Aquatic Life	**full recovery**
Sportfish	**decrease**
Water quality	**poor**
Cost to Household ($ per year)	**$75**

Would you contribute the requested amount for the program?
☐ Yes **☐ No**

Question: 15

The project would lead to the following condition. $25.00 each year from each household will be needed to implement the program . Please consider the program and then indicate if you would contribute to such a trust fund.

Aquatic Life	**partial recovery**
Sportfish	**no change**
Water quality	**poor**
Cost to Household ($ per year)	**$25**

Would you contribute the requested amount for the program?
☐ Yes **☐ No**

Question: 16

The project would lead to the following condition. $50.00 each year from each household will be needed to implement the program . Please consider the program and then indicate if you would contribute to such a trust fund.

Aquatic Life	**full recovery**
Sportfish	**increase**
Water quality	**good**
Cost to Household ($ per year)	**$50**

Would you contribute the requested amount for the program?
☐ Yes **☐ No**

Question: 17

The project would lead to the following condition. $10.00 each year from each household will be needed to implement the program . Please consider the program and then indicate if you would contribute to such a trust fund.

Aquatic Life	**full recovery**
Sportfish	**no change**
Water quality	**current conditions**
Cost to Household ($ per year)	**$10**

Would you contribute the requested amount for the program?
☐ Yes **☐ No**

Question: 18

What is your **ideal project**? Please check your favorite level for each attribute of the project and indicate your ideal cost to household for the project.

Aquatic Life	**☐ Full recovery ☐ Partial recovery conditions ☐ Current**
Sportfish	**☐ Increase ☐ Decrease ☐ No change**
Water quality	**☐ Good conditions ☐ Poor ☐ Current**
Cost to Household ($ per year)	**$**

Finally, we need some basic background information about you.

19. What is the zip code at your primary residence? ________

20. Were you born in the Clinch River Valley?

☐ Yes ☐ No

21. What is the total number of years you have lived in the Clinch River Valley? ______

22. Including yourself, how many people currently live at your residence? _______

23. How many of those people are 18 or older? ______

24. With which political party do you identify?

1.☐ Republican party (or GOP)
2.☐ Democratic party
3.☐ Other party
4.☐ No party affiliation
5.☐ Green party
6.☐ Reform party
7.☐ Don't know/no answer
8.☐ Other___________

25. Do you completely, somewhat, or slightly identify with the party you identified above?

☐ Completely
☐ Somewhat
☐ Slightly
☐ Don't know/no answer

26. Which of the following categories best describes your political views?

☐ Strongly liberal
☐ Liberal
☐ Slightly liberal
☐ Middle of the road
☐ Slightly conservative
☐ Conservative
☐ Strongly conservative
☐ Don't know/no answer

27. Are you currently registered to vote?

☐ Yes ☐ No

28. Has anyone in your household purchased a Virginia or Tennessee fishing license within the last three years?

☐ Yes ☐ No

29. Does anyone in your household belong to any environmental organizations?

☐ Yes ☐ No

30. From the following options, do you consider yourself to be:

1.☐ American Indian 2.☐ Asian
3.☐ Black 4.☐ Hispanic
5.☐ White 6.☐ Refuse to answer
7.☐ Other

31. From the following broad income categories, please indicate the one that includes the estimated annual income for your household for 2001.

☐ Less than $10,000
☐ $10 to $20,000
☐ $20 to $30,000
☐ $30 to $40,000
☐ $40 to $50,000
☐ $50 to $60,000
☐ $60 to $70,000
☐ $70 to $80,000
☐ $80 to $90,000
☐ $90 to $100,000
☐ More than $100,000
☐ Don't know

32. What is your profession or major source of income, i.e., school teacher, farmer, rancher, lawyer, retired, etc ? _______________

Thank you very much for taking the time to complete this survey! Your help is very much appreciated. The answers you provided to us will remain confidential.

Yuki Takatsuka
Department of Economics
University of Tennessee
505-A Stokely Management Center
Knoxville, TN 37996-0550
(865) 974-3303
ytakatsu@utk.edu

VITA

Yuki Takatsuka was born in Nara, Japan on January 10, 1970. She graduated from Koriyama High School in Nara in March 1988. She received a bachelor's degree in Education from Kyoto Women's University in March 1993. After spending two years at Toei Kyoto Studio, a film making company, as a PR representative, she moved to Maryville, Tennessee, to teach at the Blount County Japanese School. In 1996, she enrolled in the University of Tennessee, Knoxville, and received the Bachelor of Arts in Economics in 1997. In August of 1998, she entered the graduate program in Economics. After receiving the Master of Arts in Economics in August of 2000, she continued her study in the program focusing on environmental economic issues. The doctoral degree was conferred May, 2004.

Yuki accepted a postdoctoral fellow position in the Division of Commerce at Lincoln University, Canterbury, New Zealand, starting from February of 2004, where she continues her work in environmental economics.