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A targeted literature review – contingent valuation method

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A TARGETED LITERATURE REVIEW -
CONTINGENT VALUATION METHOD[1]

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ABSTRACT:

The purpose of this literature review is to address key methodological developments of contingent valuation (CV) that are relevant to the MISSFISH project. The history of CV development dates back to early 1960s when it was first used to estimate the benefits of outdoor recreation in a Maine backwoods area. Since then the methodology has progressed in many facets of environmental resources. The technique is amenable to use in private good markets to identify consumer preferences for a new product, however, the use of it in this context is so far very limited. It is our hope that this research would help in developing methodological imperatives aimed at improving our understanding in using it in private good. The main objective of this review is to investigate the suitability of the technique to measure consumer preferences on quality and sustainability aspects of fish products.

Keywords:

Contingent valuation, survey approach, willingness to pay

CONTENTS

1. Introduction:

Contingent Valuation (CV) is generally a method used in the estimation of the value of non-market good such as clean air or water. However, the method can also be used for market goods, where prices are currently not available (as in the case of new product developments). CV methodology has been used to generate willingness to pay (WTP) or willingness to accept (WTA) functions for a large and diverse set of consumer goods to-date for use in planning and policy contexts, but not for fish and fish products, the target goods of this study. The CV method aims to construct a hypothetical market for a good or range of goods (as realistic and structured as possible) in a survey setting. WTP value elicits from individual respondents, contingent on the market constructed. The hypothetical markets must be highly structured in order to ensure that respondents are confronted with a well-defined situation and to elicit a choice contingent upon the occurrence of the posited situation rather than any other. Realism is essential, to ensure that the extrapolations made from the individual WTP are valid, accurate and have meaning. To achieve an accurate measure of non-market benefits, the survey must simultaneously meet the methodological imperatives of survey research and the requirements of economic theory.

The main tasks of this paper are five fold: first, to understand the development of CV methodology for public goods, the significance of which is manifest in the labelling of products on the basis that the fish used comes from a sustainably managed fishery has a public good element; second, to discuss the various options of CV elicitation method and to explore their respective advantages and disadvantages; third, to review the literature on CV methodological development, data collection and analysis; fourth, to review the major issues raised in the CV literature for the use of CVM per se; and finally, to review the major issues associated with the use of CV in private good context.

2. Welfare analysis and CV methodology

As noted, CV methods have their basis in public goods, and notably welfare analysis, which may have pertinence to the project not only in respect of the theoretical development of the methodology itself but also as the labelling being considered in the project has a public good element.

A public good may be defined as " a good that must be provided in the same amount to all the affected consumers" (Varian, 1990). The notion of benefits from public goods is somewhat different from other types of benefits; i.e. improving the welfare of society overall by improving the provision of one good, without a corresponding reduction in the provision of another. Furthermore, one person's consumption of public good does not preclude another person's consumption, and it is difficult to identify all beneficiaries. The total benefit derived from a public good is the sum of the benefits to all that consume the public goods. Modern welfare economics operationalises a variant of the Pareto Criterion by trying to find ways of placing a monetary value on the gains and losses associated with changes in the provision of a public good. This is based on the two key assumptions. The first assumption is that the economic agent (consumer), when confronted with a possible choice between two or more bundles must have preference for one over another. Also it is assumed that through his/her actions and choices, the consumer will attempt to maximise his/her overall level of utility. Both of these assumptions have implications for the CV methodology, which is unique among benefit measurement techniques for its ability to obtain detailed distributional information. Additionally, CV is dependent on the consumer sovereignty assumption, which states that an agent's spending behaviour in a market is a sufficient signal of his preferences for various goods.

Welfare economics assesses a given policy by judging whether a particular policy is Pareto improving. The compensation test of Pareto improvement is not in widespread use because the compensation is rarely paid. Some economists have proposed an alternative welfare criterion known as Potential Pareto Improvement Criterion or the Potential Compensation Test (Hicks 1939; Kaldor 1939). This criterion has been controversial because, without the actual payment of compensation, it is possible to make a very small group of people much better off while making the vast majority worse off. Nevertheless, the potential compensation test is very popular and widely used among applied economists. CV methodology provides the information to evaluate benefits by a variety of criteria, including voting and the Potential Pareto Improvement Criterion. Application of the Potential Pareto Improvement Criterion requires the use of the Hicksian compensating version of demand curve and consumer surplus. Hicks-compensated demand functions shows the quantities consumed at various prices assuming that income is adjusted (compensated), so that utility is held constant at a specified utility level. The difference between the Hicks-compensated and the ordinary demand functions is one of the main considerations in the comparison of equivalent variation[2] (EV), compensating variation[3] (CmV) and consumer surplus (area under the Hicksian demand curve) measures of welfare change.

During the last two decades considerable research effort has been devoted to problems of estimating demand for public goods,. A major part of this research effort has been devoted to finding a mechanism for the direct questioning of consumers in order to reduce mis-representation of their preferences for public goods. This can be achieved through the knowledge of the Hicks-compensated demand curves and these can only be derived from consistent econometric estimates of complete sets of demand functions for all goods estimated separately for each individual.

It is important to keep in mind that the welfare analysis of CV in this manner is applicable to public goods since the private goods market functions in a completely different manner. Outcomes in private goods market occur at the equilibrium price where demand and supply are equal. Such a competitive equilibrium, however, meets the welfare economic test of Pareto optimality described above. In the private goods markets model all consumers have some influence on the market-clearing price. The average consumer of a private good is one who purchases the mean quantity of the good.

3. Variation in CV elicitation designs

CV methodologies simulate a market for a non-market good[4]. The process estimates the respondents' consumer surplus for the environmental good, and the maximum amount the non-market good is worth to the respondent. This is generally achieved by asking individuals their willingness to pay for the good and record the answer. This is called an open-ended CV format because the respondent is not given a price to accept or reject. Respondents often find it difficult to assign a value spontaneously to a non-market good without some form of assistance. As a result, many open-ended CV formats tend to produce an unacceptably large number of non responses or protest zero responses to the WTP questions (Desvousgas *et al.*, 1983). Asking respondents to give a monetary valuation in response to an open-ended question presents them with an extremely difficult task (Arrow *et al.*, 1993). CV proponents

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[2] EV measure asks what change in income (given the original prices) would lead to the same utility change as change in the price. It is the income change equivalent to the welfare gain due to the price change.

[3] CmV measure asks what compensating payment or offsetting change in income is necessary to make the individual indifferent between the original situation and the new price set. This is often interpreted as the maximum amount that the individual would be willing to pay for the opportunity to consume at the new price set.

[4] We use an example of non-market good to explain the variation in designs, since most developments have occurred in non-market goods.

also recognise that presenting respondents with a set of money values from which they are to choose is likely to create anchoring and other biases. On the other hand, closed-ended CV surveys (referendum surveys), have become more popular as a technique for eliciting the value of environmental resources. The format of the closed-ended question is a dichotomous-choice (DC) question, where the respondent is presented with a value and gives a "yes"/ "no" answer as to whether or not they would pay this amount.

There are a few widely used elicitation techniques that attempt to overcome the weaknesses of general CV in both open-ended and closed-ended formats. Many CV researchers have accepted these techniques as capable of reducing non-responses and making it easier for respondents to complete successfully the valuation process. The commonly used elicitation methods are;

- the bidding game;
- the payment card;
- the discrete choice (take it or leave it offer);
- the discrete choice with follow-up approaches and;
- the modified dichotomous approach

Each of these approaches is evaluated below.

Until recently, the most widely used CV method was the **bidding game** (Davis 1964). The process is identical to normal auctions and, therefore, is likely to be familiar to respondents. This is normally modelled on a real-life situation in which individuals are asked to state a price for the environmental non-market good. This bidding game format is best adapted to personal interview surveys, but it also may be used in telephone surveys. The use of this format in mail surveys, however, is very limited. The interviewer iteratively changes the stated amount of money to be paid or received until the highest amount the respondent is WTP, or the lowest amount the respondent is WTA, is precisely identified. Thus, the identified amount is an estimate of a point on the total value curve. According to Cummings *et al.*, (1986), the bidding process is likely to capture the highest price consumers are willing to pay and thereby measures the full consumer surplus. Also, as Hoehn and Randall (1983) stated, the process of iteration used in CV bidding process will enable the respondent to consider more fully the value of the non-market good. Many researchers have demonstrated that starting-point bias occurs when the bidding game format is used (Cummings *et al.*, 1986; Boyle *et al.*, 1985).

The **payment card method** was first developed by Mitchell and Carson (1981 and 1984) as an alternative to the bidding game. This method maintains the properties of the direct question approach while increasing the response rate to WTP questions by providing respondents with a visual aid. This is a more sophisticated direct questioning technique, which specifies the increment or decrement in value for the non-market good to be provided in quantitative terms. Furthermore, this method provides substantial details about the institutional structure of the hypothetical market. The question may be an open-ended or closed-ended format. The open-ended format provides an exact monetary amount for WTP by the respondent, which is a point on the demand curve. The closed-ended format provides a yes or no answer to a question specifying both the precise amount of a non-market good to be gained or lost and the precise amount of money to be paid or received. The payment card procedure avoids the need to provide a single starting point and offers the respondents more of a context for their bid than is provided by the direct question method. The adaptability of payment cards to mail surveys is very limited and the method seems to pose less of an anchoring problem than the bidding game or direct questioning. This method is potentially vulnerable to biases associated with the ranges used on the cards and the location of the benchmark (Mitchell and Carson 1989).

The third CV elicitation method is the **discrete choice** (also known as dichotomous choice, take-it-or-leave-it, and referendum), which was developed by Bishop and Heberlein (1979). Only the closed-ended type of questions can be used in the dichotomous choice format. This approach uses a large number of predetermined prices chosen to bracket expected maximum WTP amounts of respondents. The most desirable form of CV elicitation is the use of a dichotomous question that asks respondents to vote for or against a particular level of taxation, as occurs with most real referenda (Arrow *et al.*, 1993). Because respondents find it very difficult to identify precisely their true point value of access to some environmental good, open-ended valuation questions can be unreliable or can discourage response. In contrast, most consumers are familiar with being confronted by a posted price for a good and the need to make a decision to purchase at that price. This is the strategy behind the discrete choice CV questions. The advantage of the discrete choice method over other methods is that it simplifies the respondent's task in a fashion similar to the bidding game without having the iterative properties. The respondent, just like any other consumer, has only to make a judgement about a given price. The main obstacle of this method, relative to other elicitation methods, is that many more observations are needed for the same level of statistical precision in sample WTP estimates because only a discrete indicator of maximum WTP is obtained instead of the actual maximum WTP amounts. Another problem is that analysis is dependent on some assumptions about how to parametrically specify either the valuation function or the indirect utility function to obtain the mean WTP. Bishop and Heberlein (1979) noted that a logistic or probit regression[5] curve could be fitted to the percentages of respondent's willingness to pay each of the randomly assigned prices. Integrating the area below the logistic curve, would provide the equivalent measure to the mean WTP. It also is possible to obtain the mean WTP directly from the parameters of a probit equation.

The fourth widely used elicitation process is the **discrete choice with a follow-up approach**. Using this method Carson and Mitchell (1986) asked a question requiring a yes or no answer regarding the respondent willingness to pay a specified price. If the respondent says yes, another question is asked using a higher price randomly chosen from a pre-specified list. If the respondent says no, a lower price is used in the follow-up question. Although this procedure offers potential for considerable gains in efficiency, the inherent problems of discrete choice still remain. Further, the follow-up questions used in this method are similar to the iterative procedures of the bidding game. The main disadvantage is that this method is not suitable for mail surveys because of the follow-up approach.

An extension of this procedure, known as the **modified dichotomous choice** method, was used to measure the existence value of wildlife in USA by Stevens *et al.* (1991). In this approach, the respondent was confronted with the specified amount of money, he or she would contribute toward continued existence of the resource. The amount of money was randomly selected within fixed intervals over a range of $5 to $150. Also, all respondents were given an opportunity to bid an amount less or greater than the specified amount of money. Responses, therefore, could be viewed as originating from either an open-ended or a closed-ended dichotomous choice-bidding format. Unlike the discrete choice follow-up approach, this method can be used in mail surveys.

The selection of elicitation design, however, depends on the type of good chosen to study and the structure of the market. The method selected to use in MISSFISH research is very much similar to the payment card method with open-ended format. This procedure avoids the need to provide a single starting point. Considering the complexity of the problem we have in our research, and the amount of information we have to provide to respondents, this is the best procedure suitable for our research.

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[5] For more details, see Appendix I.

4. Methodological development of CV techniques

One of the main elements of this research project is to evaluate the use of contingent valuation (CV) methods to identify consumer preferences for seafood labelled on the basis that they are either of high quality or the raw material is sourced from a sustainably managed fishery. CV is a relatively new research concept in seafood research and therefore, most of the literature reviewed here is based on its application to environmental resources, where it is used to assign prices for those commodities that are not exchanged in the market place. Its application to this project has required a number of theoretical and practical issues to be addressed and certain developments made. These are discussed as part of this literature review.

The CV method first came into use in the early 1960's when Robert K. Davis (1963) used questionnaires to estimate the benefits of outdoor recreation in a Maine backwoods area. Following his work, Ronald Ridker (1967) used the CV method in several studies of air pollution benefits. Over the next few years several other economists used the CV approach to value various recreational amenities. The most influential of the early studies was that conducted by Randall et al., (1974). This study was notable for, among other things, its theoretical rigor and its use of photographs to show the visibility levels. In this experimental design certain aspects of the bidding game were varied systematically to see if they affected the WTP amount in some systematic fashion. Since the early 1970's the CV technique has been used by economists to measure the benefits of a wide variety of goods, including recreation, hunting, water quality, decreased mortality risk from a nuclear power plant accident and toxic waste dumps. In 1979 the Water Resources Council published its newly revised "Principles and Standards for Water and Related Land Resources Planning" in the *Federal Register*. This important document set forth the guidelines for federal participation in project evaluation. The inclusion of CV as one of the three recommended methods was a sign of CV's growing acceptability. More recently the US Army Corps of Engineers and the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund), have begun to use CV for measuring benefits and damages. Funding from the US Environmental Protection Agency (EPA) has played a key role in CV's development. Almost all of the CV studies funded under this program were designed to test various aspects of the method and to establish its theoretical foundation. Efforts of EPA and many researchers since then have contributed significantly on the development of an overall framework, based on a theory of individual behavior in CV market settings.

Bishop and Heberlein (1979) have undertaken a number of CV experiments using discrete responses, which are analysed by maximum livelihood[6] (ML) experiment procedures or similar approaches. In a study of goose hunting in central Wisconsin, they evaluated outdoor recreation with the CV approach using two distinct experiments. A hypothetical market consisting of a sample of 353 hunters was interviewed to obtain a willingness to sell (WTS) value for their hunting permits, and their willingness to pay (WTP) value to obtain a permit. Alternatively, using a simulator market experiment, they sent a real offer to a different sample of 237 hunters to buy their permits for a specified price. In both experiments, they have analysed the individual responses with a logit[7] model to derive an estimate of the average consumer surplus (CS) from a hunting permit. In previous approaches, whether using the iterative bidding or direct payment method, questions with continuous responses were included, which were analysed using regression techniques. Loehman et al. (1981), and

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[6] ML is a method of point estimation with some stronger theoretical properties than the method of ordinary least square. It is of broader application in that it can also be applied to regression models that are nonlinear in the parameters.

[7] For historical as well as practical reasons, the CDFs commonly chosen to represent the 0 and 1 response models are the logistic and the normal, the former giving rise to the logit model and the latter to the probit. For more details of the model refer Appendix I.

Desvousgas et al. (1983) using discrete responses and Logit and Probit techniques have made similar attempts. Bishop et al. (1983) further analysed the same data and found that in discrete-choice cases the price variable was the only one that was always significant in predicting both WTP and WTS. The main drawback of these procedures is that they are not exactly compatible with utility theory. This procedure will not be considered in MISSFISH analysis as a result of these drawbacks.

Hanemann (1984) made a significant contribution to discrete response analysis by addressing the issue of how Logit models should be formulated to be consistent with the hypothesis of utility maximization, and how measures of compensating and equivalent surplus should be derived from the fitted models. Hanemann suggested a procedure that explicitly recognizes the utility-maximizing choices underlying individual responses. He further introduced a stochastic component directly into the utility function. For any individual, the true compensating and equivalent surpluses are random variables. Hanemann further considered three possible welfare measures. Two of those considered, the mean and median of the distribution of the true compensating or equivalent surpluses are shown to be invariant with respect to an arbitrary monotonic transformation of the random utility function. Using data collected by Bishop and Haberlein (1979), he formulated a Logit model to be compatible with the assumption that the experimental responses are the outcome of a utility-maximizing choice. Further, he showed how the value of a permit could be derived from the fitted binary response models. Finally, he compared the results with those obtained by Bishop and Haberlein. The results point out that many estimates reflect differences in the type of experiment and method of statistical estimation, as well as the choice of welfare measures. He preferred the ML to the GLS[8] procedures used by the Bishop and Haberlein in the presence of zero proportions of acceptances for some offers. If there are any differences in responses, it can be proved only by taking some given utility model and deriving the resulting statistical results for the responses. Hanemann's study, however, provides a greater insight into the analytical procedure suggested in the MISSFISH research.

Sellar et al. (1985) compared the results of travel cost (TC) and CV methods and pointed out that the TC provides an estimation of Marshallian consumer surplus[9] (MCS), whereas CV provides a Hicksian equivalent measure[10] (HEM) of welfare change. However, when the income effect is small, the difference becomes more narrow. This study provides a direct relevance to the MISSFISH study since its objectives include an estimation of reveled reference (MCS) and the expressed preference (HEM). In their study, they found that the income effect is small given that the value associated with recreational boating contributes very little to the boater's total income. The study was conducted on four lakes in east Texas using an open-ended CV model. The bid curve was estimated using linear, linear with a squared term in Q, and a double logarithmic form[11]. Differentiating the bid curve, they have obtained an inverse Hicksian demand curve for each lake. This demand curve is unique to the reference welfare level of the boater given in the posited contingent market, nonparticipation. The area under this curve to the left of the mean number of visits provides a Hicksian equivalent measure of welfare change for the average boater. The closed-ended format of the CV method used the binary response model to analyse the data. Data were collected using a

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[8] The procedure of transforming the original variables in such a way that the transformed variables satisfy the assumptions of the classical model and then applying ordinary least squares (OLS) to them is known as the method of generalized least squares (GLS).

[9] MCS is defined as the area under the ordinary (Marshallian) demand curve and above the price line.

[10] Hicksian consumer surplus measures may be thought of as MCS measures calculated from demand curves where total utility is held constant at different specified levels. Hicks suggested two measures of the gain or loss which hold utility constant at the initial level (compensating variation and surplus), and two measures which hold utility constant at some specified alternative level (equivalence variation and surplus).

[11] These are some functional forms that can be used in estimation of a WTP function. More details of the functional forms and the procedure of differentiating the bid curve are given in Appendix I.

mail survey conducted for 2000 sample of boat owners. The response rate of the survey was 62.4 percent. To find the accuracy rate, respondents were asked to rate the accuracy of their value response and this measure is unique to this analysis. The demand curve estimated for the two CV methods reveals that the open-ended procedure yielded a lower measure of CS than the closed-ended procedure. The difference is due to the location of two demand curves. There seemed to be some problems with the open-ended format in that these boaters did not appear to reveal their true value for the lakes through the open-ended CV market situation. However, the closed-ended format appeared to yield a more reliable estimation for the CS. It is proposed that in MISSFISH this hypothesis is tested and consumer preferences will be measured in both formats.

Sellar et al. (1986) addressed the issue of the proper specification of the Logit model for the estimation of non-market commodity demand. They further illustrated the implications of the choice of functional form. An empirical example was used to illustrate the argument using data collected from Texas. The basic referendum voting-style approach involved asking whether or not the consumer would be WTP some specific amount of money for recreational boating. The consumer's decision involved a dichotomous choice, which was analysed by arraying probabilities of positive responses at specific amounts and by analysing quantal choice procedures. They argued that when the CV procedures involve asking for non-iterative quantal choices, the Logit model is applicable. However, simple linear specification for the explanatory variables in the Logit model is inappropriate because such specification may not be consistent with the implications of consumer theory. Therefore, an alternative log-linear form was proposed. It was shown under what condition it is consistent with economic theory. A linear specification was found to be inappropriate implying an upward sloping demand curve for the Texas data. Among others, a log-linear form was used in terms of meeting the restrictions suggested by the economic theory. The estimated demand curve indicates that the choice of a particular functional form can have an important impact on the mean WTP measured from the model. The arguments offered regarding the functional form seem very appropriate to the MISSFISH research, as does the alternative approach adopted in this analysis, in which the probabilities are left in the form of fitted algebraic expressions. The marginal expected values are determined by the numerical integration over a continuum of values from zero to the maximum level of X variable[12]. However, a hazard of truncation biases remains.

Cameron et al. (1987) developed a ML estimation procedure, which exercises the variation in the threshold values to allow direct and separate point estimates of regression. This procedure eliminates truncation bias. They formulated a model for the demand for recreational fishing days based on formal micro-economic theory. The data used consisted of 416 responses in an in-person survey of recreational fishermen, conducted on the south coast of British Columbia, Canada. Respondents were asked whether they would have still gone fishing that day if the cost of the day's trip was some pre-specified number of dollars higher. This procedure is known as the threshold offer. The analysis estimated the desired coefficients and approximate asymptotic standard errors using a Probit regression algorithm. They noted that the Probit procedure could be implemented either through (1) conventional Probit estimation followed by a transformation of the parameter estimation and the calculation of approximate asymptotic standard errors, or (2) directly through the maximization of the likelihood function. They also investigated the influence of each variable on WTP values. In the log-linear model, heterogeneity among the anglers was shown to result in differing values across observations for each derivative. Also noted was the exogenously weighted means of these derivatives across all respondents. One of the advantages of this approach was the ability to easily determine the derivatives of total value with respect to each explanatory variable. For this example, overall mean WTP was estimated at $48.83. In general, they emphasized that analyses using CV data need no longer

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[12] Please refer figure 1 given in Appendix I.

be limited to the estimation of an approximate marginal distribution of valuation over an entire sample. Instead, it has been identified as possible to isolate the impact upon resource valuation due to specific site amenities and the individual user's characteristics.

Boyle et al. (1988) compared three commonly used techniques of asking CV questions: iterative bidding, payment cards, and dichotomous choice (DC). The result revealed that no single technique proved superior to any other and that each has its own strengths and weaknesses. We considered these results in designing the questionnaire and determining the analytical procedure in our research. In one experiment, only iterative bidding and payment cards were used and each respondent participated in only one treatment. The bidding treatment was designed in order to obtain DC values from the same data set. Other CV studies suggest that interviewers can influence respondents' stated values; this study tested the interviewer bias in the values estimated. Interviewers and treatments were rotated at each location to differentiate between interviewer and location effects. Thus, comparisons across interviewers occurred while treatment and interview locations remained constant. Data for the analyses were collected by personal interviews with canoeists and boaters as they completed their trips on the lower Wisconsin River during the summer of 1982. A total of 502 people were interviewed but 85 of these refused to participate. The mean WTP for iterative bidding was $29.82; while for the payment card it was $29.36. DC values were derived using the Logit function estimated using the initial bids and the respondents' answer to them. Evaluating this function at the sample mean leads to a conditional estimate of WTP value of $91.76. The estimated mean was derived by integrating one minus the estimated Logit CDF over offers from zero to infinity. The estimated Logit function should be normalized[13] to derive a proper expected value when the area of integration is truncated. Thus, the resulting estimate of WTP under normalization procedure was found to be $18.88, which is more reasonable. DC is the easiest technique to administer in a survey setting.

Cameron (1988) challenged Hanemann (1984) and Seller et al. (1986) for utilization of Logit models to estimate the value of nonmarket resources from the closed-ended (referendum) survey set. The methodology presented in this paper is different from strategies described in the previous two papers. The major difference in close-ended data is that the offered threshold amounts are varied across respondents, whereas ordinary Logit models have a constant zero threshold. It also emphasized that referendum data are not discrete-choice data in the conventional sense. Maddala (1983) provides a taxonomy of distinct types of discrete regression models, in which referendum data are just a related family. The normality assumption in discrete-choice based models is no longer valid; hence it depends on Logit models. All censored or discrete-choice models require the computation of cumulative densities. For Logit models, which are based on standard logistic distribution, the cumulative density does have a closed form. The density is simply a ratio of exponentiated quantities, which are cheap and easy to calculate. The shapes of these two distributions, standard normal and standard logistic, are identical except for the thicker tail of the standard logistic distribution. Therefore, the logistic-based model provides a very convenient and accurate approximation of the normal-based models. In this paper, the author reviewed competing interpretations of Logit models and described the likelihood function for use with referendum data under the logistic assumption. Further, normal and logistic distribution-based models were examined using a subset of the data from previous study to determine whether those models would yield similar inferences. Finally, he emphasized why the traditional random utility maximization approach is unnecessary with referendum data. Avoiding the utility function approach, it was shown that parameters and standard errors for utility theoretic Hicksian demand curve can be extracted directly. However, estimated demand functions need not be limited to those corresponding to the linear in parameters (utility-different

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[13] Normalization procedure is necessary for the CDF to adhere to the property that the area under its probability density function is equal to one.

specifications), which can be handled by packaged Logit programs, as we intended to do in MISSFISH research.

Boyle et al. (1988) pointed out technical errors made by Sellar et al. (1985), which lead to misstated closed-ended estimates of WTP. They examined the erroneous specification of Seller's equation, which lead to incorrect expected WTP. Thus, the estimated CDF have neglected the mass distribution of the upper tail, resulting in under-estimated value. The paper suggests that the estimated CDF should be normalized prior to estimating the expected values. The biggest argument was that in Seller's paper, results were obtained from general statistical properties and that these hold regardless of whether a Logit model or Probit model or any other continuous distribution is used. As Hanemann (1984) suggested, the median of the estimated distribution can be used as an alternative welfare measure for the fat tail problem. Further, Hanemann suggests that the median is desirable from an empirical perspective because it is relatively robust with respect to marginal changes in the shape of an estimated distribution. However, Boyle et al. suggest that the median has an undesirable feature in that it does not fully reflect the values of individuals who have the most to gain or lose, as the case may be, from the proposed policy. For example, if the estimated distribution were skewed toward high values, the median would be less than the expected value. The main disadvantage of using median is that, as a welfare measure it may nullify the flexibility of the model. Thus, CV studies are concerned with the entire range of the estimated distribution since expected values are computed by integrating the area under the curve. Also suggested is a procedure to obtain a preliminary estimate of the distribution of values. This can be done using a well-designed pre-test survey to construct an empirical CDF and subsequent analysis. This process ensures that the selected observations are balanced between the tails of the distribution and it clusters the majority of the offers around the median.

Bowker and Stoll (1988) applied the DC form of CV to quantify individuals' economic surplus associated with preservation of the crane resources. This unique application of the DC approach to an endangered species is consistent with the utility theory. Further following Hannemann, economic surplus is estimated at the sample median and mean. This WTP function represents the probability that an individual will respond positively to paying a specified amount for the whooping crane resources. The offer, according to the authors, is an argument of the utility difference. The parameters of the binary response models may be estimated using GLS or ML estimation. In this study, ML estimation procedure was used to estimate the Logit and Probit model. The survey is administered in the winter/spring of 1983 in Arkansas and Texas. The mailed and on-site surveys are carefully administered according to the accepted standards. The ML estimation of the Logit and Probit models confirmed prior expectations. The two models differed little in terms of summary statistics and parameter significance for any given specification of the utility difference. The mean values are calculated by numerically integrating the area under each estimated WTP functions over the range of the offer amounts. They found the mean equivalent surplus measures to be considerably higher than the medians in all but one case. This occurred despite the downward bias on means caused by truncating the range of integration at the highest offer. They also found that doubling and tripling the range of integration increased the means as much as 75 percent. In this application the truncation rule chosen has considerably less effect on utility theoretic specification than on logarithmic specification. Notably, the calculated results relatively invariant to both Logit and Probit approaches and have influenced the decision on selecting an analytical procedure in MISSFISH research.. An increased probability of offer acceptance was due basically to income and wildlife-oriented organization membership. Mean WTP was estimated to be between $21 to $149, depending on the level of truncation used and functional specification. It was found that the majority of estimates were $70 or less. Mail survey respondents' WTP ranged from $21 to $70. The authors indicated the sensitivity of estimates of WTP to the issues of functional form, truncation, and the statistical

estimator of WTP adopted, such as mean or median. These results provide a valuable information in designing the CV approach in our research.

Shultz and Lindsay (1990) used nonlinear ML estimation (Logit model) to analyse the relationship between the DC responses to WTP and the independent socioeconomic variables. Many ground water protection strategies have accurate data on cost aspects, but the economic value the public places on ground water protection is often unknown. An attempt was made in this study to demonstrate a methodology to estimate economic value. A questionnaire was mailed to 600 Dower, New Hampshire property owners to elicit household total WTP for a hypothetical ground water protection plan. As Cameron (1987) suggested, the authors have used an alternative method of determining the effect of a specific independent variable on WTP while holding all other variables constant. This procedure involves the transformation of the logistic WTP equation by dividing the constant term and other slope coefficients by the coefficient of the dollar bid. This transformed equation is equivalent to OLS estimation in that unit changes can be used as marginal elasticities. By following an already established CV procedure, it was estimated that the property owners' median WTP for a ground water protection plan in Dower is $40 annually. Using a conservative aggregation procedure, it was further estimated that Dower property owners would be WTP over $100,000 annually in extra property taxes for the plan. This type of aggregation is valid on public goods, however, it is not appropriate in our research since fish products are considered to be private good. However, the Logit regression procedure used in this analysis to determine the specific socio-economic characteristics that influence the WTP values, can be adopted in our research.

Duffield and Patterson (1991) addressed the problem of variance estimation and sample allocation in DC methods. First, they demonstrated the use of bootstrapping[14] to estimate the variance of the truncated mean. They then considered a nonparametric[15] estimator for the truncated mean. This estimator follows from the same utility theoretic behavior that is applied in the standard Logit or Probit applications. The only difference is that no specific functional form is assumed for the underlying WTP distribution. They also consider the theoretical relationship between the nonparametric and parametric models. In using the nonparametric model, the functional form of the cumulative distribution function of WTP is not specified but is, instead, estimated by a piecewise linear function. The nonparametric approach leads to an alternative estimator for the truncated mean, which is simply the area under the piecewise linear approximation from 0 to T. They have compared the estimated truncated means from the Logit model with the nonparametric estimates for several data sets and found them generally to be in close agreement. In fact, they have argued, given adequate sample sizes, the large differences between the two methods reflect a lack of appropriateness of the chosen functional form. Standard errors for the Logit and nonparametric truncated means also were very similar. The nonparametric approach is based on the same utility theoretic motivation as the parametric Logit or Probit models, the only difference being that the latter assume a functional form for the distribution of the WTP function. We intend to carry out hypothesis test whether the large differences between the two methods reflect a lack of appropriateness of the chosen functional form using MISSFISH data[16].

Cooper and Loomis (1992) addressed the sensitivity of DC models based WTP measures to the sample design and to alternative measures of WTP. Their paper focuses on the sensitivity of mean WTP with respect to changes in the size of the bid vector both analytically and empirically. Specifically, a sensitivity analysis was conducted by removing bid values from both the upper and lower ranges and the effects of specifying wider bid intervals was examined. For the empirical estimation, responses to ten WTP questions from three different

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[14] This is a specialised technique of estimating a truncated value.
[15] Nonparametric refers to distribution free test of hypothesis. In this approach we do not have to assume, for example, that the population of interest is normally distributed.
[16] For more details please refer Appendix I.

surveys were analysed. Using an estimator of WTP that allows for both negative value and positive value, WTP was re-estimated for each question with up to the four lowest values removed, and with up to the four highest values removed. In addition, WTP was re-estimated with every other bid value removed. The large decrease in mean WTP using both negative and positive values with a truncation of the upper bid range tends to suggest that the tail of the distribution is 'fat'. In fact, an empirical comparison of Logit distribution for several data sets disclosed a positive relationship between the fatness of the tail of the distribution and the impact on WTP of removing the upper bids. The effect on mean WTP of a truncation of the lower bid values is relatively small. Increasing the intervals between the bid values had rather unpredictable behavior on mean WTP. The result highlights the advantages of taking more care on determining the sample design.

Ready and Hu (1995) have suggested a statistical approach to the 'fat tail problem' for DC format. If a cumulative density function estimated from DC data has an unrealistically fat right-hand tail, mean WTP will be overestimated. Truncating the range of integration results in a lower-bound estimate of the true mean WTP. A normalization procedure proposed by Boyle et al., (1988) unnecessarily depresses the estimate further. If a lower bound estimate is sufficient for policy analysis, then the simple truncated logit estimate originally suggested by Bishop and Heberlein (1979) is appropriate. A new statistical approach is presented in this paper that allows a best guess estimate of mean WTP. Because this estimate involves extrapolation beyond the range of the data, it tends to be highly variable. Considering the problems and advantages of truncating at different points, best guess estimate of mean WTP seems more appropriate, in truncating the MISSFISH bid function.

Kealy and Turner (1993) developed a test to find whether open-ended and closed-ended CV mechanisms lead to significantly different results. The test is based on joint estimation of WTP responses to open and closed-ended questions asked from one sample of individuals. For the *public good*, the closed-ended values were 1.4 to 2.5 times as large as the open-ended values, depending on the specification. Also, the correlation between the error components of the responses to the two questions is strong, but it is less than one. Explanations for a discrepancy in the errors and WTP values include perceived differences in incentives for strategic behaviour depending upon the question format and differences in individual's ability or willingness to ponder the different questions. No differences in WTP for estimates were found in the case of the *private good* where there were no incentives for strategic behaviour and where people were generally more familiar with the commodity and with paying for it. The weakness of this approach is that they compared results only for two commodities using a restricted sample population, i.e., college students. The results do not generalise to all structures of the contingent market, public goods, or populations. However, the findings of a difference between closed-ended and open-ended values highlights the need to develop theoretical models to explain why such differences occur and it is one of the objectives of MISSFISH data analysis.

5. Major issues:

Some of the major issues discussed in this section have been studied in details elsewhere, nevertheless there are still some unresolved problems. The purpose of this review is to explain the importance of these problems on the MISSFISH project.

5.1. Validity, reliability and the biases of the methodology

As previously stated the application of the CV approach to the valuation of public goods has grown dramatically over the last 25 years, with more sophisticated survey designs being the major improvement. The issue of random behaviour and the approaches used to establish the major improvement. The issue of random behaviour and the approaches used to establish the

validity and reliability of results have been emphasised in CV methodologies. Random behaviour is the antithesis of validity and reliability. Validity is dependent on the difference between the good or attribute that which one wished to measure and that which one actually measured. The reliability is the error term of the estimated equation. If the estimated value of the error term is a non-random variable, then a bias is likely to be present.

One way to test validity is to examine whether the measures produced by the estimated model relate to other measures as predicted by theory. The CV measure should conform to theoretical expectations (theoretical validity) and should also be correctly correlated with other measures of the model (convergent validity). **Bateman and Turner, (1993)** suggested a further variant of this approach is to examine the explanatory power of the bid functions. However, the large number of zero WTP values and the high variance associated with CV, could result in a low R^2 value. **Mitchell and Carson (1989)** suggest an R^2 value of 0.15 as minimum. However, psychologists point out that the very nature of social survey techniques makes R^2 statistics of limited use **(Bateman and Turner, 1993).**

According to standard economic assumptions, the strategic behaviour in CV will be a function of the respondents' perceived payment obligation and the respondents' expectations about provision of a public good. Because of strategic behaviour, respondents tend to give a WTP amount that differs from their true WTP amounts in an attempt to influence the provision of the public goods. However, this is not the case with regard to private good because the provision is not a matter at all. **Samuelson (1954)**, in his original article on the provision of public goods, maintained that individuals could not be expected to reveal their true WTP for strategic reasons. There are some tests available to overcome strategic behaviour. A simple strategy we could practice in the survey is to use both open-ended and closed-ended questions. Although the good (fish product) is desired, we do not expect to experience many unusually large WTP amounts. We also note that if the payment is thought to be probable there is a tendency to give a zero WTP value. **Mitchell and Carson (1989)** pointed out that the percentage of respondents giving very large monetary amounts is very small, while the percent of respondents giving a zero WTP amounts is fairly large.

The CV approach suffers from a variety of theoretical and practical difficulties. There are several potential sources of bias given the nature of the CV technique and the survey instrument. Among the more important biases are hypothetical, strategic, starting point, information, sample-related, and the vehicle biases **(Edwards and Anderson 1987)**. In general, starting-point bias occurs because the value selected has an appreciable impact on observed final bids. This impact could take place in two ways. First, if the starting point is far away from the true value, the procedure terminates before the true bid is reached. The starting value also conveys information to the respondent about expected or reasonable bids and, thereby, influences the final bid outcome. The information transfer effect is related directly to the initial or starting bid amount.

When respondents are asked how much in increased price they would be willing to pay in the form of an increased price versus how much they would pay via other methods, the response may be significantly different. This difference in WTP, dependent on the method of payment, is known as vehicle bias. Generally, the vehicles used in CV are utility bills, entrance fees, taxes, user fees, and higher prices. At times, respondents do not understand the scenario in the way intended by researchers because of the gap between plausibility and understandability. Therefore, the payment vehicle is either misperceived or is itself valued in a way unintended by the researchers. It was recognised in the pilot survey that an increase in price would be the best payment vehicle in this study given the nature of private good.

Respondents also may change their values depending on the amount of information they are given about the commodity or situation. For example, if information on average price is given, the respondent may provide a different value than they would were they not informed

about the average cost. This phenomenon is termed information bias. An information overload effect can occur whereby respondents ignore important information and focus on and possibly misinterpret unimportant information. The definition of sustainability and quality, decisions about the sampling frame, and attempts to obtain valid WTP responses and non-responses are some of the decisions to be made. Although the theoretical and practical problems associated with sampling errors should not be taken lightly, non-response is probably a much greater source of bias in survey research **(Cochran 1983)**. Whether or not sampling errors exist, systematic differences between respondents and non-respondents will usually invalidate inferences based solely on data from respondents. This could be evaluated by sub-sampling at least 10 percent of the non-respondents when testing for sampling bias.

Sample selection bias concerns differences in behavioural parameters that weight the determinants of behaviour. This occurs when the probability of obtaining a valid WTP response among sample elements is related to the respondent's value for the good. Field interviews are generally free of sample selection bias because there is less potential for non-respondents to be consciously self-selected. **Edwards and Anderson (1987)** demonstrated various sources that could influence the sample selection bias and two parametric procedures that test for their occurrence. However, we do not see the relevance of conducting such tests in MISSFISH study. They also provide an illustration of the magnitude of non-response bias in estimates of aggregate benefits. **Mitchell and Carson (1989)** demonstrated various sources of bias and their magnitude along with methodological problems and possible treatments.

At the design stage of the survey questionnaire, an attempt has made to reduce bias problems to an 'acceptable' level. The questionnaire was modified significantly, as a result of the pilot survey and comments from the focus group.

5.2. Question ordering and respondent experience:

Boyle et al. (1993) used Grand Canyon white-water boating to address the issues of question ordering and respondent experience in CV. A question order effect or sequence bias arises when the order of multiple valuation questions in a single survey instrument influence the estimated values unintentionally. The research focused on the relationship between Colorado River flows and Hicksian surplus for a white-water trip on the water. The study design involved respondents who had experienced a white-water trip at a specific average flow, answering CV questions for six different average flows. This experimental design provides the opportunity to consider two lines of investigation. First, are respondents' answers to multiple CV scenarios in a single survey significantly and systematically related to the order in which the questions are presented? These potential effects are also known as sequence bias and question order bias. Second, are respondents' answers to a CV question regarding their actual white-water trip comparable to their responses to the scenario evaluations of trips at specified flows? A unifying theme between these two investigations is that two types of white-water rafters were surveyed. Commercial passengers are individuals who pay an outfitter to provide a guided river trip. Private boaters organise the lead their own raft trips with friends and family. Both groups of respondents can draw on the experience from their Colorado River trip when answering the valuation questions. In addition, private boaters have extensive white-water rafting experiences elsewhere. If experience has a role to play in the formulation of values and in respondents' understanding of valuation scenarios, then an instrument effect, such as questions ordering, may be less likely to appear in the private boater valuation estimates. In case of fish products, respondents' understanding of valuation scenarios is not that complex compare to the valuation scenarios of unfamiliar environmental goods. The instrument effect (question ordering) has been tested in the questionnaire in focus group and the pilot. To consider these possibilities further, there are statistical tests that could be conducted in the analysis. In general, a question ordering effect would violate the

principle of procedural invariance. This can be tested by hypothesizing that estimated Hicksian surplus will be unaffected by the order in which the CV questions are asked. The null hypothesis is, therefore, the mean Hicksian surplus values are equal for all products. Rejecting of this null hypothesis would indicate a question-order effect, implying that procedural invariance is violated. Failure to reject the null hypothesis indicates that question-ordering effect is not present, but other types could still be present.

In Boyle et.al.'s study CV data were collected via mail surveys conducted in 1986. A total of 506 usable responses were obtained (337 commercial boaters and 169 private boaters). Using dichotomous data a logit equations were estimated. With respect to question ordering, the private boater data did not demonstrate any significant effects. On the other hand, marginally significant question ordering effects were identified for commercial passengers. The results, however, not conclusive enough to decide the order of a multiple valuation questions in a CV survey is not an issue. The fact that the significant differences were not identified for private boaters, and this conclusion does not hold for commercial passengers, indicates that more research is required. An experience effect is further evident if respondents value their actual white-water trip differently than written scenarios of trips. No effect was identified for experienced boaters, but significant difference did occur for less experienced boaters. This suggests that respondents' experience may play a role in value formation, resulting in survey instrument effects in valuation estimates.

5.3. Non-use values:

Although, the non-use values are not directly relevant to MISSFISH study, it is worth mentioning their importance in a CV related literature review. The estimation of non-use values by CV method has been widely criticised in the recent past. In response to this National Oceanic and Atmospheric Administration (NOAA) commissioned a "blue-ribbon" panel of eminent economists to report on the calculations of non-use values. Generally the findings of the NOAA report **(Arrow et al., 1993)** gave qualified recognition to CV method, but with series of recommendations about the implementation of the technique. The NOAA panel's two major conclusions were that: (a). CV studies convey useful information as reliable by standards that seem to be implicit in similar contexts, like market analysis for new and innovative products, and the assessment of other damages normally allowed in court proceedings, and (b). The appropriate agencies should begin to accumulate standard damage assessments for a range of oil spills and that process should improve the reliability of CV studies in damage assessment. The two main conclusions of the NOAA report were followed by a number of detailed recommendations. In the summer of 1989 Exxon Oil Company retained a distinguished group of economists to investigate the CV method. Their empirical work not only focused on the Exxon Valdez oil spill and CV's ability to measure its damages, but including various other issues **(Hausman, 1993)**. To summarise, the Exxon CV surveys have some serious flaws. To regard them as examples of good practice in CV or a crucial test of the CV method is justified only if one believes that measurement results are invariant with respect to measurement practice. However, this is not true in economics or any other science **(Hannemann, 1995)**. **Centre for Coastal Zone Management (1995)** developed a method of incorporating non-use values of benefits associated with coastal defence project as a proportion of total economic values. If total value is considered in any environmental projects the aspects of non-use value provides a complete picture of benefit side. Non-use value is not a critical issue in the MISSFISH project. However, other issues raised by the NOAA panel and other authors have been considered in questionnaire design and analytical procedures.

5.4. Scope Test:

Scope issues involve comparisons of values for goods that differ in a quantitative or qualitative fashion. *Sequence issues* involve how the value of a good changes with the order in which it is valued and the nature of the goods offered before it. Some critics of the CV method have argued that the method is incapable of demonstrating scope and is therefore too unreliable to obtain useful information. This is generally a consistency check of the estimated values. **Carson and Mitchell (1993a)** have studied the issue of scope in CV. This check relates to the responsiveness of valuation estimates to changes in the scope or size in an environmental commodity. Carson and Mitchell also looked at the structure of experiments designed to look at sequence and scope issues and the testable hypotheses that arise from them.

The first empirically based claim that CV surveys were likely to be insensitive to the scope of the good being valued was put forward by **Kahneman and Knetsch (1992).** Based on the results they argue that respondents were WTP only slightly more for cleaning the lakes in one part of Ontario than for cleaning up all the lakes in Ontario. This lack of sensitivity to scope is almost inevitable because respondents are expressing ideological values (receiving a warm glow or purchasing moral satisfaction are similar terms, which are used interchangeably). In contrast to this argument **Carson and Mitchell (1993b)** compared an estimate of WTP for a change from boatable to fishable quality water on Monongahela river from a sample taken from that area, to WTP from a national sample for the same improvement in national water quality using a very similar survey instrument. After correcting for differences in sample characteristics they obtained an estimate for Pittsburgh area residents of $26 for improvement in Monongahela river quality and an estimate of $68 for the same improvement in national water quality. The difference is large in percentage terms (over 160%) and highly significant ($t = 4.88$, $p < 0.01$). The good is sensitive to the scope this case. Kahneman and Knetsch are inclined to dismiss the results on the grounds that "given the uncertainties of comparisons across studies and sample areas, this evidence against embedding is not persuasive". Most of the studies claimed that the results are insensitive to the scope of the good being valued are based on short telephone surveys or self-administered mall-intercept surveys. Moreover, the survey scenarios used in those experiments are generally unclear about the nature of good being valued (whether it is public or private), the manner of the good's provision, or the payment obligation. In case of private goods, such as fish products, the magnitude of the problem is not that significant.

6. CV studies on fish consumer preferences

The use of CV technique in measuring consumer preferences in private goods is not very common. Some authors have discussed in detail the differences of using CV in private and public good markets[17]. In a competitive market, where goods are in rival supply and property rights are non-attenuated, an exchange takes place that is towards a Pareto-efficient equilibrium. Preferences are expressed through actual behaviour in such markets, via a cash payment knowing that the money might be put in alternative uses. This pattern of consumer behaviour is quite different from how respondents behave in CV surveys. Because of the theoretical differences of markets, there are grounds for questioning the appropriateness of CV in consumer good markets, and therefore few studies carried out in estimating consumer preferences using CV methodology.

Wessells and Anderson (1995) estimated consumer preferences for a variety of alternative safety assurances using CV. Consumer's selection and WTP for food safety assurances were elicited using an in-person market like experiment. Safety perceptions may play as important

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[17] For a detailed description of CV application in private and political market models, see Mitchell and Carson (1989).

a role in determining seafood demand since unsafe seafood causes actual hazard. Even if a mandated seafood inspection system is in place, inspection alone may not be sufficient to change negative perceptions. In order to understand the consumer preferences a WTP experiment for seafood safety assurances was performed in October 1990. The main objectives of the study were, to learn (1) what specific information would most assure consumers that seafood poses little health risk and is of high quality? and (2) how much, if anything, were consumers WTP for this information? The paper also discussed the hypothetical nature of questions asked under the CV method. However, research conducted on one market product (strawberries) indicates that there was less than one- percent statistical difference between the hypothetical WTP and actual price consumers did pay. From a validity point of view this result indicates the success of CV on private good market.

This study also reported results of an experimental study, in which a non-random group of consumers was assembled to test the hypothesis that consumers are able to distinguish between seafood safety assurances and to determine a WTP for these assurances. This group of consumers was collected from telephone calls to random households. Participation was limited to 55 consumers to maintain the manageability of the experiment. They were paid a $10 gift certificate to participate and the experiment was conducted at the University of Rhode Island Food Science Laboratory. All participants answered a written survey consisting of 48 questions regarding their household seafood consumption, perception of seafood safety and quality and their demographic characteristics. To make the experiment as realistic as possible, a particular seafood product (a flounder) was chosen as a reference product. It has been reported in a previous study that 91% of the respondents in the area consume flounder. Each experiment participant was asked to consider a pound of flounder selling at the current market price ($4.50) which carried no consumer information other than price. Consumers could purchase one seafood safety assurance from a list of ten possibilities. To facilitate the process, the respondents were first asked to rank the ten assurances in order of preferences. Respondents were then asked how much, if anything, they were WTP above $4.50 per pound for their most preferred assurance. Next, they were asked their WTP for the least preferred assurance. They were then asked to assign a WTP value to each of the remaining assurances. They were free to re-arrange their initial ranking and alter their WTP values until they were satisfied the rankings and values were representative of their preferences. There was a parallel qualitative study to test hypotheses that consumers are able to discern among seafood safety assurances, rank their preferences and assign values to the alternatives.

Results of the study show that this sample of consumers had definitive preferences for alternative types of seafood safety assurances and are WTP a premium for seafood with these assurances. The sample of residents was WTP as much as 10% extra per pound for catch date assurances. Yet, some information, such as inspection by processor or retailer, was valued very low. Results of the study prove that respondents can assign a monetary value for safety assurances in seafood, which has significant implications for MISSFISH research. The biggest drawback of the study is that the results do not come from a representative sample and thus lack of scientific validity. The study, however, points to the need for, and usefulness of, continuing research using the experimental framework on a random sample representative of the national population. Careful attention should be paid to include seafood as well as non-seafood consumers in the event that a proportion of the non-consumers are such because of concerns about seafood safety. However, having a sample of both seafood and non-seafood consumers in a national sample is not possible due to (a) sample size becomes very large, and (b) some consumers are not experienced to express their preferences on fish quality or any other attributes. The importance of the freshness and the label providing the catch date in fish was pointed out in the research.

Wessells et al., (1999) use CV to evaluate consumer's potential acceptance of an eco-labelling program for seafood products. Data gathered using a telephone survey of 1,640 seafood consumers across the US. The sample size seems very small to make a scientific

inference of the population. The survey was used to capture information about respondent's purchases of seafood, and respondents' hypothetical purchases of eco-labelled salmon, cod and shrimp marketed in retail outlets. These products were chosen because they are among the most popular seafood products in the US, in terms of per capita pounds consumed. The survey allowed respondents to indicate whether they would prefer eco-labelled or non eco-labelled seafood products, where each product is offered at a different price. Elicitation of respondent choice for the difference was conducted using a contingent choice survey. The idea of the contingent choice survey was to present pairs of products to the respondent, of which the respondent must choose one. Contingent choice survey is a similar method to the usual market transactions. Attributes of the choices are varied to allow for econometric analysis of the relative value of each attribute. In this survey, attributes included the presence of the eco-label, price, and certifying agency or organization. Consumers were presented with three paired comparisons, in random order, addressing three distinct seafood products given above. The base price varied for each species, based on the range of common retail prices for each product at the time of the survey. Premiums ranged between -$2.00 to $5.00 per pound. The logit model used in the analysis includes 56 independent variables, including 34 interactions between primary model variables and dummy variables identifying the seafood species in question. Results of the survey illustrate numerous factors that are relevant to MISSFISH research. Some of the significant impacts are choices of respondents, which suggest that a wide range of conditions may influence consumer acceptance of a labeling program. The results indicated that changing the behavior of consumers to affect fisheries significantly requires an integrated campaign to increase awareness and understanding of the environmental issues, and understanding of the connection between sustainable fisheries and seafood purchase decisions. This has direct relevance to the MISSFISH research. In addition, seafood eco-labels will have to compete with other product attributes, such as taste, brand, safety etc., that consumers already use when making purchase decisions. Preferences for eco-labelled fish will likely to differ by species, geographical region, consumer group and perhaps by the certifying agency. These are somewhat unusual hypotheses except for certifying agency, which will be able to test in our UK and Denmark markets. Around two thirds of all respondents were unsure of the status of Pacific salmon and Atlantic cod stocks. Eco-labels will only be relevant to those consumers who purchase seafood. Non seafood users did not participate in this market. This research did not extend it's products outside of the US in their decision making process. However, with sufficient market research and consumer education, results of this survey indicate that, at least in the US, certifying and eco-labeling of certain seafood products may be a feasible long-run approach to promoting sustainable fisheries. US consumers seem amenable to purchasing eco-labelled seafood. It is our hope that European markets follow the US experience to accept eco-labeling of all seafood products to promote sustainable and quality fisheries.

7. Conclusion

In market research, surveys on purchasing intentions are useful because the divergence between intended and actual purchases can be derived. If a product is well positioned and an aggressive market strategy is planned, a conservative estimate would be that 90% of those who say they definitely will buy the product actually do so (Urban and Hauser, 1980). The reason why actual purchases are likely to differ from intended purchases is the intervention of unforeseen events and new information (Juster, 1964). However, in the real market situation some fraction of those who say they do not intend to buy the item will end up buying it. This experience with market research might not apply to CV surveys. A typical market research survey usually provides considerably less information than a standard CV survey. Second, people have control over the timing of their purchase of private goods, but not of the timing of their voting on public goods using CV. Some of the divergence between intended and actual purchases arises from change in timing, which matters to market researchers in a way that does not apply to CV. These facts are important to note when using CV in private goods

market research. It should be noted that, where there are parallel CV and revealed preference estimates of use values such as fish products, the results are often fairly close. There have been 78 studies since Knetsch and Davis (1966) which provide large number of comparisons between CV and revealed preference; on average, the CV estimates of WTP in these studies are about 10% lower than the revealed preference estimates (Carson et al., 1994). For morbidity risks, Magat et.al, (1988) find that conventional CV gives a lower value than stated preference using conjoint analysis.

CV is being widely used in many countries to measure both use and non-use values for many purposes involving market and non-market goods in spite of the current controversy on the assessment of non-use values for natural resource damages. The basic premise of CV is that it employs surveys to elicit respondents' value for a commodity. However, the respondents are not actually making a payment during the survey; they are expressing their willingness or predicting their decision to pay. There are many surveys related questions that are inherent in CV research as it is based on survey techniques. The answers to a survey will vary with the type of commodity, the type of respondent, and the way the survey was conducted. The analytical procedure also affects the outcome of a CV study. With use values such as fish products, CV estimates can be checked against those obtained from revealed preference. For non-use values, revealed preference provides no alternative to CV. However, in this research CV provides one way of tracing out the demand curve for sustainable and quality fish products, which perhaps cannot be revealed through market data, but nevertheless exists and should be included in an economic analysis of the market/product.

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APPENDIX I:

METHOD OF ANALYSIS – WTP FOR MANAGEMENT REGIME FISH PRODUCTS

The survey questions were designed to be administered by personal interviews. As such, it was desirable that the questionnaires be short enough to be completed in under thirty minutes while at the same time be elaborate enough to clearly describe the commodity and the context. The commodity is simply the fish product that was produced under the management regime and labelled by a responsible and trustworthy institution. The payment vehicle does not pose any problems since it is just an additional price premium over the present average price.

Parametric Methods:

We concentrate first on estimating and testing the parametric model. Non parametric estimates of value, and comparison of these with parametric estimates, are discussed after this.

The advantage of parametric methods are that they make it relatively easy to impose preference axioms, pool data across experiments, and extrapolate the calculations of value to different populations than the sampled populations. Their primary limitation is that, if the parameterisation is not flexible enough to describe behaviour, then the mis-specification will usually cause the mean WTP calculated from the estimated model to be a biased estimate of true WTP.

1. Multiple regression analysis

An iterative process of multiple regression analysis would identify most important variables for predicting the maximum willingness to pay. This is the most straightforward and the simplest method when we impose the linearity assumption in the distribution.

2. Estimation of logistic regression model

The linear specification of the model is quite restrictive and has the unattractive property that marginal WTP is constant. It is quite likely that a more flexible form is preferable. In logistic regression, the parameters of the model are estimated using maximum-likelihood, in which the coefficients that make the observed results most likely are selected. The non-linear logistic regression model uses an iterative algorithm for parameter estimation. Using DC data formats we could experiment the mixed log-normal, gamma, and Weibull distributions of tastes.

a). Probit Model

Probit model parameter estimation is one step in estimating the non-linear probability model. We first examine the specification of the taste distribution using referendum responses to the first bid and responses to the double and treble bids and using the open-ended responses. Probability of a "yes" response to a bid, when the consumer has characteristics, $x_1,...,x_k$ is given by,

Prob $(Yes/\beta x_1,...,x_k) = \emptyset(x_1\beta_1 + ... + x_k\beta_k - \alpha\beta)$

$\emptyset$ cumulative standard normal distribution

$\beta_1, \ldots, \beta_k$ and α are parameters.

Then mean WTP is given by the formula

$$W = (x_1\beta_1 + \ldots + x_k\beta_k) / \alpha$$

which can be estimated by using fitted parameters from the Probit model.

b). Logit Model

Probability models are, as a rule, estimated from survey data, which provide large samples of independent observations with a wide range of variation of the regressor variable. One of the preferred methods of estimation is Logit. This permits the estimation of the parameters of almost any analytical specification of the probability function; in addition, it yields estimates that are consistent and asymptotically efficient with ready estimates of their asymptotic covariance matrix.

Logit uses an iterative scheme, which is supplemented by starting values for the parameter vector and by a convergence criterion to stop the process. As for the convergence criterion, the iterative process stops when successive parameter values are nearly equal or when the score vector comes quite close to zero. This should be achieved in five or, at the most, ten iterations.

Non Parametric Model

This section calculates non-parametric estimates from the OE responses, and bounds on WTP using the double and treble referendum responses.

Numerical integration procedure

Based on the responses to each WTP value, some amounts can be chosen for the Dichotomous Choice (DC) analysis. We can make an attempt to avoid the fat tail problem in the Logit curve by truncating the cumulative density function (CDF) at an appropriate point. A logit CDF can be estimated from the DC data set as follows:

$$LOG\left[\frac{P}{1-P}\right] = \alpha + \beta X_i$$

The estimated CDF would look similar to Figure 1, along with the actual proportions of "no" responses observed for each of the bid levels. A logit CDF could provide an estimate from the data using only an intercept (α) and log of bid as explanatory variables.

The expected WTP will be calculated as,

$$E(WTP) = \int_0^{X\max} [1 - F(x)]dx = X_{max} - \int_0^{X\max} F(x)dx$$

where x is a random variable (WTP), $F(x)$ represents the probability of a no answer and a cumulative density function (cdf), and X_{max} corresponds to the highest closed ended dollar offer used in the valuation exercise. An analytical solution to this equation can be obtained using mathematical software.

The value for integration of the function between the bid amounts 0 and maximum point would give us the expected WTP value.
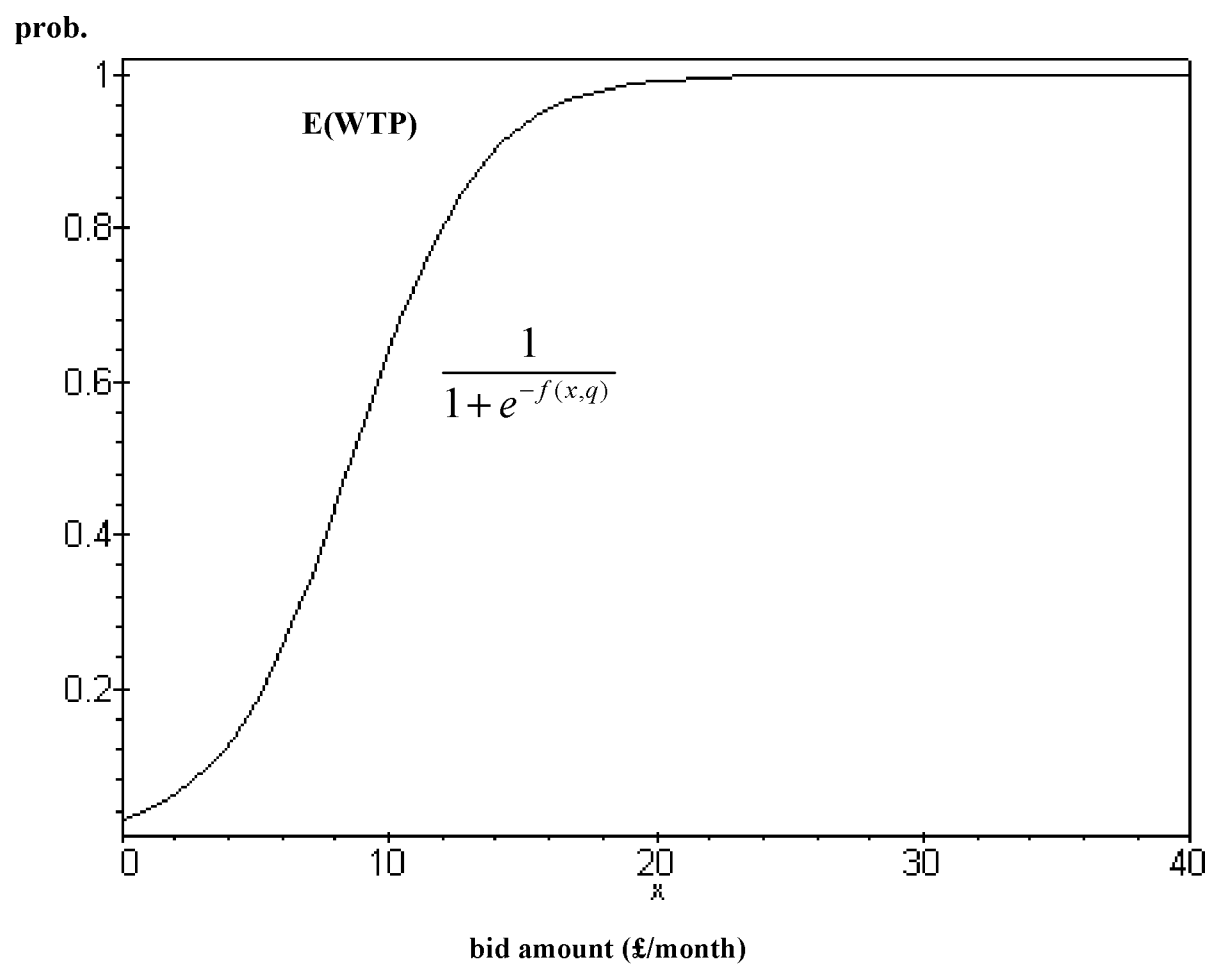
Figure 1.   **Integration of the Logit Curve**