Valuing the willingness to pay for environmental conservation and management: A case study of scuba diving levies in Moo Koh Similan Islands Marine National Park, Thailand

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Abstract

Scuba diving is a popular marine based tourism activity which generates a significant amount of revenue for Thailand's tourism industry. However, the intense level of scuba diving is imposing a strain on the coral reef and marine life. Appropriate management policies are required to control the level of diving and environmental cost of diving. The study uses the contingent valuation method to estimate the demand for scuba diving in Moo Koh Similan Islands Marine National Park, Thailand. The empirical results show that willingness to pay estimates from the double-bounded models were THB 1,017 (US $24.45) for Thai divers and THB 1,146 (US $27.55) for overseas divers.. The results also show that a single flat fee for both Thais and overseas divers are more appropriate as the difference in WTP of the two groups was only three US dollars. If scuba diving fee charges were increased to THB 1,125 (US $27.04), Moo Koh Similan Island Marine National Park would have an economic gain of THB 38,793,592 (US $932,520) per year.

Keywords: Contingent valuation, Dichotomous Choice, willingness to pay, scuba diving, coral reef.

1. Introduction

Valuation of marine resources in the absence of a market can be done through the use of either the revealed or stated preference method. This study discusses the use of the contingent valuation method (CVM) to estimate scuba divers' willingness-to-pay for scuba diving fee in order to measure the economic benefits of Moo Koh Similan

Islands Marine National Park. The first section of this paper discusses the methodologies employed in the contingent valuation study, namely, the single-bound and double-bound dichotomous choice contingent valuation methods (DCCVM). The next section describes the CVM questionnaire, hypothetical market scenario, and alternative bid levels. The following section specifies the dichotomous choice contingent valuation models along with the description of model variables. Descriptive statistics and parameter estimates of the single- and double-bounded DCCVM models are presented and discussed in the subsequent section and the paper finishes off with a concluding section on the overall findings and policy implications.

2. Methodologies Employed in CVM

The contingent valuation method (CVM) is one of the non-market valuation methods commonly used to find the economic value of non-market environmental commodities. Mitchell and Carson (1989) gave a very clear definition of the CVM as a method that uses hypothetical survey questions to elicit people's preferences for public goods by finding out what they are willing to pay (WTP) for specified improvements in them. CVM survey questions are hypothetical because the goods in focus are not normally traded in the market or because actual payments are not made, consequently they have no actual market value. Fortunately, CVM circumvents the absence of the markets by presenting consumers with hypothetical markets in which they have the opportunity to buy the good in question therefore providing information on how much they are willing to pay to obtain the good, or in this particular case, use the resources for recreational reasons.

There are a number of ways to obtain the respondents' willingness to pay (WTP) for the contingent valuation method, such as, bidding games, payment cards, and open-ended questionnaires, however, the methods chosen for this study are the single-bounded and double-bounded dichotomous choice contingent valuation (DCCVM) or the so called referendum method.

2.1 Single-Bounded DCCVM

In the single-bounded survey, respondents are faced with one bid value to which they can respond with either a '*yes'* to accept that they are willing to pay the proposed amount, or a '*no'* which means they refuse to pay the proposed amount. The probability of obtaining a 'yes' or 'no' response can be represented by

$$Prob\ (no) = \pi^{n} = G(BID;\theta) \tag{1}$$

$$Prob\ (yes) = \pi^{y} = 1 - G(BID;\theta), \tag{2}$$

where $G(BID;\theta)$ is some statistical distribution function with parameter vector θ, which can be estimated using a qualitative choice model such as the logit model. The logit mode can have two forms, the log-logistic cumulative density function

$$G(Bid) = \frac{1}{[1 + e^{a-b(\ln Bid)}]}, \tag{3}$$

or the logistic cumulative density function,

$$G(Bid) = \frac{1}{[1 + e^{a-b(Bid)}]}, \tag{4}$$

where $\theta \equiv (a,b)$ and a and b are the intercept and slope coefficients to be estimated. Hanemann (1984) pointed out that this statistical model can be interpreted as a utility maximization response within a random utility context, where $G(BID;\theta)$ is the cumulative density function of the individuals' true maximum WTP because utility maximization implies that an individual will say 'yes' to *BID* only if *BID* is less than or equal to his maximum WTP, and will say 'no' if *BID* is greater. The most commonly used technique for estimating the logit model is maximum likelihood (ML) estimation (Lee 1997). In a case where there are N respondents, let BID_i be the bid offer to the i^{th} respondent. The log-likelihood function for this set of responses, following Hanemann et al. (1991) is

$$lnL^{s}(\theta)=\sum_{i=1}^{N}\{d_i^y ln\pi^y(Bid_i) + d_i^n ln\pi^n(Bid_i)\} = \sum_{i=1}^{N}\{d_i^y ln[1-G(Bid_i;\theta)] + d_i^n ln\,G(Bid_i;\theta)\} \quad (5)$$

where d_i^y is one if the *ith* response is '*yes*' and zero otherwise, whereas, d_i^n is one if the *ith* response is '*no*' and zero otherwise. This estimator is consistent (though it may be biased in small samples) and asymptotically efficient.

2.2 Double-Bounded Model

The double-bounded DCCVM is a more information intensive and asymptotically more efficient than the single-bounded DCCVM (Hanemann et al. 1991). In the double-bounded dichotomous choice format, respondents are faced with a two-sequence bid offer. First, they are asked whether they would 'accept' or 'reject' the first bid, then, the second bid amount is offered. The second bid maybe higher or lower that the initial bid depending on the respondent's response to the first bid. Therefore, the double-bounded DCCVM could have four possible outcomes,

[1] both answers are 'yes',
[2] both answers are 'no',
[3] a 'yes' followed by a 'no', or
[4] a 'no' followed by a 'yes'.

The two-sequence bid offer provides a censor or bound of the respondent's WTP. If the respondent's answer to the initial and the higher bid levels are both affirmative, then their WTP is right censored. If the answer to the initial and the lower bid levels are negative, then their WTP is left censored. However, if both answers alternate in sign, then their WTP is in an interval, with the second bid acting as an upper or lower bound to the respondent's unobserved WTP.

According to Hanemann et al. (1991), the likelihood of these outcomes are π^{yy}, π^{nn},π^{yn}, and π^{ny}, respectively. Assuming the respondent would always try to maximize his/her utility, the formulas for these likelihoods would be

$$\begin{aligned}\pi^{yy}(Bid_i, Bid_i^u) &= Prob\{Bid_i \le \max WTP \; and \; Bid_i^u \le \max WTP\} \\ &= Prob\{Bid_i \le \max WTP \mid Bid_i^u \le \max WTP\} \\ &\quad Prob\{Bid_i^u \le \max WTP\} \\ &= Prob\{Bid_i^u \le \max WTP\} \\ &= 1 - G(Bid_i^u; \theta);\end{aligned} \quad (6)$$

$$\begin{aligned}\pi^{nn}(Bid_i, Bid_i^l) &= Prob\{Bid_i > \max WTP \; and \; Bid_i^l > \max WTP\} \\ &= G(Bid_i^l; \theta);\end{aligned} \quad 7)$$

$$\begin{aligned}\pi^{yn}(Bid_i, Bid_i^u) &= Prob\{Bid_i \le \max WTP \le Bid_i^u\} \\ &= G(Bid_i^u; \theta) - G(Bid_i; \theta); \text{ and}\end{aligned} \quad (8)$$

$$\begin{aligned}\pi^{ny}(Bid_i, Bid_i^l) &= Prob\{Bid_i \ge \max WTP \ge Bid_i^l\} \\ &= G(Bid_i; \theta) - G(Bid_i^l; \theta).\end{aligned} \quad (9)$$

Note that with $Bid_i^u > Bid_i$, $Prob\{Bid_i \le \max WTP \mid Bid_i^u \le \max WTP\} \equiv 1$. That is why $Prob\{Bid_i \le \max WTP \mid Bid_i^u \le \max WTP\} Prob\{Bid_i^u \le \max WTP\}$ collapses into $Prob\{Bid_i^u \le \max WTP\}$. Similar theory applies for $Bid_i^l < Bid_i$, because $Prob\{Bid_i^l \le \max WTP \mid Bid_i \le \max WTP\} \equiv 1$, the likelihood of π^{nn} collapses into $Prob\{Bid_i^l > \max WTP\}$.

Given a sample of N respondents, the log-likelihood function for this set of responses is

$$
\begin{aligned}
lnL^{s}(\theta) = \sum_{i=1}^{N} \{ & d_i^{yy} ln\pi^{yy}(Bid_i, Bid_i^{u}) \\
& + d_i^{nn} ln\pi^{nn}(Bid_i, Bid_i^{l}) \\
& + d_i^{yn} ln\pi^{yn}(Bid_i, Bid_i^{u}) \\
& + d_i^{ny} ln\pi^{ny}(Bid_i, Bid_i^{l})
\end{aligned} \quad (10)
$$

where $d_i^{yy}, d_i^{nn}, d_i^{yn}$, and d_i^{ny} are binary-valued indicator variables. d_i^{yy} takes the value of one if the respondent accepts both the initial and the higher bid, and takes the value of zero if the response is otherwise. d_i^{nn} takes the value of one if the respondent rejects both the initial and the lower bid, and takes the value of zero if the response is otherwise. d_i^{yn} takes the value of one, if the respondent accepts the initial bid offer but rejects the higher bid offer, and takes the value of zero otherwise. d_i^{ny} takes the value of one, if the respondent rejects the initial bid offer but accepts the lower bid offer, and take the value of zero otherwise.

3 The DCCVM Questionnaire

The survey questionnaire consists of five parts. The first part sought to ascertain the respondent's personal profile. It contained questions regarding the respondent's social, economic and demographic characteristics, such as, age, gender, income, level of education and country of residence. It also elicited whether or not the respondent is an environmentally conscious individual by asking whether he or she belonged to or had ever donated money to any conservation organization. The second part determined the respondent's scuba diving experience, where experience was measured by the number of dives the scuba diver has logged in the past five years. Also in this part, scuba divers were asked for their personal motivations for visiting Moo Koh Similan Islands Marine National Park. Preliminary findings from questionnaires and private interviews during the pilot survey in January 2004 led to the conclusion that there are five main reasons why scuba divers would visit Moo Koh Similan Islands Marine National Park. The first reason was the locality of the site. Scuba divers are more likely to visit the site more frequently if they lived near the site. Secondly, scuba divers look for bargains when they make decisions on where to go diving, therefore, they are more likely to visit a site that the overall cost of scuba diving is cheaper. The influence of 'word of mouth' was the third reason for scuba divers visiting the site. They are more likely to visit a scuba diving site if the site was recommended to them by acquaintances or scuba diving magazines. The fourth reason was the beauty of the site. Moo Koh Similand Islands Marine National Park was once acknowledged by the scuba diving community to be one of the most beautiful dive sites in the world. The last reason for visiting the site was because scuba divers are always keen to try out new scuba diving sites. Scuba diving is like any other eco-tourism activity, tourists are always seeking to explore new places whether it would be on land or under water.

Respondents were allowed to select more than one reason because visitors do visit the park for more than one reason. Additionally, an open-ended question was available for those who had other reasons for visiting the Park that was listed above.

The third part elicited information on respondent's travel cost. Details of this part are discussed in a separate paper. Part four of the questionnaire contained questions on WTP. Respondents were asked to accept or reject several proposed scuba diving fee or bid levels. Before answering the questions, respondents were reminded by the interviewers that the proposed fee or bid levels were only hypothetical. They were reminded that their responses would not in any way affect the current fee structure currently charged by the Park. It was important for the interviewers to make sure that every respondent clearly understood this point to avoid any strategic behavior. This will eliminate the problem of 'strategic bias' in which the respondent deliberately overstates or understates his or her true bid in order to influence the outcome.

Once the interviewer was certain that the respondent understood the hypothetical scenario, he/she presented the first bid to the respondents as follows

"According to Thai regulations, you will be charged a diving fee to dive in Similan Islands. Are you willing to pay 200 baht/day to dive in Similan Islands?".

The respondent could either answer in the affirmative (accept the bid) or in the negative (refuse the bid). If the answer was affirmative, he or she would then be offered a higher bid (*BIDH*), but if the answer was negative, then a lower bid was offered (*BIDL*). If the respondent was unwilling to accept both the initial and the lower bid, the next question was to enquire about the reasons for the rejection. The respondents were asked to choose from the following

[1] I don't think I should have to pay,
[2] They don't charge diving fee anywhere else,
[3] I'm only willing to pay a small amount,
[4] I need more information before I decide to pay, and
[5] Other reasons please state.

In the next question, the respondents were asked to state their WTP in an open-ended question. This was to make sure that their refusal to accept any bid levels was not a protest behavior. However, respondents who had stated a zero WTP were considered as a protest bid and excluded from the analysis together with the ones that have selected reasons [1] and [2] above.

Figure 1 DCCVM Questioning Sequence

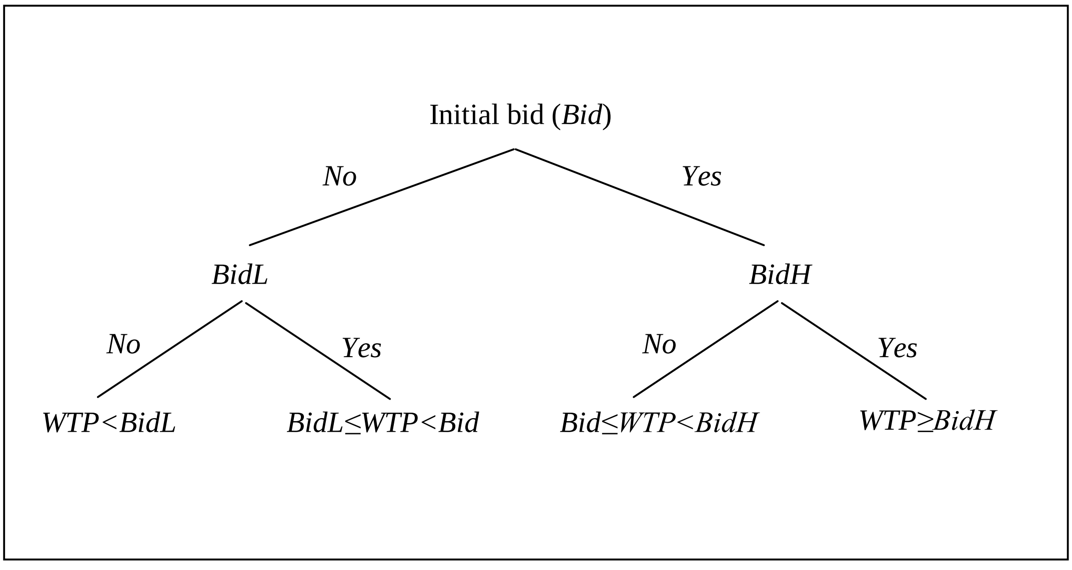

Figure 1 displays the DCCVM questionnaire sequence to elicit WTP. It can be assumed that a respondent's WTP was lower than the lowest bid (*WTP<BIDL*) if he or she refused to accept the initial and the lower bid offer. If the respondent rejected the initial bid but was willing to accept the lower bid, it can be assumed that his or her true WTP lied between the lower and the initial bid (*BIDL≤WTP<BID*). If the respondent accepted the initial bid but rejected the higher bid, is can be assumed that his or her true WTP lied between the initial and the higher bid (*BID≤WTP<BIDH*). If the respondent accepted both the initial and the higher bid, then his or her true WTP was assumed to be equal to or higher than the *BIDH*.

Five different sets of bid offers pre-selected before the survey were distributed randomly across the participants in the survey. These bids were selected on the basis of results obtained from a pretest during the pilot survey, from which an informal estimate of the WTP distribution was derived. The sets of bids used for the DCCVM questionnaire are displayed in Table 5.1.

Table 1 Alternative Bids or Scuba Diving Fee Levels for the DCCVM Questionnaire (in Thai Baht)

BID	BIDL	BIDH
200	100	400
600	400	1200
1000	600	2000
1500	800	2500
2000	1500	3000

4 Model specification

It is assumed that the scuba diver will accept a proposed level of scuba diving fee and still maximize his/her utility under the following condition,

$$v\ (1,\ Y\text{-}BID\ ;\ s) + \varepsilon_1 \geq v\ (0,\ Y\ ;\ s) + \varepsilon_0, \qquad (11)$$

and will reject it if otherwise. The indirect utility function, v, is assumed to equal utility, u. Y is the average annual income after tax and other expenses in thousand dollars, *BID* is the bid offer, or in this case, the scuba diving fee, and s, represents other socio-economic characteristics affecting individual preferences including his/her personal motivations. ε_0 and ε_1 are the identically, independently distributed (i.i.d.) random variables with zero means.

The utility difference ($\Delta\eta$) can be described as

$$\Delta v = v\ (1,\ Y\text{-}B\ ;\ s)\ v\eta\ (0,\ Y\ ;\ s) + (\varepsilon_1 - \varepsilon_0). \qquad (12)$$

When faced with binary choice situations, the logit model is preferred over the probit model because the logit model estimation is based on the cumulative distribution whereas the probit model is based on the normal distribution, which is numerically more complicated to estimate (Hill, Griffiths and Judge, 2001). For this reason, the logit model was used in this study.

Logit models may be estimated either in linear or logarithmic form. Therefore, in the initial phase of the study, the single- and double-bounded models were both estimated in linear and logarithmic forms. However, results from maximum likelihood estimation using the likelihood function (5) for the single-bounded model and (10) for the double-bounded model showed that the parameter estimates were more significant if the single-bounded model was estimated using the logarithmic form, and the double-bounded model using the linear form.

For an individual who is faced with a choice of whether to ‘accept’ or ‘reject’ a hypothetical bid level, the probability (P_i) that the individual will accept or say ‘yes’ to a bid offer (*BID*) for the single-bounded model can be expressed in the logarithmic or log-logistic form as

$$\begin{aligned} Prob\ (yes) &= F\eta\ \Delta v \\ &= (1 + e^{-\Delta v})^{-1} \end{aligned}$$

$$= \frac{1}{1+e^{-(\alpha+\beta_1 lnBid+\beta_2 \ln S+\beta_3 lnPM)}}, \quad (12)$$

and the double-bounded model expressed in the linear or logistic form as

$$Prob\ (yes) = F\eta\ \Delta v$$

$$= (1+e^{-\Delta v})^{-1}$$

$$= \frac{1}{1+e^{-(\alpha+\beta_1 Bid+\beta_2 S+\beta_3 PM)}}. \quad (13)$$

where $F\eta$ is a cumulative distribution function, β_i represents the coefficients of the bid, socio-economic variables, and personal motivation variables, and α is the intercept. Definitions of the variables used in the model are defined in table 5.2.

Table 2 DCCVM Model Variables

Variable	***Label***
RESP	Dependent variable, takes the value 1 if respondent is WTP the proposed bid amount, 0 if they refuse to pay.
BID	Hypothetical amounts of scuba diving fee proposed to each respondent.
Socio-economic	
INC	Average annual income after tax and other expenses in US dollars
GEND	Gender, 1, if respondent is male, 0 otherwise
EDU	Formal education in years
AGE	Age in years
CONSER	1, if respondent belongs to or has financially supported any conservation groups, 0 otherwise
DIVE	Number of dives logged in the past 5 years
THA	1, if respondent is a Thai national, 0 otherwise
Personal motivations	
REA1	1, if the trip is motivated by the site being near to where the respondent lives, 0 otherwise

REA2	1, if the trip is motivated by the competitive pricing of diving at this site, 0 otherwise
REA3	1, if the trip is motivated by the recommendation of others (word of mouth), 0 otherwise
REA4	1, if the trip is motivated by the beauty of the site, 0 otherwise
REA5	1, if the trip is motivated by the respondent's interest in trying out new scuba diving sites, 0 otherwise

The dependent variable, RESP is a binary variable taking the values of 0 or 1 depending on the response to the hypothetical level of scuba diving fee, or BID. If the respondent 'accepts' to pay the proposed fee then RESP=1, but if the respondent 'rejects' the proposed fee then RESP=0. BID is the variable representing the hypothetical level of scuba diving fee and is reported in Thai baht.

Income (INC), gender (GEND), age (AGE) and the level of formal education (EDU) are some of the variables designed to capture the scuba diver's socio-economic background. Income (INC) is measured as average annual income after deduction of tax and other expenses, measured in thousands of US dollars. INC is expected to have a positive relationship with the dependent variable RESP meaning that people with higher income are more likely to have a higher WTP. Unlike INC, however, the study has no previous expectations in terms of whether GEND and AGE have a positive or negative relationship with RESP. The level of formal education (EDU), on the hand, is expected to have a positive relationship with RESP. It is anticipated that higher education would imply higher awareness and appreciation for natural resources, which should result in a higher level of WTP.

The variable CONSER is a dummy variable which is included in the model to identify whether the scuba diver is active in environmental conservation activities. CONSER is expected to have a positive relationship with RESP because those who are environmentally more conscious should be WTP more than those who are not. However, this is under the assumption that the scuba divers are aware that their fees will go towards conservation.

The number of dives the scuba diver has logged in the past five years (DIVE) is designed to capture whether divers who have more diving experience and/or dive more frequently are likely to pay more. Similar to GEN and AGE, there are no a priori expectations on the relationship between DIVE and RESP.

The last set of variables in the DCCVM model is the personal motivation dummy variables (REA1 to REA5). They are designated to capture the personal reasons of each visitor for visiting the site. These variables are not mutually exclusive therefore a respondent can select as many reasons as they like. All the personal motivation variables are expected to have a positive relationship with RESP.

5 Results and Discussion

5.1 Descriptive statistics

The sample consisted of 127 Thais and 301 overseas divers. The overseas divers came from Europe, North and South America, Central Asia, Southeast Asia, Australia and New Zealand, and the Middle-east. The average age and education for Thais were 33.3 and 17.04 years respectively, while the average age and education for overseas divers were 35.5 and 15.08 years, correspondingly. Average annual income after tax and other expenses for overseas divers was US$42,450 and US$23,843.3 for Thai divers. Using the number of dives in the last five years as a measure of enthusiasm, Thais demonstrated a slightly higher level of enthusiasm with an average of 140.5 dives per person as compared to overseas divers who had an average 116.6 dives per person. Thais were also relatively more environmentally active with a higher proportion having financially supported conservation groups.

In terms of personal motivating factors, scuba divers were allowed to select more than one reason for visiting the Park in the questionnaire's tick boxes. Out of 421 scuba divers who participated in the survey, 332 selected REA4. This indicates that more than 75% of the scuba divers come to Moo Koh Similan Islands Marine National Park to see the Parks beautiful dive sites. The second most selected motivating factor is REA3, the recommendation of others. This is followed by REA5, trying out new dive sites, REA2, paying less to dive at the Park, and REA1, the Park is near where they live, leaving REA6, which are other personal motivating factors not included in the questionnaire, as the least selected motivating factor for visiting the Park.

The means, standard deviations and percentages of key variables described above can be found in Table X. The variables are categorized under combined, Thais and overseas divers, Thai divers, and overseas divers, respectively.

Table 3 Descriptive Statistics

	Combined		Thai		Overseas	
Variables	**Mean**	**St. Dev.**	**Mean**	**St. Dev.**	**Mean**	**St. Dev.**
Socio-economic variables						
Annual income (US$'000)	36.97	30.61	23.34	22.28	42.72	31.81
Age (years)	34.9	8.91	33.4	7.3	35.58	9.4
Education (years)	15.6	4.0	16.9	3.7	15.1	4.1
Dive experience (dives)	139.4	278.3	192.3	383.3	117.0	216.3
Dummy variables						
Male (%)	0.63	-	0.51	-	0.68	-
Thais (%)	0.30	-	-	-	-	-
Conservation (% of 'yes')	37.85	-	45.67	-	34.56	-
Reason for visit variables (number of responses)						
Near where I live	51	-	38	-	13	-
Pay less to dive here	56	-	26	-	30	-
Recommended by others	201	-	42	-	159	-
Beautiful dive sites	332	-	107	-	225	-
Trying out new dive sites	134	-	25	-	109	-
Others	49	-	14	-	35	-

5.2 Empirical Results

Six statistical models were analyzed in this study, three of which were single-bounded DCCVM, and the other three double-bounded DCCVM. The study is interested in capturing the level of WTP of the scuba divers combined (combining both Thais and overseas) and the WTP of Thai and oversea divers separately, as well as the different levels of WTP if the bounds of the DCCVM were increased from single to double in order to compare the differences. The six models were

Model 1: Single-bounded DCCVM: Combined Thai and oversea respondents

Model 2: Single-bounded DCCVM: Oversea respondents only

Model 2: Single-bounded DCCVM: Thai respondents only

Model 4: Double-bounded DCCVM: Combined Thai and oversea respondents

Model 5: Double -bounded DCCVM: Oversea respondents only

Model 6: Double -bounded DCCVM: Thai respondents only

From exploratory data analysis, it was found that the single-bounded DCCVMs performed better when estimated in logarithmic form, whereas the double-bounded DCCVMs performed better in linear form. Therefore, models 1 to 3 are logarithmic and 4 to 6 are linear. The statistical analysis of all six models started with a full model, in other words, all socio-economic and personal motivation variables were included. Using the variable deletion approach, one variable at a time was dropped if it had an insignificant relationship with the dependent variable RESP, or had less than 0.1 level of significance. The final models selected for the three single- and three double-bounded DCCVM are presented in Tables 5.4 and 5.5, respectively.

Table 4 Parameter Estimates of the Single-Bound DCCVM

Variables	**Combined (Model 1)**	**Overseas (Model 2)**	**Thais (Model 3)**
LNBID	-1.3721**	-1.4191**	-1.3509**
	(0.1627)	(0.1963)	(0.3196)
THA	-0.7303**	-	-
	(0.2968)		
CONSER	0.2467	0.0559	1.2094**
	(0.2367)	(0.2827)	(0.5060)
LNINC	0.2687*	0.0609	0.9500**
	(0.1431)	(0.1755)	(0.3160)
LNDIV	-0.5803**	-0.3065	-1.5811**
	(0.2118)	(0.2455)	(0.5132)
REA1	1.3427**	1.2689*	1.2528**
	(0.4023)	(0.7240)	(0.5686)
ONE	2.3705**	3.1070**	-0.2181
	(0.5979)	(0.7404)	(1.008)
McFadden R^2	0.20293	0.1850	0.30343
Log L	-234.1192	-169.3889	-57.9763
χ^2 (goodness-of-fit)	119.2108*	76.89813*	50.50996*
N=424			

Standard errors in parentheses
* significant at $p \leq 10\%$
** significant at $p \leq 5\%$

Figure 2 Probability of 'Yes' Response to Hypothetical Bids-Single Bound

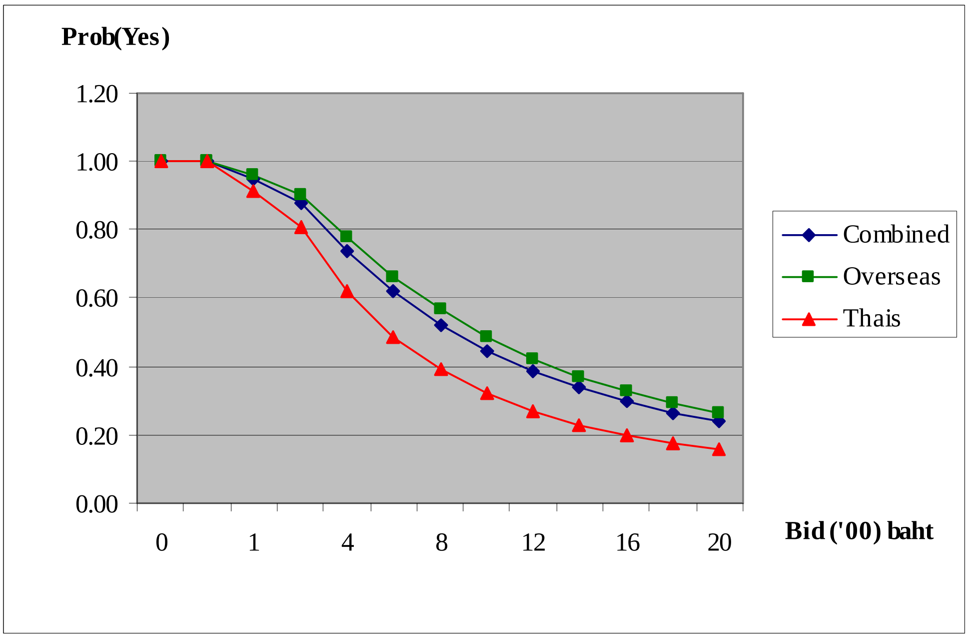

Figure 5.2 compares the probabilities of 'yes' response to hypothetical bids in the single-bounded model of Thai divers, overseas divers and the two groups combined. The diagram clearly shows that Thai scuba divers have a lower probability of saying 'yes' than overseas scuba divers for every bid level except for bid level zero baht. At zero baht, probabilities of all three groups were equal to one. At the current fee level of 200 baht, the probability of saying 'yes' to the offer was predicted to be 0.81, 0.90, and 0.88 for Thais, overseas and the two groups combined respectively.

Table 5 Parameter Estimates of the Double-Bound DCCVM

Variables	**Combined (Model 4)**	**Overseas (Model 5)**	**Thais (Model 6)**
BID	-0.0854**	-0.0985**	-0.0572**
	(0.0113)	(0.0136)	(0.0221)
AGE	0.0059	0.0040	-0.0458**
	(0.0090)	(0.0102)	(0.0227)
THA	-0.5755**	-	-
	(0.1885)		
CONSER	0.1610	0.0589	0.6184**
	(0.1535)	(0.1844)	(0.3077)
INC	0.0043	0.0004	0.0241**
	(0.0028)	(0.0031)	(0.0076)
DIV	-0.0848**	-0.0796*	-0.1249*

	(0.0382)	(0.0454)	(0.0734)
REA1	0.8078**	0.6388	0.4505
	(0.2537)	(0.4347)	(0.3507)
ONE	0.6429	0.6243	0.5583
	(0.3270)	(0.3679)	(0.7589)
FCCC	0.4245	0.3808	0.5410
LOG-L	-529.2683	-379.8066	-140.8338
$\chi 2$ (goodness-of-fit)	85.9020	66.5416	29.86740*
N=424			

Standard errors in parentheses
* significant at $p \leq 10\%$
** significant at $p \leq 5\%$

Figure 3 Probability of 'Yes' Response to Hypothetical Bids-Double Bound

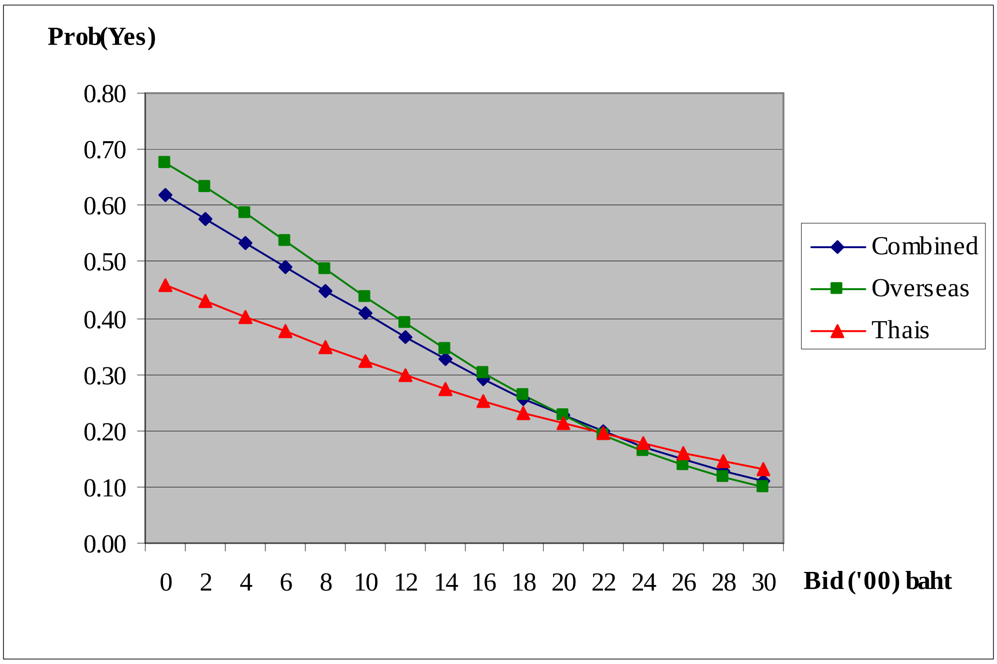

Figure 5.3 compares the probabilities of 'yes' response to hypothetical bids in the double-bounded model of Thai divers, overseas divers and the two groups combined. At the current fee level of 200 baht, the probability of saying 'yes' to the offer was predicted to be 0.43, 0.63, and 0.58 for Thais, overseas and the two groups combined respectively. The diagram also shows that Thai scuba divers have a lower probability of saying 'yes' than overseas scuba divers for every bid level up until bid is equal 2200 baht. At that point, the probability of saying 'yes' is approximately 0.2 for all

three groups. As bid level increases beyond 2200 baht, Thai scuba divers have a high probability of saying ‘yes’ than overseas scuba divers.

5.3 Interpretation of Regression Results

The variable LNBID for models 1 to 3 and BID for models 4 to 6 are all statistically significant at 1% level. In addition to the high level of significance, all of the their coefficients have negative signs indicating a negative relationship with the dependent variable RESP. In other words, the higher the scuba diving fee, the less likely, or the lower the probability that the respondent would be willing to pay.

One variable which differs between the single- and double-bounded models is the variable AGE. It is significant in the double-bounded model but not in the single bounded model. Within the double-bounded model, AGE is only significant in model 6, for Thai respondents and only in that group the sign of the AGE coefficient is negative. This would indicate that for Thai respondents, the probability of a accepting the bid will decrease as the age of the respondent increases, or, older divers are less likely to pay. This may be explained by the fact that older scuba divers were used to scuba diving without having to pay a fee, hence, their difficulty accept new fee regulations, whereas younger scuba divers have been charged scuba diving fees since they started diving, therefore, paying a fee is the norm and they are more open-minded to changing fee levels.

When analyzing oversea and Thai respondents combined in model 1 and 4, the variable THA for both the single- and double-bounded model is significant at 5%. THA is supposed to capture the affects on the probability of the respondent’s accepting a proposed fee level if he/she were Thai. Since THA is significant, it indicates that Thai and oversea divers have different probabilities of accepting a proposed fee and may have different levels of WTP. Hence, it is important to study Thai and overseas divers separately as well as together.

CONSER is significant at 5% for models 3 and 6 which are Thai respondents only. The relationship between CONSER and RESP is however, positive all across six models. The positive relationship shows that a respondent who has financially supported or belonged to a conservation group will have a higher chance of accepting a level of fee or a higher level of WTP. This relationship is expected because it is assumed in the study that those who have financially supported or belonged to a conservation group may have a stronger sense for conservation and are willing to pay more for conservation than those who have not supported or do not belong to a conservation group.

The income variable, INC, is positive all across six models suggesting a positive relationship between INC and RESP. However, it is only significant at 5% in models 3 and 6 suggesting that income is significant only with Thais and not with overseas. This finding suggests that only for Thai divers, the level of income is important in determining whether or not the scuba diver would be willing to pay for the fee.

A scuba diver with more dive experience has a lower probability of willingness to pay than a scuba diver with less experience. This is confirmed by the negative relationship that the variable LNDIV in models 1 to 3 and DIV in models 4 to 6 has with the dependent variable RESP. Divers with less experience are willing to pay more because they still have very high utility for diving whereas divers with more experience may be going through diminishing marginal return and are less likely to want to pay for any extra charges like the diving fee.

The last variable included in the model is REA1. It captures the respondent's personal motivation for visiting the site. REA1 explains the relationship between the respondents WTP and whether the site is near where the respondent lives. It is positive across all models indicating that if the person lives near to the site, he/she is more likely to accept the bid offer.

5.4 Measuring Goodness-of-Fit

The goodness-of-fit measure commonly used for binary discrete choice data is the McFadden pseudo R^2 which is written as

$$R^2 = 1 - \frac{L_0}{L_{\max}} \tag{14}$$

where L_0 is the log-likelihood in the null case where all coefficients are assumed equal to 0, and L_{max} is the log-likelihood at convergence. McFadden pseudo R^2 from the single-bounded DCCVM results for models 1 to 3 were 0.2029, 0.1850, and 0.3034, respectively.

The double-bounded DCCVM however, cannot use the same goodness-of-fit measure due to the difference in properties. Kanninen and Khawaja (1995) pointed out that the doubled-bounded model is premised on the assumption that the response to the initial bid and the follow-up bid are consistent. The conditional nature of the follow-up bid thus has a 'bid value' effect. This implies that the double-bounded model would not have a standard null case as in the single-bounded model where all coefficients can assume the value of 0, particularly with the variable *BID*. This immediately rules the possibility of using McFadden pseudo R^2 as a goodness of fit measure.

Kanninen and Khawaja therefore proposed an alternative approach called the '*sequential classification procedure*' which was used to estimate the percentage of fully, correctly classified cases (FCCC) of responses predicted by the model. FCCC is the sum of the fully, correctly classified cases (n) divided by the number of observations as shown below.

$$\text{FCCC} = \frac{n}{N} \tag{15}$$

In order for a prediction to be fully, correctly classified case (*n*), the prediction must be correct for both the first and second response. It is the important feature of this procedure which takes the sequential and conditional nature of the double-bounded model into account.

Using the sequential classification procedure, FCCC for the double-bounded DCCVM for models 4 to 6 were found to be 0.4245, 0.3808, and 0.5410 respectively. A criterion that Kanninen and Khawaja suggested can be used as an absolute level of judgment for the FCCC is the '*maximum chance criterion*' (Hair et al., 1998) or C_{max}. It is the percentage value of the group with the highest probability of occurrence. The idea is, FCCC should be at least be equal to or greater than the probability of the response with the highest frequency of occurrence because if all predictions were classified to be that response, then it would have the same probability.

The double-bounded DCCVM survey had responses to different levels of bids as presented in table 5.6.

Table 6 Frequency of Responses

	Percentage of Respondents (n=424)			
Initial Bid	**Yes/Yes**	**Yes/No**	**No/Yes**	**No/No**
200	8.02%	11.32%	1.18%	1.42%
600	3.30%	9.43%	2.83%	4.72%
1000	2.83%	4.01%	4.25%	8.73%
1500	0.94%	6.13%	2.59%	8.25%
2000	1.89%	3.54%	1.65%	12.97%
Total	16.98%	34.43%	12.50%	36.08%

The group with the highest frequency or percentage of response is *No/No* which is 36.08%, hence, C_{max} = 36.08%. All three models in the double-bounded DCCVM study outperformed this number.

5.5 Economic Benefit Estimates

A number of methods can be used to compute the value of mean WTP. One is the method proposed by Bishop and Heberlein (1979) where a logit model is fitted to the response of a hypothetical bid level and the mean or expected WTP is found by numerical integration of the area below the logistic distribution function truncated from 0 to maximum bid (*BIDH*). However, this method is argued to be not quite correct by Hanemann (1984) as he believes a numerical integration from 0 to ∞ would be a better measure for computing expected WTP as long as WTP is constrained to be a non-negative random variable. In cases where WTP is not constrainedcx to be non-negative, the correct formula to calculate expected WTP would be a numerical integration from -∞ to ∞ which was proposed by Johansson et al. (1989).

This study has assumed WTP to be a non-negative random variable and the assumption is satisfied by the condition in (1). The constrained mean WTP for both the single-bounded log-logistic DCCVM and double-bounded logistic DCCVM were calculated using methods proposed by Hanemann (1989) and Hanemann et al. (1991). The expression for the constraint mean WTPs and median WTPs are presented in Table 5.7.

Table 7 Expressions of median and mean WTP for single- and double-bounded DCCVM

Model	***Single-Bounded (log-logistic)***	***Double-Bounded (logistic)***
Constrained Mean WTP	$e^{-\alpha^{*}/\beta} \times \dfrac{\pi / \beta}{\sin(\pi / \beta)}$	$\dfrac{ln(1+e^{\alpha^{*}})}{\beta}$
Median WTP	$e^{\alpha^{*}/\beta}$	$e^{\alpha^{*}/\beta}$

where α^* is the adjusted intercept[1], and β is the slope coefficient.

Parameter estimates from maximum likelihood estimation reported in Tables 5.4 and 5.5 were used to calculate mean and median WTP for both the single- and double-bounded DCCVM respectively. Results are presented in Table 5.8.

Table 8 Estimates of WTP (Thai Baht ('00)/year) from the Single- and Double-Bound DCCVM

	Single-bounded			**Double-bounded**		
WTP	**Combined (Model 1)**	**Overseas (Model 2)**	**Thais (Model 3)**	**Combined (Model 1)**	**Overseas (Model 2)**	**Thais (Model 3)**
Mean	26.0617	26.7049	18.3055	11.2562	11.4604	10.7233
Median	8.5662	9.6540	5.7339	5.6143	7.4923	-2.8921

[1] α^* is adjusted by summing the coefficient of all variables, except *Bid*, by its own mean and adding the sum to the original intercept term α. This can be expressed as α^* = constant + (coefficient_k x mean_k), where k represents socio-economic and personal motivation variables. Note, however, the variable Bid is not included in the calculation of α^*.

Mean and median WTP estimates for both the single- and double-bounded model showed that Thai divers were willing to pay less than overseas divers. However, when estimating the Thais and overseas divers combined, mean and median WTP showed values which were more or less an average of the WTP of the two groups. For example, the mean WTP of Thais in the double-bounded model was THB 1,072 (US $25.77) whereas the overseas divers were willing to pay THB 1,146 (US $27.55), but Thais and overseas divers were estimated together, mean WTP was THB 1,126 (US $27.07).

Point estimates of mean WTP from the double-bounded models were also smaller than those of the single-bounded model. For instance, mean WTP for the single-bounded combined model (model 1) was THB 2,606 (US $ 62.64) whereas the double-bounded combined model (model 4) was THB 1,126 (US $27.07). Therefore, the WTP estimate from the single bounded was more than double of the double-bounded model. These findings were also apparent in Hanemann et al. (1991). Their study showed that not only was the WTP estimate lower in the double-bounded model, but also the confidence interval was lower as well.

Hanemann et al. claimed that the advantage of the double-bounded DCCVM over the single-bounded model was the fact that even though the initial bid was not correctly specified, the higher bid (BIDH) will help recoup against too low a choice of the initial bid, and the lower bid (BIDL) will recoup against too high a choice. This in turn, can solve the problems in which CVM studies have been criticized for, namely, starting point bias as well as anchoring effects and yea-saying.

Using estimated WTP from the double-bounded model, as it is more efficient than the single-bounded model, one can estimate the economic value of Moo Koh Similan Islands Marine National Park based on the total number of visitors to the park each year, averaged over 5 years from 1999-2003, which was 34,464.2[2], and mean WTP from the combined model (model 4), the economic value would be US $932,520 per year.

[2] Source: Moo Koh Similan Island Marine National Park (2003)

In 2003, a similar contingent valuation study was conducted in Thailand by Seenprachawong to estimate reef benefits of Phi Phi Islands, a popular scuba diving site in Thailand with very similar characteristics to Moo Koh Similan Islands Marine National Park. When comparing WTP and economic benefit estimates of this study and Seenprachawong's, it was found that Seenprachawong's estimates for Thais and overseas tourists were only US $7.17 and 7.15, respectively, significantly lower than estimates of this study. However, his total benefit estimate of US $1.387 million was 32 percent higher. His higher value for total benefit estimate can be explained by a significantly higher number of users. Phi Phi island is more easily accessible than Moo Koh Similan Islands Marine National Park and more variety of recreational activities are carried out on the island.

6 Conclusions

This study attempted to achieve two outcomes, one, to measure the economic value of scuba diving in Moo Koh Similan Island Marine National Park through the employment of the dichotomous contingent valuation methods, and two, to compare the willingness-to-pay estimates between the single- and double-bounded dichotomous choice contingent valuation methods. Based on the parameter estimates of the two models, the study found that willingness-to-pay estimates from the single-bounded model were twice the size of the double-bounded models. This is due to starting point bias or the bias in the settings of the initial bids. However, this can be resolved if follow-up bids were used. Hence, the double-bounded model is the more efficient estimator of willingness-to-pay (Hanemann et al. 1991).

Willingness to pay estimates from the double-bounded models were THB 1,017 (US $24.45) for Thai divers, THB 1,146 (US $27.55) for overseas divers and THB 1,125 (US $27.05) for Thais and overseas divers combined. All these figures are much higher than the currently charged scuba diving fee level of THB 200 (US $4.8) per day (Thais and overseas divers are charged the same rate). This means that Moo Koh Similan Island Marine National Park can increase scuba diving fees by more than five fold but it should maintain equal pricing between Thais and overseas divers instead of discriminate pricing because the difference in willingness-to-pay between the two groups are less than three US dollars.

If scuba diving fee charges were increased to THB 1,125 (US $27.04), which was the mean willingness-to-pay level found in the study, Moo Koh Similan Island Marine National Park would have an economic gain of THB 38,793,592 (US $932,520) per year. This demonstrates that the Park can obtain significant revenue gain through changes in tourism charges alone without having to increase the pressure on the environment by increasing the number of visitors to meet the costs or running and maintaining the park. Fortunately, regulations limiting the number of tourists and boats visiting the Park each day have been placed and consequently diving firms, yachts and taxi boats are all required to register with the Park before taking tourists out scuba diving or snorkeling. However, with the ever growing demand of visitors wanting to have an opportunity to visit the site, the Park will have to find a balance between the consumers' needs and protection of the fragile resources, especially during peak season between November and April where demands are very high. A study on carrying capacity of the Park is highly recommended.

Scuba diving attracts relatively higher spending tourists both domestically and internationally. However, higher spending doesn't necessarily mean they are willing to pay higher fees. A high proportion of scuba divers are concerned about how the revenue generated from the scuba diving fee is being managed. They are willing to pay a higher fee if they are confident that their fees would be spent on the conservation and preservation of the Park's resources. Therefore, it is very important for the government to be transparent and keep the scuba diving community well informed.

Coastal coral reefs are declining at an alarm rate therefore it is important to establish the non-market value of the coral reef which can be used as an input to assess the overall cost effectiveness of coral reef management and conservation programs (Park et al. 2002). Sustainable marine-tourism management programs, although require a long period of time before seeing the fruitful outcome, the government should not find that funding would be an issue that could interrupt or withhold the process because park visitors are willing to pay a fee to support conservation and preservation of the resources as long as they are reassured that their contributions are properly managed through a transparent process.

6 References

Bishop, R. C., Heberlein, T.A. (1979). "Measuring Values of Extramarket Goods: Are Indirect Measures Biased?" American Agricultural Economics Association 61(1979): 926-930.

Hair, J. F. J., Anderson, R.E., Tatham, R.L., Black, W.C. (1998). Multivariate Data Analysis 5th Edition. New Jersey, Prentice Hall.

Hanemann, M. (1984). "Welfare Evaluations in Contingent Valuation Experiments with Discrete Responses." American Agricultural Economics Association 66(1984): 332-341.

Hanemann, M. (1989). "Welfare Evaluations in Contingent Valuation Experiments with Discrete Response Data: Reply." American Agricultural Economics Association 71(4): 1057-1061.

Hanemann, M., Loomis, J. and Kanninen, B. (1991). "Statistical Efficiency of Double-Bounded Dichotomous Choice Contingent Valuation." American Agricultural Economics Association(November 1991).

Hill, R., Griffiths, W., Judge, G. (2001). Undergraduate Econometrics. New York, John Wiley & Sons, Inc.

Johansson, P.-O., Kristrom, B., Maler, K.G. (1989). "Welfare Evaluations in Contingent Valuation Experiments with Discrete Response Data: Comment." American Agricultural Economics Association 71(4): 1054-1056.

Kanninen, B., Khawaja, M. (1995). "Measuring Goodness of Fit for the Double-Bounded Logit Model." American Agricultural Economics Association 77(November 1995): 885-890.

Lee, C.-K. (1997). "Valuation of Nature-based Tourism Resources Using Dichotomous Choice Contingent Valuation Method." Tourism Management 18(8): 587-591.

Lee, C.-K., Han, S-Y. (2002). "Estimating the Use and Preservation Values of National Parks' Tourism Resources Using a Contingent Valuation Method." Tourism Management 23(2002): 531-540.

Mitchell, R. C., Carson, R.T. (1989). Using Surveys to Value Public Goods: The Contingent Valuation Method. Washington, D.C., Johns Hopkins University Press.

Moo Koh Similan Island Marine National Park (2003). Summary Report: Similan Island Marine National Park, Pang-Nga Province, for Fiscal Year 2003. Pang-Nga, Moo Koh Similan Island Marine National Park: 20.

Park, T., Bowker, J.M., Leeworthy, V.R. (2002). "Valuing Snorkeling Visits to the Florida Keys with Stated and Revealed Preference Models." Journal of Environmental Management 65: 301-312.

Seenprachawong, U. (2003). "Economic Valuation of Coral Reefs at Phi Phi Islands, Thailand." International Journal of Global Environmental Issues 3(1): 104-114.