Choice Modelling Stated Preference Valuation Technique in Perhentian Island Marine Park Environmental Goods

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Abstract

Marine ecosystem via creating economic, environmental, social, cultural, and security opportunities can be important from global, national, and local point of view. Thus, the countries those aimed to reduce dependency of economy from other related sectors (e.g. manufacturing of goods), strive to plan and manage the growing uses of marine ecosystem; especially those which geographically located close to the ocean and marine ecosystem. This pilot study through this paper presents preliminary results on economic values of Perhentian Island Marine Park (PIMP); the community of Putrajaya, Bangi, Kajang and University Putra Malaysia have been interviewed with 30 sample size in June 2012. The Strategic Plan 2011-2015 of the Department of Marine Park Malaysia (DMPM), based on the IUCN/World Bank index in 2015 presents the ecological Key Performance Indicators (KPIs). Hence, by adopting the Choice Modelling Stated Preference (CMSP) valuation technique, this study aims to use these KPIs as the attribute levels to compute the economic values on the Perhentian Island Marine Park that located in the East Coast of the Peninsular Malaysia. Results of this preliminary study indicate to achieve the objectives of the study Multinomial Logit (MNL) can be applied.

Keywords: Choice Modelling, Environmental valuation, Key Performance Indicator, Marine Park;

1. Introduction

Economic efficiency can be considered through checking robust policy analysis. Cost Benefit Analysis (CBA) technique is the main approach for evaluating economic efficiency of policy options and it applied by economists. In any CBA, estimation of the cost is easier than estimating the non-use value (NUV) and social benefits particularly when dealing with non-market goods, such as Marine Parks (MP). Furthermore, in each valuation outcome, apart from the values that have been estimated, it is important to determine the economic valuation of the environmental goods and services provide useful, suitable and appropriate information regarding a policy; and decision makers can utilize this provided information.

The importance of this study can be considered from the economics and management point of view as well; Costanza *et al*. (1997) have comprehensively listed ecosystem functions and services (e.g. MPs). And then Moons (2003) extended the list by adding recreation, non-use values, options and other values, which consider as parts of natural capitals. Nowadays, from conventional theory of economics, it has been known as one of the production factors. In addition, Pearce and Barbier (2000) illustrated the basic relationship between physical, human and natural capitals and economic ecosystem (Arabamiry, Yacob, Radam, Samdin and Shuib, 2009). Economists believe available resources should be taken and used in the best procedure into public decision making – this means rational choice. Therefore, monetary valuation is needed to capture the total value of public goods (e.g. MPs). Based on the nature of public goods, market failure prevents market mechanism to assess these values. Thus, economic valuation is a process of valuing those goods by employing people's intervention, as such has been applied in this study.

From the management view, fundamentally, effective integration, combination of different incompatible, inconsistent and contrast values are difficult tasks that related to environmental goods and services or public goods (tourism and pollution). Various management options related to public decision making need multi-criteria decision-support procedures of valuation technique like Choice Modelling (CM). Alternative management strategies impose different implications of attributes and their level in CM. CM is an emerging technique which supports non-market valuation as a well-known alternative method. For the respondents, this refers to individuals preferences between one group of attributes or services at a given cost, and other attributes and services at the other different cost levels. Moreover, Kenyon and Hanley indicate that policy makers are more interested in generating a combination of multi-criteria analyses, general public approaches and environmental valuations (e.g. CBA). Seemingly, CM is the best procedure because other methods (e.g. CV) which are sensitive to scale and more than a couple of quantities are uncommon to be valued. Scale itself can be an attribute in the Choice Experimental(CE) procedure (Hanley, Mourato and Wright, 2001).

Based on Act 1951 and fee order in 2003, all visitors to MPs in Malaysia should pay conservation charge (i.e. RM5 for adults and RM2 for others, except for the residents of the islands encompassed by the MPs); the fees are collected to finance trust fund expenditure for the management of the MP centers and basic facilities for tourists. There was an increasing trend in visits to MPs from 2000 to 2010, particularly in 2010, which was the highest amount for Pahang and Terengganu. During this period, Pahang usually had the highest visitors (except 2007), while Johor had the smallest number of visitors (Figure 1) (Department of Marine Park Malaysia(DMPM), (2012a)).

In each Marine Ecosystem (ME) corals are the key element. It may seem that current situation of corals and other ecological attributes (in this study) in some Marine Parks are not in acceptable situation. For instance, coral cover is in faire condition (in PIMP with 32.8 percentage) and suffered from bleaching phenomenon (Department of Marine Park Malaysia, 2011, 2012b). In addition, not only the overall number of Marine turtles but also -because of low site stress (which stressors are climate change, pollution and over fishing) - abundance and size of fish species have been decreasing over the years. Furthermore, sources of pollution that affecting the water quality has been increased.

2. Literature review

2.1. Environmental Economic Valuation

In the real world, sometimes, the society is willing to pay more than the real price. In fact, consumer surplus indicates the correct measure of values that people hold for public goods, in which the price is higher than the market price and below the demand curve of the community. Furthermore, in order to achieve the probable sustainability of marine areas, in this area at least, there should be a balance between the costs that they incur and the benefits created by them. The market mechanism determines the value and effective allocation of resources for production. Although this value is held on by people, there is a difference between the benefits of goods and services and norms of people's behavior (trade-off). Kahn (2005) believes that, in environmental economics, when the invisible hand of Adam Smith does not work, market failure takes its place. One of the categories of market failure is public goods.

Individuals make choices with respect to their preferences given certain constraints (such as income, available time and so on). As Freeman (2003) quotes, in a given situation, although several goods and services provided by natural areas (e.g. MP) to the human community have values, due to the absence of price and no market, these environmental values are not actually traded. Total Economic Value (TEV) is divided into use and non-use values (US and NUV) (Bateman *et al.*, 2002); the following equation can demonstrate the components of each subdivision. TEV= US+NUV= (DUV+IUV+OUV) + (BV+EV). Ecological functions of Marine Ecosystem (ME) and coastal areas by providing various values (directly and indirectly) are important (Freeman III and Myrick, 1995; Hanley, Bell, and Alvarez-Farizo, 2003; Millennium Ecosystem Assessment, 2003). Therefore, proper management of these renewable resources for continuing returns and preventing diminishment in their productivity in the future is important. In spite of their economic consequence value, some reasons such as climate change and human pressure (Remoundou, Koundouri, Kontogianni, Nunes, and Skourtos, 2009) are still depleted and collapsed them. Non-market Valuation Techniques which is consist of Revealed Preference (such as

Travel Cost Method) and Stated Preference (for instance Contingent Valuation and choice modelling Methods) can be utilized for Economic valuation.

When the intention of the study in Non-market valuation is the consideration on the impact of a policy (such as management process), the most suitable SP technique is Choice Modelling[1]; which is more recommended than CVM. In order to achieve plausible results in the CM analysis, the experimental design of questionnaire should be appropriate. It seems first attempt to apply CM in Malaysia is by Othman (2002) and recent economic valuation about MP is Yacob (2008)'s study in Redang Island Marine Park that has been applied the CM to estimate ecotourism development values.

3. Methodology

3.1 Theoretical Framework

The characteristic theory of value- which states, a bundle of characteristics of any goods can describe this goods (Lancaster, 1966)- and random utility theory (RUT) (Luce, 1959; McFadden, 1973), which are the bases of CM technique (Bateman, *et al*., 2002). By applying these two theories, through probability choice model and attributes of environmental goods, it can be valued if one of these attributes defines the price or cost terms (Hanley, Wright, and Koop, 2002).

Rational individuals make decisions which maximize their utility, and it considered as the basis of discrete choice models (Train, 2009). All choice modelling (CM) theorists, such as Bateman *et al*. (2002), Hensher *et al*. (2005), as well as Adamowicz and Boxall (2001) believe that Random Utility Theory (RUT) is the theoretical basis for Attribute Base Stated Choice Model (ABSCM), in which individuals choose alternatives that provide them with the greatest utility. Hence, when utility associated with selected alternatives increases, its probability will also increase as well. The alternatives are a combination of attributes, thus, the econometric structure of ABSCMs can be characterized as follows and the components of individual utility (U) are: deterministic (and observable) component (V) and unobservable or stochastic component (ε) (Adamowicz & Boxall, 2001),

$$U = V + \varepsilon \quad (1)$$

where indirect utility function (V) can be illustrated as follows:

$$V_i = \beta_K X_i \quad (2)$$

β is the coefficient vector of K attributes that associate with alternative i, and X is the vector of attributes. From an outcome (such as conservation), a particular level of satisfaction or utility will be driven by the individual. By selecting an alternative i, conditional choice probability is as follows (McFadden, 1973):

$$\text{Prob}(i) = \exp(\mu \beta_k X_i) \Big/ \sum_{j=c} \exp(\mu \beta_k X_i) \quad (3)$$

μ and c are the scale parameter and choice set, respectively, whereby the respondent who has a choice task faced with a series of attributes (generated by the researcher). Each choice set comprises offered alternatives which include attributes. Since one of the components of utility is unobserved (error term), the analysis is faced with one of the probabilistic choices (Bateman *et al*., 2002). Thus, the probability that respondent n to choose alternative i (Train, 2009) is indicated as follows:

$$P_{in} = \text{prob}(V_{in} + \varepsilon_{in}) > (V_{jn} + \varepsilon_{jn}); j \neq i \quad (4)$$

$$= \text{prob}(V_{in} - V_{jn}) > (\varepsilon_{jn} - \varepsilon_{in}); j \neq i \quad (5)$$

(Probability is a cumulative distribution, and in the behavior model, only if $U_{in} > U_{jn}$;$j \neq i$). According to Bennett and Blamey (2001), this means that a rational individual choose i over j if the difference in an observed term (deterministic) of her/his utility exceeds the difference in the unobserved (or error) part.

For respondent n the probability of choosing an alternative (or option) i as the level or number of desirable attribute increases (and the undesirable attribute decreases) over alternative (or option) j (McCartney, 2009).

For estimating RUM, knowing the distribution of error term (ε) is essential. Independently Identically Distribution (IID) is an assumption for error term. According to McFadden (1973) and Train (2009), this means that "probability of any particular alternative i being chosen as the most preferred can be expressed in terms of logistic distribution." Therefore, model specification as the conditional logit model is known as follows:

$$P_{in} = \frac{\exp(\mu V_{in})}{\sum_j^J \exp(\mu V_{in})} \quad (6)$$

Or:

$$P_{in} = \frac{\exp(\mu(\beta' V_{in}))}{\sum_j^J \exp(\mu(\beta' V_{in}))} \quad (7)$$

The probability that respondent n chooses alternative i is P_{in} $(or\ V_{in} = X_{in})$. The utilization of maximum likelihood procedure for estimating logit and conditional logit models employs one of the software packages, such as LIMDEP, STATA, GAUSE, and SPSS; which in this study SPSS and LIMDEP have been utilized.

3.2 Multinomial Logit Model

With the assumption of liner in parameters for V_{in} , individual utility function (systematic component), which is the function of attributes (Caussade *et al*., 2005), can be stated as follows:

$$V_{in} = \beta_1 x_{in} + \beta_2 x_{2in} + \cdots + \beta_k x_{kin} \quad (8)$$

In which x_s is the variable and β_s is the coefficient that is going to be estimated in each survey. When the dependant value takes more than two values, Multinomial Logit (MNL) will specify it. In equation 6, as pointed out by Hensher *et al*. (2005), with reference to the scale parameter (μ) in the MNL model and under IID (some normalization), where systematic utility function ($\beta' v_{in}$) is linear in the parameters as covariance are all zero and essentially the variances are the same ($\mu = 1$) , therefore, β and μ cannot be identified independently and separately (Swait, 2006). If the above explanation is ignored, scaled marginal utility is only interpreted for the estimated parameters. Furthermore, μ is inversely proportional to standard deviation of distribution of ε (error term) (Bateman *et al*., 2002). To obtain one more unit for a particular attribute the question is, how much a respondent is willing to pay? The key output from the economic valuation method (such as CM) is the estimate of this amount, in which the literature mentions is a measure of welfare, MU or marginal WTP and also part worth (Bateman *et al*., 2002). From the choice probability as shown in equation (7), welfare measure can be calculated by estimating the coefficient value of β (by maximizing along the log likelihood function) over the parameters. Therefore, partworth (or implicit price) is calculated as follows:

$$\text{Partworth} = -\beta_a / \beta_b \quad (9)$$

For linear utility, β_a is the coefficient of any non-monetary attribute, while β_b is the coefficient of cost attribute. Also, it is noteworthy that, partworth ratio can be applied in order to determine the rate of two non-monetary attribute coefficients that one can trade-off against the others.

3.3 Survey Framing and Experimental Design

In order to collect the data, a CM questionnaire is used for the survey. In this study, after some checking with the software (e.g. SPSS) and based on the literature and previous studies (e.g. McCartney, 2009) and suggestion (Caussade *et al*., 2005), the experimental design is developed and constructed.

3.3.1 Level of Attributes

in this study, four ecological attributes and relevant management process (McCartney, 2009) for Perhentian Island Marine Park (PIMP) are selected.

Each attribute level is divided into three levels, which consist of 0% change level (or baseline) and based on the predicted indices (KPIs) in strategic plan of DMPM two levels for each ecological and relevant management practice outcome increment (5% and 10%).

3.4 Structuring of Questionnaire

By reviewing previous studies, the pre-test is designed by pursuing the steps of managing a choice model questionnaire based on the literature and objectives of the study. Before going to the sections of the questionnaire, the topic is briefly introduced to the respondents. At the first section it concerns the knowledge of the respondents and the use of PIMP, for instance, their awareness, current visit, future possible visit and so on. This section is followed by the attribute information and the choice set. Since sustainable use of public goods is the intention of each environmentalist's point of view, therefore, in order to save on paper consumption, instead of presenting in each questionnaire, photos and verbal descriptions as posters are also prepared in order to clarify any scenario and attribute presented to the respondents. In addition, some information is provided to the respondents with regard to the choice set in the questionnaire. The respondents' budget constraint is also considered before going to the choice set. Although some questions are hypothetical, but they may be practical because DMPM is reviewing and updating the MP management plan after each five-year period. Since strategic plan of DMPM will expire in 2015, hence, the review will be issued in the next review process if DMPM is willing to do it. The final section of the questionnaire concerns demographic questions in generic (e.g. age, gender, etc.). Furthermore, in order to prevent any language barrier, the questionnaire is prepared in two languages; namely, English and Malay.

4. Results and recommendations

In each questionnaire-based survey, before going to actual survey a pilot survey could be conducted. Therefore, in this study, in order to ensure respondents understanding and they are able to answer accurately and in clear manner, 30 samples were collected and respondents were interviewed in June 2012. The following results are based on this test.

4.1 Profile of Respondents

4.1.1 Socio-demographic characteristics

Respondents who aged at least 18 years old were interviewed. Results of descriptive analysis in terms of socio-demographic variables are presented in Table 1 (Table 1). The age of respondents ranged between 21 and over 51 years old. The sample mean age was 39.9. About 53.3% of those interviewed were males. In terms of education level, it was found that 53.3% held pre-university degree; and then with the same percentage i.e. 23.3% of respondent diploma and 23.3% university degree have respectively. Percentage of respondent occupation status is respectively 43.3%, 23.3%, 10% and 6.7% for Administration &management, Student, Professional &technician and sale, services and business. Meanwhile, gross monthly income has been classified based on Malaysian currency i.e. Ringgit Malaysia to 3 levels from RM2000 to RM4000; respondents income were 47%, 37% and 17% for each level respectively (Table 1). Commonly in a health and developed economies, individuals income level, education level and occupation status are correlated. It seems that these situations are evident in this test.

4.1.2 Characteristics of Visits

Descriptive analysis of respondent's characteristics about the visit is illustrated in Table 2. About 93.3% of respondents were aware that PIMP is a MP. About 53.3% of respondents visit the PIMP more than one time. And about 73.3% of respondent are Malaysian meaning that this site is familiar to Malaysian citizens (Table 2). As indicated in Table 3 about 83.3% of respondents strongly disagree that PIMP is not an important area for recreational activities. About 43.3% and 50% respectively agreed and strongly agreed that PIMP is an important area for commercial use. In addition, 80% of respondents strongly agreed that for future generation PIMP should be maintained. Furthermore, 76.6% and 20% of respondents respectively agreed and strongly agreed that for their visit in the future the park should be maintained. These results mean that besides believing the use values of PIMP (direct and indirect use values) the respondents are also concerned with non-use values (bequest, option and existence) of this site. Moreover, in support of the above mentioned results 76.67% of respondents believed that to provide better provision, accommodation and infrastructure, the adjacent coastal area need to be developed further.

While when they asked about current management and ecological situation 30% of them did not agree and 66.67% of them answered that more information can help them make better decision. Before going through these questions brief information was introduced to the respondents.

Thus, public awareness (especially local people) through useful information can increase positive public performance regarding ecological; and can decrease their destruction activities on the adjacent environmental. Policy makers can achieve their management aims via giving this information to the local community.

4.2. Results of the Maine attributes for choice Modelling (CM)

In this study main attributes for economic valuation are divided to two parts: Ecological Attributes (EA) and Management Process (MEA) relative to them. It is expected both of EA and MEA have positive sign, except entrance fee (PRI) and extra charge (EC) that have negative sign. Results of conditional logit model illustrated in Table 4, which based on equation (8) in methodology, econometric model for each part can be as follows:

$$v = \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \varepsilon$$

X_S are attributes and βs are coefficients in each part. Respondents' preferences of EA and MEA are shown in this model. The coefficient sign of attributes are consistent with theory and are significant as indicated in Table 4. As in methodology illustrated (equation 9), in order to estimate economic value for EA and MEA parts; in other words marginal rate of substitution between each part attributes and entrance fee and extra charge, entrance fee and extra charge employed as a factor to estimate the economic values which displayed in lower section of each model in Table 4. According to Gujarati (2002), the equivalent of the F test in the linear regression models, is likelihood ratio (LR) statistic, therefore null hypothesis that simultaneously βs (marginal effects) are jointly zero can be examine with likelihood ratio statistic; At 1% level of significant and 5 degree of freedom critical chi-squared value is 15.09 while likelihood ratio statistic values are 20.0182 and 27.26 for part 1 and 2 respectively. Therefore null hypothesis is strongly rejected (Table 4).

In the multinomial logit and conditional logit models psedudo-R^2 is a criteria to measure goodness of fit of model. In this study psedudo-R^2 is 0.0512 and 0.0806 respectively for part 1and 2. While according to Louviere *et al.*, (2000) a range value between 0.2 - 0.4 has been considered that demonstrates extremely good model fits. It seems based on log-likliehood ration index (20.0182 and 27.2598 for part 1 and 2 respectively) and psedudo-R^2 model 2 is better than model 1. Forasmuch as CC and WQ are keys in marine environment and regarding marginal value it seems model 1 be better (Table 4). It was estimated that the management of Marine Park Malaysia would be effective at 40% level in 2010. Perhaps this means ecological condition regarding attributes that have been chosen in this study in east cost peninsular Malaysia MPs are not in acceptable condition. Based on biophysical indicators in Strategic Plan of Department Marine Park Malaysia 2011-2015, which is an attempt to improvement in these indicators, and this plan will be expired by 2015; hence, to attain or achieve effective management of MPs in the next plan the results of such studies can help to policy makers in DMPM.

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Figure 1: Number of visitors to marine parks in Malaysia by states (2000 to 2010)

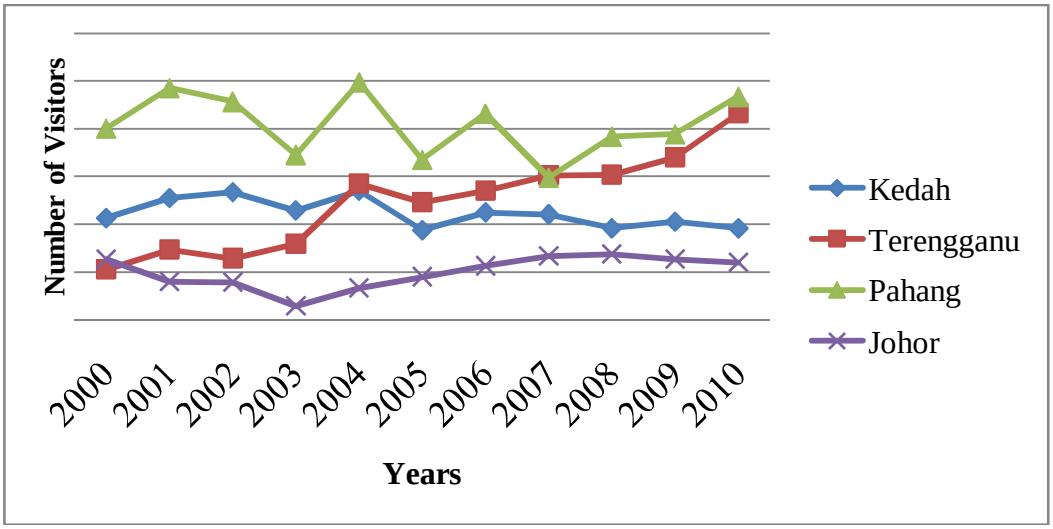

Table 1: Characteristics of respondents based on socio-economic background

Variables	Definition	Frequency(n==30)
Gender	Male	16(53.33)
	Female	14(46.67)
Age	Under 20	0(00.00)
	20-30	5(16.66)
	31-40	8(26.67)
	41-50	15(50)
	More than 50	2(6.67)
Education level	Informal education	0(0.00)
	Primary school	0(0.000)
	Secondary school	0(0.00)
	Pre-university	16(53.34)
	Diploma	7(23.33)
	University degree	7(23.33)
Occupation	Professional &technician	3 (10)
	Administration &management	13 (43.33)
	Sales	3(10)
	Services	2(6.67)
	Business	2(6.67)
	Labor	-
	Housewife	-
	Retired	-
	Student	7(23.33)
	Others	-
Monthly income (RM)	Under 2,000	14(46. 67)
	2,001-3,000	11(36.67)
	3,001-4000	5(16.66)

Note: Figures in parentheses indicate percentage of n

Table 2: Distribution of visit characteristics of PIMP

Variable	**Definition**	**Frequency (n=30)**
Awareness	PIMP is a MP: Yes	28(93.33)
	PIMP is a MP: No	2(6.67)
Number of visit	First time visit	14(46.67)
	More than one to 4 times visit	16(53.33)
	Frequently	-
	Future visit:	
	- Yes	20(66.67)
	- No	1(3.33)
	- Maybe	9(30)
	Origin place:	
	- Citizen	22(73.33)
	- International:	8(26.67)

Note: Figures in parentheses indicate percentage of n

Table 3: PIMP from respondent's point of view

	Strongly disagree	Disagree	Unsure	Agree	Strongly agree
For recreational activities PIMP is **not important** area	25(83.33)	3(10)	-	2(6.67)	-
For commercial use PIMP **is important** area	1(3.33)	1(3.33)	-	13(43.34)	15(50)
In the East Cost Peninsular Malaysia, **PIMP is a key part of tourism industry**	-	-	-	7(23.33)	23(76.67)
For future generation PIMP should be maintained		-	-	6(20)	24(80)
Should be available for others to use even if I am unable to visit	-	-	-	17(56.67)	13(43.33)
Its cultural, heritage and social values are not its importance	11(36.67)	12(40)	4(13.33)	2(6.67)	1(3.33)
For my visit in the future should be maintained	-	-	1(3.33)	23(76.67)	6(20)
Key management aimed at its conservation should not be essential because it is not an important natural environment	19(63.34)	10(33.33)	-	-	1(3.33)

Note: Figures in parentheses indicate percentage of n

Table 4: The conditional logit model for EA and MEA

Model 1 (EA)			
Variable	**Coefficient(β)**	**Std. Error**	**P -value**
Coral Cover (CC) (β_1)	0. 6522	0.1381	0.0000*
Marine Turtle (MT) (β_2)	0.2567	0.1212	0.0343**
Fish Species (FS) (β_3)	0.3512	0.1071	0.0010*
Water Quality (WQ) (β_4)	0.4458	0.1049	0.0000*
Entrance Fee (PRI) (β_5)	-0.0185	0.0098	0.0597***
Summary statistics			
Number of Observation	210		
Log likelihood(L(β))	-185.6180		
Log likelihood, No coefficients (L(0))	-195.6271		
Pseudo- R^2	0.0512		
Adjusted Pseudo- R^2	0.0397		
Marginal values of EA attributes			
CC	35.254		
MT	13.88		
FS	18.98		
WQ	24.10		
Model 2 (MEA)			
Variable	**Coefficient(β)**	**Std. Error**	**P -value**
Management process relative to CC (MCC) (β_1)	0.3716	0.1459	0.0109**
Management process relative to MT (MMT) (β_2)	0.4538	0.1532	0.0031*
Management process relative to FS (MFS) (β_3)	0.4935	0.1068	0.0000*
Management process relative to WQ (MWQ) (β_4)	0.4468	0.1174	0.0001*
Extra Charge (EX) (β_5)	-0.0209	0.0103	0.0429**
Summary statistics			
Number of Observation	180		
Log likelihood(L(β))	-155.3908		
Log likelihood, No coefficients (L(0))	-169.0207		
Pseudo- R^2	0.0806		
Adjusted Pseudo- R^2	0.0677		
Marginal values of EA attributes			
MCC	17.780		
MMT	21.71		
MFS	23.61		
MWQ	21.38		

Notes: * Significant at 1%, ** Significant at 5% and * Significant at 10%,**