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Application of Economic Valuation Method in the Environmental Impact Assessment Procedure

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ABSTRACT

Some of environmental impact assessment (EIA) objectives make available by Economic Valuation (EV) techniques like Contingent Valuation Method (CVM). EIA has not included EV techniques yet in Iran. Present study is the first attempt of using CVM as an EV technique in the EIA. We chose CVM because it can estimate all of values. It replaces with cost benefit analysis (CBA) in EIA procedure. Tehran-Shomal freeway is our study site. It has 121 km length which joins Tehran as Iran capital to Chalus as a tourism city in the north of Iran. Tehran-Shomal freeway also, is a part of the International North-South Transport Corridor (INSTC) connects eastern Asia to Europe. As the NGOs and people are seriously concern about environmental degradation, the project has been faced a strict challenge and has not completed yet. The CVM can replace with CBA in the EIA procedure and a get a logic response for present challenge. Total WTP was US$ 77.23×10^6 after running a Logit model for supporting natural resources along Tehran-Shomal freeway. If we compare WTP with the cost of Tehran-Shomal freeway, we will find the completion of freeway construction has explanation from economic view point.

Key words: Contingent valuation method, values, economic explanation, logit model, Iran

INTRODUCTION

As some of Environmental Impact Assessment (EIA) objectives are provided by Economic Valuation (EV) techniques, using of Economic Valuation (EV) methods in the EIA procedure of projects has grown significantly in recent years (Lindhjem *et al*., 2007; Abelson, 1996; Georgiou *et al*., 1997; McCracken and Abaza, 2001; Pearce *et al*., 2002; Chen, 2009). We desire to choose the best option among all of options in the EIA procedure like EV process. Further, EIA intends to identifies the environmental cost and benefit analysis of the projects to the community. Accordingly, economic valuation techniques can offer mentioned EIA objectives clearly.

Any EV also needs to build on a careful assessment of physical impacts which is the output of well-conducted EIA processes. With these obvious synergy between EIA and EV, it is surprising that the two traditions have not more often merged into what can be termed "environmental economic impact assessment" (EEIA). Some scattered initiatives of EEIA have been furthered, for example by the World Bank (World Bank, 1996; Dixon and Pagiola, 1998) and the Asian Development Bank (ADB, 1996).

The Contingent Valuation Method (CVM) is one of environmental economic valuation frequent employed techniques. It was originally proposed by Ciriacy-Wantrup (1947). This study was about soil erosion. Davis (1963) used CVM for two types of non-use values including, option and existence values. Now, it is recognized as a simple, flexible nonmarket valuation method which is widely used in Cost-Benefit Analysis (CBA) and Environmental Impact Assessment (EIA) (Venkatachalam, 2004).

CVM is a broadly used nonmarket valuation method. It has application in the EIA (Mitchell and Carson, 1989; Cummings *et al*., 1986). It can estimate all of values types or total values (Walsh *et al*., 1984; Choe *et al*., 1996; Tukker, 2000). It elicits the individuals' preferences for the basic infrastructural projects such as water supply and sanitation (Venkatachalam, 2004).

In spite of concerns about CVM validity and reliability (Smith, 1993; Freeman, 1993; Arrow *et al*., 1993), it is commonly used in developed and developing countries (Whittington *et al*., 1992). The validity refers to the "accuracy" and reliability refers to "consistency" or "reproducibility" of its results (Kealy *et al*., 1990).

The first objective of this study is to show practically how CVM (as an economic valuation technique) is a capable tool which has application in EIA. This study is the first attempt of applying CVM in Iran Environmental Impact Statement (EIS). It can replace with Cost Benefit Analysis (CBA) in EIA procedure in the future. The second objective is finding an important answer to an important question: Tehran-Shomal freeway has economic explanation or not? This answer will be found with quantities results via a Logit model.

We complete EIA for a freeway construction with economic valuation carrying out. Our selected method is CVM because it can estimate both of use and non-use values along freeway. These values refer to natural resources along freeway.

Each project should have economic explanation. Otherwise policy makers ignore to having it. Many studies use CBA for finding economic explanation. We apply economic valuation for finding economic explanation. Because it considers all of values like environmental values which has any market. In the traditionally economic explanation environmental values are ignored because they have not any monetary valuation.

MATERIALS AND METHODS

Study site: The study site is Tehran-Shomal freeway. Tehran-Shomal freeway with 121 km length joins Tehran as Iran capital city to Chalus in the north of Iran. Chalus is a tourism city. It is near to Caspian Sea. Tehran-Shomal freeway also, is a part of the International North-South Transport Corridor (INSTC) connecting eastern Asia to Europe from Iran and Russia.

The first study of freeway plan returns to 1974 then it has been left until 1996. As the NGOs and people worried about environmental degradation, the project was faced a challenge. After 16 years, the physical progress is less than 10%.

Examining the difference between the availability of inputs and outputs with and without the project is the basic method of identifying project costs and benefits. It is, also normally the same as "after/before comparison". The comparison of with/without is an attempt to measure the cost/benefit arising from the project. The "after/before" comparison, fails to account for changes in the environmental quality directly because it has not market price. Therefore, there are two options presented in this study as illustrated in Table 1.

Contingent valuation method: We used Contingent Valuation Method (CVM) in this study. It has been frequently employed as one of the ordinary approaches to estimate all of the economic values of non-market goods, for instance plants, wildlife and environmental quality goods (Hanemann, 1994). The component of all values is illustrated in Fig. 1:

$$TEV = UV+NUV \quad (1)$$

Table 1: Options in Tehran-Shomal freeway construction project

Option	Most important results and probable consequences
Without construction	Sure the environment but high accident cars
With construction	Degraded environment but safer and shorter route

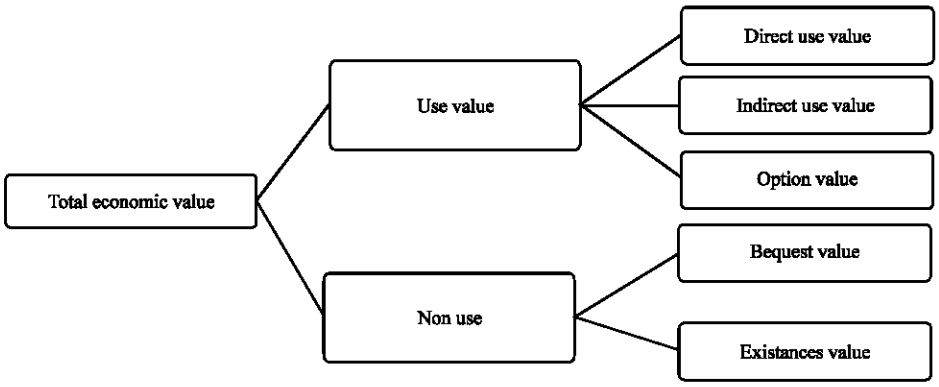

Fig. 1: Component of total values

$$UV = DV+INV+OV \quad (2)$$

$$NUV = BV+EV \quad (3)$$

If we combine Eq. 2 and 3 we will have:

$$TEV = DV+INV+OV+BV+EV \quad (4)$$

where, TEV: Total economic values:

- **UV** : Use values
- **NUV** : Non use values
- **DV** : Direct values
- **INV** : In direct values
- **OV** : Option values
- **BV** : Bequest values
- **EV** : Existence values

The non use value can, however, be subdivided into existence, bequest and option value. For example in a wetland beside Tehran-Shomal freeway, existence value reflects benefits from the improvements of domestic water supply services that can play an important role to avoid health dangers and impacts. However, many households are willing to pay for protection from such health impacts of water services, even those located in remote.

The bequest value is the value a habitant places on the ability to conserve a resource so that it can be used by future generations. In other words, respondents might be willing to pay to restore water quality for the time being and in future but from knowledge that their heirs and future generations will have good water quality.

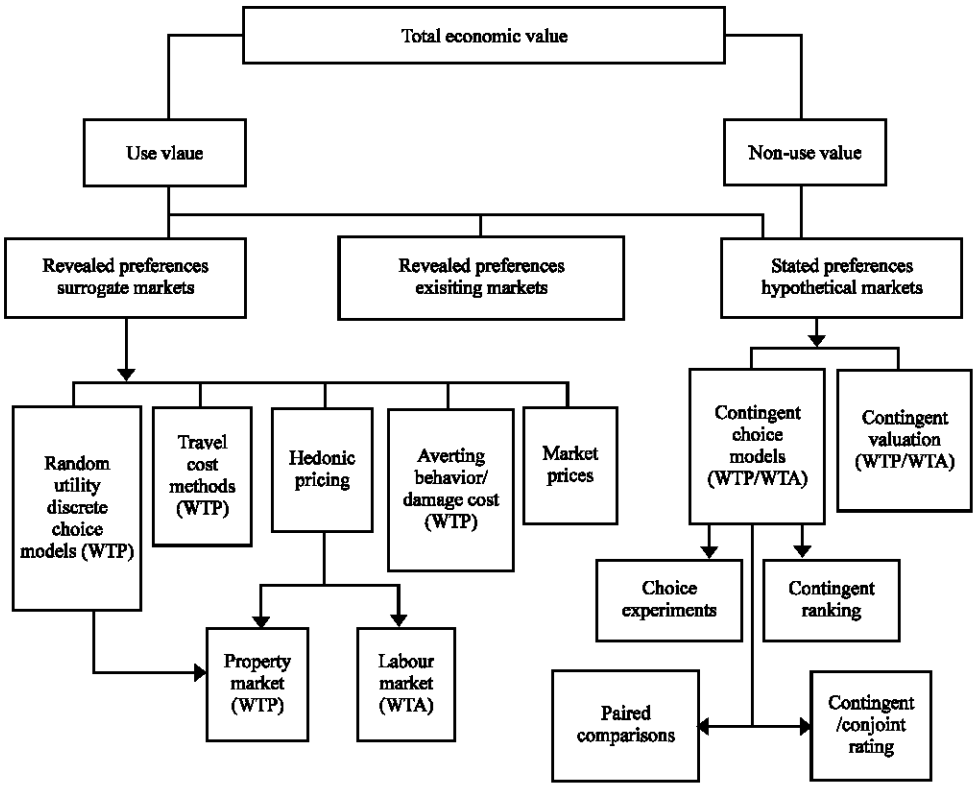

Fig. 2: Relationship between TEV, WTP and estimation methods

The third part of nonuse value is option value; the concept of option value refers to the value placed on a resource's future use. For instance, if there are some plants have not any importance now but would be have pharmacological value for future generation. It is an example for option value. For estimating non-use values we can use methods like: Contingent Choice Model (CCM) and Contingent Valuation Method (CVM).

The CVM base is the stated intentions of individuals' Willingness To Pay or (WTP) (Walsh, 1986). CVM is named contingent because it fundamentally tries to determine from respondents what t hey would be willing to pay under certain hypothetical market scenarios (Lee and Han, 2002; Voeks and Rahmatian, 2004).

The object of CVM is to measure consumer surplus for the environmental qualities. There are two advantages of contingent valuation method. First, CVM is able to assess an individual's WTP of the present conditions and also values their WTP with hypothetical changes. Second, CVM is able to value trips with multi destinations by asking hypothetical questions for each specified destination (Lee and Han, 2002). CVM is a demand side approach with Hypothetical markets (Chen, 2009). It allows individuals to state their willingness to pay for changes in the quantity or quality of environmental goods and services. The demand-side valuation relies on the estimation of individual demand for non-market goods. CVM is the most popular stated preference method.

CVM uses a questionnaire to create a realistic but hypothetical market or referendum. It allows respondents to indicate their WTP (Mitchell and Carson, 1989). WTP is the most important part in the questionnaire design (Fig. 2).

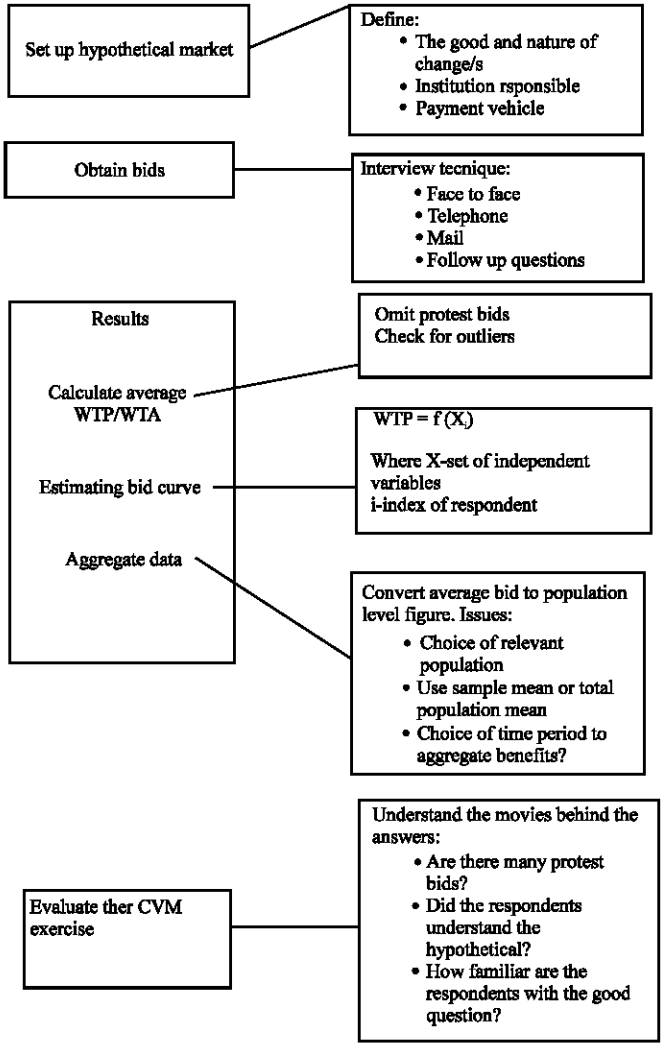

Fig. 3: CVM steps (Source: Adapted from Arrow *et al.*, 1993)

We used Dichotomous Choice (DC) question, in our study. The DC approach was first used by Bishop and Heberlein (1979). The individuals in the DC approach are asked only to accept or reject a suggested price under a hypothetical market scenario. It needs answer only a "Yes" or "No" where each individual is confronted with a different price. It is easier for them to make their decisions in the DC question because they are familiar with discrete choices in market transactions (Hanemann, 1994). DC format is generally considered as the better-quality elicitation method.

If we summarize our study, we can offer it in following steps: identification natural resources along Tehran-Shomal freeway, classification of environmental impacts, quantification of environmental impacts, set-up the hypothetical situation, face to face interview, elicit of WTP, model definition, valuation natural resources along Tehran-Shomal freeway evaluation and CVM steps is summarized generally at Fig. 3.

In some models, other coefficients may include socio-demographic characteristics, attitudinal questions, or trip characteristics. From above equation, Hanemann (1989) showed that the mean WTP can be calculated as Eq. 5 and 6:

$$\text{Mean WTP} = \frac{\beta_0 + (\Sigma\beta_2 X_2 + ... + \beta_n X_n)}{-\beta_1} \quad (5)$$

$$\text{Mean WTP} = \frac{\beta_0 + \beta_n X_n)}{-\beta_1} \quad (6)$$

Hanemann also stated where the probability that a respondent would be willing to pay for an annual permit could be estimated by Eq. 7:

$$\text{Prob(yes)} = 1 - [1 + \exp(\beta_0 - B_1 X_1 + B_2 X_2 + B_3 X_3 + ... < B_n X_n)]^{-1} \quad (7)$$

Under the dichotomous-choice approach, survey respondents were asked whether or not they would to pay for supporting natural resources beside. The respondent answered "yes" if utility from the recreation experience with the associated loss of $X in income would be greater than or equal to the individual's original utility level without it. The "Yes" respondent would hypothetically take (R = 1) and the "No" respondent would choose not to willing to pay (R = 0). Therefore, the probability of a "Yes" response is represented as follows:

$$P\ (\text{Yes} \mid \$X) = P\ [f\ (R = 1,\ I\text{-}\$X) \geq f\ (R = 0,\ I)] \quad (8)$$

Because the individual's utility function is not observable for us, we can assume that the "utility function" has a stochastic term which results in the following transformation of the probability function:

$$(\text{Yes} \mid \$X) = P\ [v\ (R = 1,\ I\text{-}X) + \varepsilon_0 \geq f\ (R = 0,\ I) + \varepsilon_1] \quad (9)$$

"ε_0" and "ε_1"are error terms with means of zero. If the distribution of the difference in the error terms is assumed to follow a logistic distribution, then a Logit model can be estimated (Hanemann, 1984, 1989; Loomis, 1987). We estimated a Logit model in our study because WTP is a dummy variable.

RESULTS AND DISCUSSION

For economic explanation we should sum all of costs for freeway construction. It includes construction costs and environmental costs. The project mangers stated total costs of freeway construction US$ 1127.23×10^6. We apply CV method for environmental degradation costs. CV method can offers mean WTP. We estimate mean WTP after running Eq. 2 for our data rooted in the questionnaire.

Our questionnaire has four parts: Awareness, attitude, willingness to pay scenarios and Scio-economic profile of respondents. The first part of the survey evaluates respondent's knowledge about related topics to case study. It also warms up them to go to more important section, the attitude part is essential because it affected the heart of questionnaire which is WTP scenarios. We carried out pretest with 200 individuals. After estimation according Cochran equation with pretest data, it was done with 511 individuals (Cochran, 1963). Data was entered in an excel file and then transfer to work file of Eviews software. We obtain a Logit model (Eq. 3) with coefficients will come in Table 2.

Table 2: Coefficients variable for model

Variables	Coefficient	Std. error	z-statistic	Probability
β_0	-6.29	1.43	-4.38	0.0000
Gender	4.45	0.51	8.72	0.0000
Environmental sensitivness	0.67	0.17	3.94	0.0001
Education	1.75	0.35	4.98	0.0000
Income	0.001	0.0003	3.36	0.0008
Bidding price	-0.96	0.15	-6.32	0.0000
McFadden R^2	0.680342			
Log likelihood	-79.84236			
SE of regression	0.217240			
Probability (LR stat)	0.000000			

$$\text{Mean WTP} = \beta_0+\alpha_1\ (\text{Gender})+\alpha_2\ (\text{Environmental sensitiveness})+ \alpha_3\ (\text{Education})+\alpha_4\ (\text{Income})+\alpha_5\ (\text{Bidding price}) \quad (10)$$

$$\text{Mean WTP} = \frac{\beta_0 + (\Sigma + \beta_n X_n)}{-\beta_1}$$

$$\text{Mean WTP} = \frac{-6.29.324 + (\Sigma + \beta_n X_n)}{-0.968738} = 1.84\ \text{US\$}$$

We estimated mean WTP US$ 1.84 per household per month or US$ 22.13 annually. It is with regarding our model coefficients. We calculated total WTP also US$ 77.23×10^6. According to Chen (2009) the CVM is applied not only for the evaluation of an environmental sensitive facility but also for damage assessment and the calculation of compensation payments in the practical world. So, it is a reflection of damage assessment of Tehran-Shomal freeway construction, too.

CONCLUSION

The purpose of environmental economic valuation is to support the links between the environment and the economy. Despite the fact that the environment and the economy have been regarded as separate and distinct traditionally, now they are seen as closely interrelated. Sustainable development needs the integration of environmental, economic and social concepts. It justifies how to allocate public spending on different parts of environment.

EIA and economic valuation techniques like CVM have some similarities. The EIA needs the use of a specific economic valuation technique specially CVM. It necessitates specific impacts be quantified in monetary terms. The EV techniques (e.g., CVM), in EIA often concentrate on the construction phase of the projects. Since there are likely to be environmental impacts during the construction, operational and decommissioning phases of a project like our case study which is a freeway. Thus, the economic valuation should apply to the full life period of the project.

Both CVM as economic valuation tool and EIA have the same basic purpose of supporting decision making on the environmental aspects of a major project. CVM is a tool used to perform the economic valuation of the natural resources. In the same time, EIA is a process to evaluate potential positive and negative environmental impacts of a project. One of the weaknesses of EIA relates to low offering quantity results. This weakness can be complimented by applying CVM as

environmental economic tool. CVM can play an invaluable role in improving EIA. Thus, we can enter economic valuation techniques like CVM in the EIS as a new stage. It is a substitute of Cost Benefit Analysis (CBA). We replace CVM in EIA procedure instead of CBA.

EV could enter into the EIA procedure from the preliminary screening of projects to the (EIS) stage and we put it in final step. In the EIS, EV is valuable in judging and comparing significance of impacts (as an alternative to standard EIA weighting/scaling or ranking/rating techniques), determining the appropriate level of mitigation, comparing alternatives and generally providing a more transparent and objective analysis of tradeoffs that is more informative for decision-making (Lindhjem *et al*., 2007).

We compared total costs of freeway construction with the total benefit of Tehran-Shomal freeway construction in the last step. Our results showed total costs of freeway construction is less than total benefits of freeway construction. It demonstrates, even we consider CVM results as an externality or environmental costs and add it to construction costs; Tehran-Shomal freeway construction has economic explanation from economic view.

In conclusion, we applied CVM as an economic valuation for EIA completion procedure in a practice manner. And found a quantities result for making sound decision via a Logit model with CVM.

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