Measuring the Social Value of Nuclear Energy using Contingent Valuation Methodology

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1. Introduction

In recent years, in addition to unstable energy supply and volatile energy prices, environmental concerns make energy security as the principal objective of energy policy in many nations. The International Energy Agency (2007) released what is probably its most pessimistic World Energy Outlook to date saying that oil and natural gas imports, coal use and greenhouse gas emissions are set to grow inexorably through 2030 - trends that threaten to undermine energy security and accelerate climate change, if countries do not change their energy use policies [1].

In near term, nuclear is expected to be accepted as one of the promising alternatives which can achieve both energy security and prevention of climate change. However, nuclear energy has some vulnerable points in the view of social acceptance due to the history of its development and previous. Many countries which use nuclear power as one the major energy sources have been solving the problem of low social acceptance of nuclear energy by allocating enormous subsidy to local government.

Korea decided to give 300 million dollar to the local government, Gyeongjoo, for constructing low level waste management facilities. Japan also paid 120 million dollar to Rokkasho-mura area for constructing nuclear waste repository. Sellarfield in England, Cabril in Spain also received subsidy every year from the related industries and their government. However these subsidies were provided without any appropriate estimation for the value of risk taking of nuclear energy. In addition, those subsidies are expected to increase and burden the central government for the further development and usage of nuclear.

This study, therefore, aims to evaluate the value of nuclear energy in view of social acceptance in order to contribute to effective application for the future nuclear development and policy making. We estimate the Willingness-To-Pay of nuclear energy using Contingent Valuation Method (CVM). We find high social cost of nuclear energy due to the asymmetry of information about the safety of nuclear energy will be estimated and find the solutions for improving social acceptance of our society for nuclear energy.

2. Empirical design and data collection

2.1 Theoretical framework of Contingent Valuation Methodology

The Contingent Valuation Method (CVM) has become popular and widely applied in many countries for assessing the benefits from public goods or project accruing to society [2]. CVM relies only on stated intentions of survey respondents confronted with some change scenario in contrast to indirect valuation methods such as hedonic pricing or the travel cost method which are based on observable actions of households in the marketplace. In such a scenario can describe the essential features and specify the kinds of benefits the work would generate. After then, respondents are asked their willingness to pay (WTP) for this work if it were to be implemented where this WTP is taken as an indicator for the households' utility changes [3]. To the least, it is required that they obtain a complete perception of the public goods and the benefits to be expected from it, and that they balance their expected increase in well-being to the loss of market consumption in the future as a consequence of having to pay for the goods. Moreover, respondents must believe the payment mechanism, i.e. that their answers to the survey are consequential and that they would actually have to pay the stated amount if the project is to be implemented [4]. Therefore, in order to find the depreciation of the social valuation of nuclear energy stemming from the lack of safety information about nuclear energy, two types of survey was conducted, survey with and without safety information about nuclear energy. The difference of WTP from the two different surveys will explain the amount of the depreciation of social valuation on nuclear energy originated from the low social acceptance of nuclear energy.

2.2 Survey design

This study used a direct face-to-face interview which has been shown to be the most reliable approach in contingent valuation studies [4]. The survey was conducted in May 2007. 8 different cities were selected as a survey area. To compare the effect between the areas which have nuclear power plants and don't. 4 metropolitan areas, Seoul, Busan, Daegoo and Daejon, and 4 local areas which have nuclear power plant in, Young-gwang, Kyungjoo, Ulchin and Kijang, were selected. The respondents' number of male and female is the same.

Two types of questionnaire was made to estimate the depreciate value due to lack of information from the nuclear industries to the public. Type 1 contains no additional information for the nuclear energy but type 2 has some information related to the nuclear such as accident histories, electricity generating cost, low carbon generations and radiation hormesis. Only the difference between type 1 and type 2 is information and

both types have same questionnaires. And each questionnaire had three sections. The first section collected information on the respondents' socio-economic characteristics and the second part included questions relating to the perception, attitudes and awareness of the respondents towards the nuclear energy in general. In the third section included the amount of the respondents' willingness to pay.

3. Results

3.1 Estimation results of the model without covariates

This study conducted the survey through the professional survey company using face to face interview. 329 available data after eliminating outliers which are not included within 99% confidence interval were collected from the survey. The results show the number of the people who have in mind to pay for nuclear is obviously increased and the number of the people who will not pay for nuclear is decreased from 40.4% to 16.7% which means the information did a certain role to increase respondents' WTP value. Table 1 shows the obtained data.

Table 1. Results of the survey

Type 1		Type 2	
'y'-'y'	48 (14.59%)	'y'-'y'	106 (32.22%)
'y'-'n'	114 (34.65%)	'y'-'n'	138 (41.95%)
'n'-'y'	34 (10.33%)	'n'-'y'	30 (9.11%)
'n'-'n'	133 (40.43%)	'n'-'n'	55 (16.72%)
329 (100%)		329 (100%)	

Note: 'y' indicates answer 'yes' and 'n' indicates answer 'no'.

3.2 Estimation results

Using maximum likelihood estimation, equation (6) with DBDC model was estimated including covariates. The results are shown in table 2.

Table 2. Results of Parameter Analysis

Parameter	Estimate ($)	Standard error	t-statistic	p-value	CHISQ
M^1_WTP-1	0.45	86.06	5.35	0.00^{**}	28.59
M_WTP-2	0.76	75.97	10.17	0.00^{**}	103.55
Md^2_WTP-1	0.63	86.06	4.48	0.00^{**}	20.11
Md_WTP-2	0.99	126.19	7.81	0.00^{**}	60.99

Wald Test for the hypothesis that the given sets of parameters are jointly zero
** Significant within 1% significant level
M^1 Mean value Md^2 Median value

From the Korea Statistical Information Service (KSIS), Korea population is 47,278,951 as of June, 2008. With these results we can draw the estimated value of nuclear energy. The estimated value of nuclear energy is defined as the difference between the WTP results of type 1 and type 2. Therefore the total value of nuclear energy is calculated as from 177 to 202 million dollar per year, mean WTP and median WTP respectively. The difference between Mean WTP and Median WTP is the way to withdraw the estimated value.

4. Conclusions

Nuclear is the major source of electricity in Korea and "Basic National Energy Policy" addresses nuclear will be a national main energy source by 2030. However public still keeps nuclear at a distance and insists to replace nuclear by renewable. Therefore tremendous cost to enhance social acceptance of nuclear are spent in Korea. Therefore this paper used CVM to find out the social value based on the social depreciation of nuclear energy through face to face interview. CVM estimates willingness to pay for the electricity generation of the nuclear energy from the respondents. After given information about nuclear energy, the amount of WTP and the number of payer for the nuclear are obviously increased which means social depreciation of the nuclear energy is basically come from the lack of communication both public and the government. Public who are more accustomed to nuclear energy has a higher willingness to pay value. Therefore, opposite to general idea, local areas which have nuclear power plants have a higher WTP value than metropolitan region. This study suggests large effort to share the information to the public is the only way to increase the social value and public acceptance of nuclear energy. This implication will be used as a crucial evidence for the policy makers especially who are in charge of nuclear public relations. Also it is a meaningful try to apply the CVM to estimate the social value of nuclear energy.
Further work is needed to explore alternative ways of presenting the CV scenario; to expand the scale of the survey and their consistency across settings.

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