

Economic Valuation of an Urban Green Space Using Double-Bounded Dichotomous Choice CVM

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이단계 이선 가상가치평가법을 사용한 도시녹지의 경제적 가치평가

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ABSTRACT

본 연구는 서울시 도시녹지를 1평을 늘리는 것에 대한 시민들의 지불의사금액(WTP)을 이단계 이선 가상가치법으로 계산함으로써 도시녹지의 경제적 가치를 평가하고, WTP에 영향을 미치는 변수들의 종류와 영향력 정도를 밝히기 위해 수행되었다. 지불도구는 기금이었으며, 'fat-tail problem' 없이 WTP를 계산하기 위해 생존분석을 사용하였다. 분석 결과, 서울시민들은 생활녹지 1평을 늘리는데 약 23,400원을 기부할 용의가 있었다. WTP에 영향을 주는 변수는 자연환경태도(NEP), 구조적 제한요소, 소득 및 환경보전을 위해 편리함을 양보할 의사이었다.

본 연구의 결과는 도시녹지의 개발 또는 보존과 관련된 정부의 의사결정이나 도시녹지 관련 예산 확충을 요구할 수 있는 기본 자료로 활용할 수 있을 것이다.

주요어: 도시녹지, 이단계 이선 가상가치평가법, 지불의사금액

I. INTRODUCTION

Urban green space is the soil surface area capable of sustaining vegetation, as distributed within the city

planning area, and is closely related to the life of citizens. Green space areas provide substantial environmental and ecological benefits in highly urbanized areas. In other words, urban green space con-

tributes to atmospheric purification, heat island control, energy savings, runoff retention, water quality improvement, soil erosion abatement, and biodiversity enhancement(Dwyer et al., 1992; Miller, 1997). In addition, urban green space offers people the chance to enjoy the beauty of nature's seasonal changes, while utilizing recreational areas for exercise and relaxation. The visual and recreational benefits of green space contribute to the maintenance of mental and physical health of citizens by reducing stress levels typically associated with the fast pace of urban lifestyles and by expanding opportunities for social contact with others(Ulrich, 1984;1986; Dwyer et al., 1992).

However, creating new green space is often controversial as it is difficult to measure the benefits in economic terms. Additionally, real estate prices in urban areas have skyrocketed, making land acquisition for urban green space an expensive endeavor. Consequently, many studies have been conducted to measure the benefits in monetary value. These studies have adopted a variety of methods(Dwyer et al., 1983; Morales et al., 1983; Tyrvinen and Väänänen, 1998), however those used most often include the travel cost method, hedonic price method and contingent valuation method(CVM). Each method has both strengths and weaknesses. When utilizing the travel cost method, the object is then limited to evaluating a travel destination where visitors are motivated by opportunities for recreation, and the value of the urban green space could be underestimated due to its short traveling distance. With the hedonic price method, it is not easy to determine how much influence green space has on the real-estate value and, consequently, the price. The CVM has been criticized because it calculates the value based on hypothetical answers to hypothetical question and response biases such as strategic bias and payment vehicle bias may affect the study results(More et al.,

1988; McPherson, 1992). Although it is flawed, among the three methods, CVM is currently the most widely adopted method for valuating environmental assets(Tyrvinen and Vaananen, 1998). The CVM is a way to estimate value by surveying respondents' willingness to pay(WTP) after suggesting hypothetical changes. It is named the CVM because it reckons value assuming non-existent situations. When one behaves under volitional control, there is high correlation between intention and behavior(Fishbein and Ajzen, 1975). The CVM assumes that respondents will react as if they were in the real situation, even though they are in a hypothetical situation. If this assumption is correct, the CVM has the following advantages: (a) it can estimate economic benefits, including use value and existence value, even before public goods are fully set up; and (b) it is unnecessary to indirectly estimate demand function because it can directly collect related information through respondents' WTP(Bockstael et al., 1991; Stevens et al., 1991; Mitchell and Carson, 1993).

Despite the fact that urban green space is the essential factor in maintaining the soundness of urban ecosystem and the healthiness of citizens' living environment, it has been severely damaged by rapid expansion of urban population and economic development. Over the last three years, the decrease rate of forest in urban areas averaged 3.5%, almost 35 times higher than the nationwide average. For instance, the urban green space of Seoul accounts for 27% of the city's total area. This green space ratio is comparable to that of the metropolitan cities of other nations. However, when the ratio is more closely examined, it becomes clear that it is problematic to compare green space in terms of size ratio for two main reasons. First, the division of the developed area and the green space are clearly divided in Seoul since more than 76% of its green space is composed of mountains located at the outskirts of the city. What

makes this situation even worse is the fact that the green space area is disconnected and fragmented due to discriminated urban development. Second, because of insufficient urban park space and a meager budget allocation for maintaining urban green space (1.5% out of the total budget), there is only 4.5m² of green space per person within the urban area that is easily accessible on foot (500m). This ratio is only half of the minimum ratio recommended by the FAO (Seoul Development Institute, 2001; Seoul Metropolitan Government, 2002). Recently, as citizens have expressed greater interest in the role of urban green space, several movements have developed to address issues connected to urban green space. One of the groups inspired by this atmosphere is the Seoul Green Trust which began in 2003. The Seoul Green Trust is an NGO whose purpose is to contribute to the expansion of urban green space. The main objective of the Trust is to establish 10 million Pyeoung of extra green space by expanding the green space of Seoul by 1 Pyeoung (3.3m²) per citizen over the next 20 years, while encouraging and cultivating active citizen participation in the establishment and management of green space in Seoul. In the spirit of this type of social activism, the purpose of this research is to value the economic value of urban green space by estimating citizens' WTP with double-bounded dichotomous choice CVM, and to provide the basic information necessary for planning and managing urban green space in the future by identifying the types and influence level of the variables affecting the WTP.

II. METHODS

1. Contingent Valuation Method

When the CVM is used, respondents should give their WTP based on non-existent hypothetical situations. This is as difficult as estimating the price of

products with no price tags. Therefore, a variety of WTP elicitation methods have been developed in order to gain valid outcomes while offsetting its weak points. One of these methods is single-bounded dichotomous choice (SB) approach. This method requires respondents to answer either yes or no to the given bid amount. Since the process is similar to buying commodities in every day life, respondents can estimate hypothetical changes more easily than they do using other WTP elicitation methods. This advantage has made the SB-CVM the more widely used approach since it was introduced by Bishop and Herberlein in 1979 (Dharmaratne and Brathwaite, 1998). It consists of two steps. In the first step, one of the predetermined bid amounts is presented to respondents. In the second step, the logit model is used to calibrate the value by setting the probability of receiving a yes answer as the dependent variable and the bid amount as the independent variable (Equation 1). And then a mean WTP is computed by integrating the values (Equation 2) (Hanemann, 1984; Loomis, 1988; Hanemann, 1989).

$$P(A) = [1 + e^{-(\alpha - \beta \cdot A)}]^{-1} \text{ ----- (equation 1)}$$

$P(A)$: probability of answering yes to bid amount A
 α, β : coefficients, $\beta > 0$

$$WTP = \int_0^{\infty} [1 + e^{-(\alpha - \beta \cdot A)}]^{-1} d(A) \text{ - (equation 2)}$$

Since respondents can easily answer SB questions, it is easy to use the SB-CVM for mail or telephone surveys. It also minimizes biases such as interviewer biases, strategic biases and starting point biases. However, the SB-CVM also has drawbacks. First, the outcome variables of the SB are so simplistic (i.e., yes or no) that the results can yield less specific information than that of other methods, which require a greater number of samples than other approaches. Second, in order to get a precise mean WTP value, Equation 2 has to be integrated limitlessly while the

maximum bid amount must be set to a specific value in reality, which causes fat-tail problems - bid amount over the maximum amount is left out of the calculation. In other words, the bid amount must be integrated from 0 to an infinite to get the value of WTP. To get a precise mean WTP value from the equation 2, unpractical price has to be presented as a bid amount. Since realistic number has to be used as a maximum amount, a fat-tail problem emerges (Loomis, 1988; Cameron and Huppert, 1991; Cooper and Loomis, 1992; Alberini, 1995a; Brown et al., 1996).

The double-bounded dichotomous choice (DB) CVM proposed by Hanemann(1985) is the combination of the SB and the bidding game to keep it easy for respondents to answer and to enhance efficiency, while solving the most disadvantageous drawbacks of the SB-CVM: efficiency of data. The level of the second bid is contingent upon the response to the first bid. If the individual responds "yes(no)" to the first bid, the second bid is greater(smaller) than the first bid. The DB-CVM is superior to the SB-CVM in two ways: (a) it is very efficient because the standard deviation of parameter is reduced by 60% and the confidence interval is a quarter of the SB-CVM (Cameron and Huppert, 1991; Hanemann et al., 1991); and (b) it provides a more powerful goodness-of-fit test of assumed model specification(Hanemann et al., 1991; Alberini, 1995a).

Nevertheless, fat-tail problems remain and there are starting point biases unlike SB-CVM(Cameron and Quiggin, 1994). Thus, interval censored survival analysis was suggested to calibrate the DB-CVM, to remove analytical difficulties and the fat-tail problem (Carson and Mitchell, 1987; Carson and Steinberg, 1989). This analysis used time as the outcome variable of interest until an event takes place. With survival analysis, one is able to use both exact failure and censoring data. Censoring takes place when some data on individual survival time is given, but the

exact survival time is never known(Kleinbaum, 1996). When the WTP provided by respondents is regarded as survival time and the survival time is assumed to follow a Weibull distribution, Equation 3 was generated to indicate its survival function and Equation 4 to calculate its mean WTP.

$$S(t) = \text{Exp} \left[- \left(\frac{1}{\theta} \times t \right)^\gamma \right] \text{----- (equation 3)}$$

$$\int_0^\infty \text{Exp} \left[- \left(\frac{1}{\theta} \times t \right)^\gamma \right] \text{----- (equation 4)}$$

$S(t)$: survival function, t : survival time(bid amount)
 θ : scale parameter, γ : shape parameter

When the bid amount is reasonably set, the efficiency of the DB-CVM is substantially enhanced and therefore, the number of required samples is also reduced. Optimal design using only 2 bid amounts is the best method theoretically, yet it is only feasible on simulation(Alberini, 1995b). The CVM generally requires more bids; however, too many bids lower both efficiency and power in detecting departures from the maintained distribution of WTP(Cameron and Huppert, 1991; Alberini, 1995a). There is no certain method to determine bid amount, but outcomes of the existing studies are colligated below:

- (a) If the number of evaluating respondents per each bid amount is same, middle only- offering bid amounts equivalent to 30th, 40th, 50th, 60th, 70th percentile of WTP distribution- is the most effective. The second bid amount is equal to twice (one-half) the first bid amount when respondent say yes(no) to the first bid amount(Kanninen, 1995).
- (b) When there is some gap between the first bid amount and the second bid amount, the anchoring effect is reduced(Hanemann et al., 1991).
- (c) No more than 4 or 6 bid sets is advisable (Alberini, 1995a).

(d) It is recommended that the second bid lie within the 10th-90th percentile of WTP distribution(Kanninen, 1995).

The DB-CVM was used in this research in order to calculate the WTP of Seoul citizens regarding the expansion of urban green space by 1 Pyeoung. The fat-tail problem was controlled by applying the interval censored survival analysis in calibrating the data, assuming they follow the Weibull distribution.

2. Questionnaire Construction and Data Collection

Donation was used as a payment vehicle. Although taxes are generally used as the payment vehicle for the CVM, there are two main reasons why donation was adopted for this study. First, concerns over additional tax payments makes it difficult to determine the exact WTP. Second, the donation vehicle does not cause serious strategic bias(Stevens et al., 1991; Lockwood and Tracy, 1995). The bid amount for the main survey was determined by direct questioning of 120 Seoul citizens how much they are willing to donate. The respondents for this preliminary survey were selected in two stages: first, 20 Tongs were randomly chosen in Seoul; then, 6 residents were selected by quota sampling out of each Tongs chosen in the first stage. The gender ratio and age of Seoul citizens were used as quota variables. Since respondents were not familiar with the precise concept of urban green space, interviewers first presented them with photos of urban green space and an explanation of the concept, then asked them to answer the questionnaire. The first bid was determined by "middle only" strategy. When the suggested amount is ₩0, it was excluded in percentile calculation. And if we could not find an amount that accurately fits the corresponding percentile, we chose a close amount that is commonly used amount as the

first bid amount. The second bid was set at half or at the amount twice of the amount first suggested (Kanninen, 1995). That is, the first bid amount was set at ₩8,000, ₩10,000, ₩20,000, ₩30,000 and ₩50,000, which is the 30th, 40th, 50th, 60th, 70th percentile of the cumulative ratio of WTP. The second bid amount was at the half or twice of the predetermined first bid amount (Table 1).

Table 1. Bid amount and results of survey

1 st bid(₩)	2 nd bid(₩)	Classification	Number of Respondents(%)
8,000	4,000	(N, N) ^a	41(31.5)
		(N, Y) ^b	25(19.2)
	16,000	(Y, N) ^c	45(34.6)
		(Y, Y) ^d	19(14.6)
10,000	5,000	(N, N)	28(21.5)
		(N, Y)	29(22.3)
	20,000	(Y, N)	52(40.0)
		(Y, Y)	21(16.1)
20,000	10,000	(N, N)	54(41.5)
		(N, Y)	20(15.4)
	40,000	(Y, N)	51(39.2)
		(Y, Y)	5(3.8)
30,000	15,000	(N, N)	69(53.1)
		(N, Y)	20(15.4)
	60,000	(Y, N)	36(27.7)
		(Y, Y)	5(3.8)
50,000	25,000	(N, N)	80(61.5)
		(N, Y)	21(16.2)
	100,000	(Y, N)	26(20.0)
		(Y, Y)	3(2.3)

^a: Both answers are no.

^b: A "no" followed by a yes.

^c: A "yes" followed by a no.

^d: Both answers are yes.

There are few studies on economic evaluation of urban green space in Korea(Choi, 2001; Hong, 1998). Consequently, for the purposes of this study, attitudes toward the natural environment, constraints, and socio-economic variables outlined in Table 2 were chosen as the independent variables affecting the WTP of urban green space. Attitudes toward the natural environment were measured by the Korean version of the New Environmental Paradigm(NEP) scale developed by Dunlap and Van Liere (1978). This scale uses internally consistent attitude statements to identify each respondent's perception of the ecological integration between humans and the environment(Shin et al., 2001). In line with the ecologically integrative view, this approach assumes that (a) humans are a part of nature, (b) the carrying capacity of the ecosystem is limited, and, (c) it is desirable to restrict development in order to maintain a balance between humans and nature. Additionally,

it is well documented that constraints exert direct and indirect influences on both leisure preference and leisure participation. They are conceptually grouped into the following sub-categories: intrapersonal vs. interpersonal vs. structural barrier(Crawford and Goodbey, 1987), and antecedent vs. structural barrier (Henderson et al., 1988). Constraints were operationalized by the items used in the leisure and recreation field(Jackson, 1990; Jackson and Henderson, 1995; Botha et al., 1999). For socio-economic variables, income, age and years residing in Seoul were used since they were measurable in the interval scale (Seoul Development Institute, 2001; Korea Forest Service, 2002).

A polling agency conducted sampling and data collection targeting Seoul citizens. Respondents were selected by cluster sampling with probabilities proportional to size. Only those who are 19-59 years of age were surveyed due to sampling cost consider-

Table 2. Independent variables

Variables	Description	Coding
Environmental attitudes		
YIELD	Intention to yield personal convenience to environmental preservation	No(0), Not decided(1), Yes(2)
F1-NEP	Factor 1 of NEP: man's relation with nature	Factor score
F2-NEP	Factor 2 of NEP: limits to Growth	Factor score
F3-NEP	Factor 3 of NEP: perception of balance of nature	Factor score
Constraints		
F1-CON	Factor 1 of constraint: antecedent constraints	Factor score
F2-CON	Factor 2 of constraint: structural constraints	Factor score
Socio-economic		
INCOME	Average of household monthly income	Less than ₩2,000,000(0), ₩2,000,000-₩2,999,999(1) ₩3,000,000-₩3,999,999(2) over ₩4,000,000(3)
AGE	Age	Actual age
RESIDE	Years of residence in Seoul	Within 1 year(1), 1-3 years(2), 3-5 years(3), 5-10 years(4), over 10 years(5)

rations. In the first stage, 65 Tongs were selected. In the second stage, 10 residents were selected from each of the Tongs chosen. Then, face-to-face interviews were conducted on a total of 650 Seoul citizens. The data was collected from August 8 to August 27, 2003. As in the preliminary survey, respondents were provided with the photos of and explanation on urban green space before answering the questionnaire. Then, the following questions were asked: "If the city of Seoul raises a fund to expand 1 Pyeoung of green open space in the district you live, are you willing to donate ___ won?" The interviewer then followed up with: "What if ___ won?" When respondents answered (Y,Y) or (N,N) to a bid set, they were offered maximum or minimum WTP in order to collect data in the interval censored form. When the minimum WTP suggested is ₩0, the reasons were questioned so as to confirm the possibility of protest zero and free-riding.

III. RESULTS

Since the bidding characteristics of DB may cause starting point bias, these were double-checked before the analysis. Yea-saying did not lead to any problems, since the proportion of (Y,N) was higher than that of (Y,Y) (Hanemann et al., 1991) (Table 1). No serious anchoring effect was found, because the proportion of (N,N) to most of the donations was higher than that of (N,Y) (Herriges and Shogren, 1996). Only for the combination of ₩10,000 and ₩5,000, the number of respondents saying (N,N) was one person less than those saying (N,Y). The existence of "free-riding" and "protest zero" was confirmed by the reason suggested by those whose WTP was 0 (Table 3). There were one hundred twenty-one respondents who indicated no intention to donate (18.6%), 53.7% of whom wanted Seoul City to impose taxes instead of raising funds. Given this finding, the possibility of free

riding could not be ignored. Protest zero was not problematic. By category type, there were 16, 16, 5, 5, and 3 respondents who showed higher WTP than the maximum amount of ₩16,000, ₩20,000, ₩40,000, ₩60,000 and ₩100,000: nevertheless, only two respondents revealed an inclination to pay ₩1,000,000, which was judged to be a less realistic amount. This helped to conclude that over pledging was also not problematic. Those respondents suggested diverse reasons, but most of them were related to enhancing the quality of the living environment (Table 3).

Except for respondents whose WTP via donation was ₩0, the survival analysis was carried out based on the data of the remaining 529 respondents. Both shape and scale parameters were significant (Table 4). The linear pattern of the log-log survival curve and goodness-of-fit test ($p=0.000$) supported the assumption that the Weibull distribution for survival time is correct. Since survival function means demand function, when the function is integrated, the mean WTP of respondents who were willing to pay donation was ₩23,436.9 (equation 5). If respondents without payment intention were included, the mean WTP amounted to ₩19,074. When this result is applied to total residents in Seoul whose ages range from 19 to 59 (3,269,131 persons) (Korea National Statistical Office, 2000), the ultimate value of the park stands at about ₩62,355,000,000.

$$\int_0^{\infty} \text{Exp} \left[- \left(\frac{1}{21,462.462} \times t \right)^{0.845} \right] = 23,436.9$$

----- (equation 5)

The independent variables influencing WTP were analyzed with Weibull's proportional hazard model, which is one of the parametric models of survival analysis. For the independent variables, attitudes toward the natural environment and constraints were measured with a multi-item scale, and were factor analyzed to calculate factor scores in order to ope-

Table 3. Analysis results of open-ended questions

WTP=0 ^a	Number(%)	WTP > 2nd Bid ^b	Number(%)
Prefer taxes	66(53.7)	To establish park	11 (17.7)
Financially not affordable	30(24.3)	To purify air	10 (16.1)
Uncertain fund management transparency	14(11.4)	To establish good environment	7 (11.3)
No need for green space	4(3.3)	For descendants	5 (8.1)
Unlikely to use	4(3.3)	To secure scenic landscape	4 (6.5)
Others	5(4.1)	For cleaner environment	3 (4.8)
Total	123(100)	To ease air pollution	3 (4.8)
		Very important because the environment and human beings are completely interconnected	2 (3.2)
		Green space calms strong emotions	2 (3.2)
		This amount is worth it in order to secure a better life	2 (3.2)
		Afford to pay for environmental improvement	2 (3.2)
		Others	11 (17.7)
		Total	62(100)

^a: Reasons for no intention to pay(multiple response).

^b: Reasons for intention to pay higher amount than the second bid(multiple response).

Table 4. Estimation result of survival analysis

Parameter	Estimate	S.E.	t-ratio	p-value	C.I.
Shape	0.845	0.024	34.622	0.000	0.7980-0.8920
Location	21462.462	1182.195	18.155	0.000	19145.4-23779.6

rationalize NEP and its constraints. The factor structure of the both the NEP and the constraints scale was determined through a principal component factor analysis with a varimax rotation. Based on the overall Kaiser's MSA of 0.78 and 0.89 of the NEP and its constraints, it was deemed acceptable to perform the factor analysis. Those with an eigenvalue of 1 or more were taken into account as factors. With the sample size of 650, extracted factors were interpreted on the basis of variables with factor loadings of 0.4 or more(Hair et al., 1995). The first NEP factor was named "man's relation with nature", the second factor was "limits to growth", and the third factor was

"perception of balance of nature"(Table 5). Overall, the factor pattern was similar to that of the existing study(Chung and Poon, 2001), but "the earth is like a spaceship...", generally assumed to be in the second factor, was included in the third factor. Cronbach alphas were undertaken on each of the items of three factors: 0.80, 0.62, and 0.57 for the first, second, and third factor, respectively. The alpha of the third factor was less than the minimum criterion of 0.6 suggested by Nunnally and Bernstein(1994) but the difference was not very big. It seems that rather unsatisfactory results were drawn from the factor analysis and Cronbach alphas, partly because this research used the

Table 5. Rotated factor patterns of NEP scale

NEP items	Factor 1 ^a	Factor 2 ^b	Factor 3 ^c
Mankind was created to rule over the rest of nature. ^d	0.797	0.066	-0.008
Plants and animals exist primarily to be used by humans. ^d	0.786	0.172	-0.073
Humans have the right to modify the natural environment to suit their needs. ^d	0.643	0.289	-0.166
Humans need not adapt to natural environment because they can remake it to suit their needs. ^d	0.466	0.322	0.063
Three are limits to growth beyond which our industrialized society cannot expand.	0.329	0.596	0.014
To maintain a healthy economy we have to develop a 'steady-state' economy where industrial growth is controlled.	0.202	0.572	0.076
We are approaching the limit of the number of people the earth can support.	0.112	0.406	0.326
When humans interfere with nature it often produces disastrous consequences.	-0.196	-0.097	0.518
Humans must live in harmony with nature in order to survive.	-0.161	0.024	0.500
The balance of nature is very delicate and easily upset.	0.150	0.068	0.406
The earth is like a spaceship, with only limited room and resources.	-0.007	0.295	0.406
Mankind is severely abusing the environment.	0.013	0.275	0.392
Variance explained	21.3%	12.5%	11.5%

^a: Man's relation with nature.

^b: Limits to growth.

^c: Perception of balance of nature.

^d: Anti-NEP items.

Table 6. Rotated factor patterns of constraints

Constraints items	Factor 1 ^a	Factor 2 ^b
Visited several times, so no interest	0.689	0.288
No person to go with	0.684	0.144
People in the place are not my kind	0.684	0.286
Accompanying people dont like to go	0.637	0.293
Hard to find time to go with other people	0.617	0.353
Have kids	0.479	0.324
Fear of crime in the green space area	0.465	0.461
Round-trip transportation, inconvenient	0.234	0.778
Takes too long to get to the destination	0.261	0.772
Too many people, so crowded	0.362	0.421
Variance explained	29.0%	20.9%

^a: Antecedent constraint.

^b: Structural constraint.

NEP scale translated into Korean. No matter how efficient the translation, some differences will exist between the translated version and the original due to linguistic and cultural reasons. For constrains, one factor consisted of structural constraint items while the other factor consisted of a combination of interpersonal and intrapersonal constraint items(Table 6). According to Jackson(1990), interpersonal and intrapersonal barriers play the similar role. After considering Jackson's argument, "antecedent constrains" was chosen as to identify the factor composed of both interpersonal and intrapersonal constraint items(Henderson et al., 1988). Cronbach alphas of the first and second factors were 0.86 and 0.79, respectively, both of which exceeded the modest reliability level of 0.7. The variables were selected to calibrate the Weibull proportional hazard model with the backward option.

Table 7. Estimation result of Weibull Proportional Hazard model

Parameter	Estimate	S.E.	t-ratio	p-value	Hazard ratio
Shape	0.954	0.023	31.675	0.000	
Location	10057.64	808.23	12.44	0.000	
F1-NEP ^a	-0.276	0.045	-6.183	0.000	0.759
F2-CON ^b	0.088	0.049	1.811	0.070	1.092
Income	0.154	0.040	3.823	0.000	1.166
Yield	0.395	0.047	8.432	0.000	1.484

^a: Man's relation with nature.

^b: Structural constraint.

Then the variables of p -value below 0.05 were removed. Also, the results were confirmed with Likelihood Ratio statistics. The log-log survival curve was shown to be linear so that the Weibull distribution assumption was correct. The analysis showed that "F1-NEP", "F2-CON", "INCOME" and "YIELD" were significant variables (Table 7). This finding suggests that people are more willing to pay a donation when they are less likely to perceive they have a relatively greater right to take advantage of nature and natural resources, they have more structural constraints, earn higher incomes and are inclined to yield personal convenience to environmental conservation. More specifically, the hazard ratio of "F1-NEP", "F2-CON", "INCOME", and "YIELD" were 0.759, 1.092, 1.166, and 1.484, respectively. These figures indicate that if "F1-NEP", "F2-CON", "INCOME", and "YIELD" increase by 1 unit, donation WTP becomes higher by 1.318, 1.092 ($e^{0.088} = 1.092$), 1.166, and 1.484 times, respectively. Since high loading items of "F1-NEP" were anti-NEP, estimated coefficients were multiplied by -1 to estimate the WTP increase whenever "F1-NEP" rises by 1. In addition, in the case of "YIELD", for instance, there was 2-unit difference between those with intention and those without intention. This indicates that the number of individuals with the intention to yield

personal convenience to environmental conservation was 2.203 ($e^{0.3952}$) times higher than those without.

IV. CONCLUSION

The process of pursuing rapid economic development in Korea has damaged the natural green space distributed around the cities, while the lack of green space planning and management has degraded the living environment of highly urbanized inner-cities. Moreover, there are minimal budget allocations for managing urban green space as policy makers are typically unaware of its importance in maintaining the health and well-being of the citizenry. Fortunately, increasing social awareness of the ecological, aesthetic and recreational benefits of urban green space is slowly leading to less reliance on traditional economy-oriented urban development. A case in point is that citizens register a marked preference for residential sites that include abundant green space, in spite of relatively higher prices.

This research was conducted targeting the metropolitan city of Seoul with its population of 10 million, to emphasize that expanding green space is valuable in economic terms by estimating each citizen's willingness to pay for the expansion of 1 Pyeong of urban green space, and to identify the variables that

influence the amount they are willing to pay. In order to secure higher reliability, sampling and data collection were commissioned to a polling agency, and the CVM, which has been widely used to estimate the economic value of the public goods, was adopted (U.S. Water Resources Council, 1983; U.S. District Court of Appeals, 1989). The CVM hypothesizes that respondent intention (i.e., WTP) is highly correlated with behavior (i.e., actual payment) (Fishbein and Ajzen, 1975). However, it must be noted that the CVM presents respondents with hypothetical situations, making it problematic for respondents to estimate unfamiliar situations they have not yet experienced. In order to alleviate this shortcoming, the dichotomous choice approach to elicit WTP was applied. Among them, the double-bounded dichotomous approach was chosen as it is easy for respondents to answer and yields higher data efficiency. Survival analysis was used to calculate WTP as it removes any possibility of a fat-tail problem from the outset.

After analysis, it was found that respondents' average WTP for green space was ₩19,074, and when this figure is applied to all the Seoul citizens aged between 19 and 59, the total amount stood at ₩62,355,000,000. The variables affecting the amount of WTP were one of the NEP factors ("man's relation with nature"), structural constraint, income and intention to yield the currently enjoyed convenience to the environmental conservation. This finding had been anticipated. That is, respondents were more likely to donate in the following cases (a) the less people think they are more privileged to take an advantage of nature and natural resources (b) the more they think green space is too crowded, transportation is inconvenient or travel time is too long to get to green space despite their preference for it; (c) the greater financial stability they enjoy and (d) the more they believe they owe their convenience to the sacrifice of

environment. Unexpectedly, the two other factors of NEP ("limits to growth" and "perception of balance of nature"), antecedent constraint, and age and years residing in Seoul turned out to have almost no relevance. The Korean translated version of the NEP was used for this study. This was the major reason for low reliability of the two factors, consequently making them insignificant. In the leisure and recreation field, it is known that antecedent constraint and structural constraint affect preference and the level of participation, respectively (Jackson, 1990; Jackson et al., 1993). When these findings are applied to this research, while those with high structural constraints indicated willingness to pay more to reduce those constraints, those with high antecedent constraint indicated a preference for the expansion of green space, but their preference was not strong enough to inspire a willingness to donation. In regards to age, younger individuals exhibited greater awareness of the importance of the environment, but may not have the financial resources to donate to green space areas. It appears that the number of years of residence in Seoul did not affect WTP. Bearing in mind the high relocation rates in Seoul, there is a common belief that donating to green space is not a good idea when one could leave at any time and then receive no direct benefits for a financial contribution. In 2002, 23% of Seoul's population was involved in relocating either in or out of the city (<http://webseoul.metro.seoul.kr> :6600).

As the monetary value of urban green space was calculated using objective and measurable methods based on citizens' responses, it is anticipated that these results will assist in promoting greater understanding of the importance of expansion of urban green space. In addition, these results may be used as a persuasive tool in encouraging the government to decide on the development/management of existing green space and enhancement of an urban green

space-related budget. Yet, the findings should be generalized with caution as there were certain limitations to this research. First of all, the accurate bid amount increases the efficiency of the CVM drastically and reduces the required number of samples. As there has been few previous research investigating the estimation of the economic value of urban green space in Korea, the bid amount was determined after quota sampling Seoul citizens. Non-probability sampling, however, induces less reliable results; therefore, bid amounts should be determined using probability sampling in the future studies, if financially feasible. Second, the effect of "free-riding" is around 10-30%, according to Schneider and Pommerehne (1981). In this research, 53.7% of the respondents without any intention to pay preferred "paying taxes", so it is assumed that "free-riding" partly influences the average WTP. Third, the age of respondents was restricted to 19-59. In order to obtain a more reliable average WTP, it is necessary to broaden the age range. Finally, the use value and existence value were not computed separately in this research; the total economic value was computed. When creating new green space, if items asking respondents intention to visit are included, it could be possible to estimate the two economic values separately.

Research attempting to identify the qualitative and intangible values of urban green space within the economic value would be meaningful as this might suggest economic criteria for evaluating the importance of urban green space by emphasizing the economic aspect of cost-vs.-benefits. If policy makers are provided with accurate economic valuations of feasible alternatives in advance, the findings of this study may be utilized as a basis for making decisions about the development and conservation of urban green space or by agencies seeking greater funding to manage urban green space.

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