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Using Discrete Choice Experiments to Estimate the Marginal Willingness to Pay of Insurance Premium for the Cancer Treatments in Korea:

A General Population Study

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This study, using discrete choice experiments (DCE) method, tries to figure out the characteristics of the decision-making for cancer treatments and investigates the attributes affecting the respondents' choice. Also it ascertains marginal willingness to pay (MWTP) and relative preferences for cancer treatments among the general population. The nested-logit model using full maximum likelihood allows us to estimate multi-levels of dependent variables. The empirical results show that the respondents are willing to pay more about 20.8% than they are paying now in order to increase their expected survival rate by 10 percentage points. The paper also considers the effect of several individual and socio-economic variables on the size of MWTP of insurance premium for increasing cancer survival rates. Most interestingly, the MWTP is shown to be monotonically decreasing as the people became old. We also found out that there exists severe discrepancy of estimates of MWTP of between payers and dependents and across different occupational groups.

Keywords: Discrete Choice Experiments, Marginal Willingness to Pay, Insurance Premium, Cancer Treatments

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Ⅰ. Introduction

Since 2005, Korean government has been trying to expand the coverage of health insurance focusing on the treatments of 5 most prevalent cancers. Especially, the former Korean government increased the coverage which finally led to around 10% of coinsurance rate from previous over 40% for cancer treatments. Thanks to this policy, it was expected to reduce the financial burden of cancer patients and their family members for the medical treatments by more than 50%. However, the policy implementation had faced serious financial turmoil in terms of budget expansion for National Health Insurance Corporation (NHIC), the government health insurance agency. Since the insurance premium is considered as pseudo-tax to the insured, it might cause substantial resistance from tax payers if the part of budget expansion is transferred to the insured in a form of premium hike.

Many previous studies tried to figure out and estimate the economic burdens associated with cancers, in which they basically reviewed the medical records of cancer patients and those newly diagnosed of cancers. In this study, however, we want to perform a prospective investigation on how much additional amount people are willing to pay if they want to get a coverage expansion for cancer treatments. In conducting this research, we basically notify the estimated values of average treatment costs of cancers and additional monthly insurance premium so that respondents can reveal their preferences in each given choice set. With this procedure, this study eventually tries to show the reasonable amount of insurance premium hike, if necessary, for the expansion of cancer treatment coverage.

With this regard, it is widely understood treatments for a specific cancer vary depending on the nature of the procedure and the efficacy, safety profile, outcome, and so forth. Several situations exist where patients face trade-offs between the risks and benefits of alternative treatment methods. To make an informed choice, one needs to be able to weigh up the slight differences in effectiveness of treatment against a spectrum of adverse effects associated with alternative strategies. Discrete choice experimentation, an approach for elicitation of preferences, is now being used widely in health care sectors, especially in cost-benefit analysis, assisting policy makers to assess the ‘value for money’ of a new health intervention.[1] This DCE approach identifies the key characteristics of alternative treatments, and selects a series of levels for each. Respondents choose from several options, each of which details a series of attributes with different levels. The relative importance of attributes to individuals and the trade-offs made between them, can be assessed by changing the levels of the attributes and then asking participants to make their choices.[2] This study adopts DCE method to elicit treatment-related preferences in a specific cancer from a sample of general population.

Ⅱ. Design of Experiments

1. DCE Setting

It is essential for researchers to construct a subset of optimal size of all possible combinations of attribute levels. In the DCE application, several methods of experimental designs can be employed, where fractional factorial designs (FED) are mostly employed.[3] The DCE method provides respondents various sets of choice

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1) Importantly enough, valuation can be based upon both health and non-health outcomes. Results may assist with reimbursement decision-making, clinical management and marketing strategies. It is most meaningful to compare the proposed technology with the current standard treatment for the indication of our interest.

2) DCE method has stemmed from Luce’s model of individual choice behavior (Luce, 1959). In economics fields, random utility theory (McFadden, 1973) is a starting point where DCE method is employed. According to the random utility theory, utilities are considered as random variables composed of deterministic component (i.e., levels of attributes and individual characteristics) and random error term (i.e., unobservable individual characteristics and uncontrolled environmental factors).

3) FED is often called ‘orthogonal main effects plan’ (OMEP), equivalently FFD of resolution 3 indicating that for any two attributes all combination of pairs of levels appear with proportional frequencies.

and asks them to choose which they prefer in order to obtain their preferences. Our survey instrument involves three attributes with each three different levels and one attribute with four different levels, giving a total of 108 (=3^3*4) possible outcomes. If the respondents are asked to choose one of two pairs of possible profiles, then the total possible number of situations will be 5,778(=${}_{108}C_2$). The objective of experimental design is to reduce the size of possible choice sets to a manageable number of choice sets for the respondents.

Huber and Zwerina (1996) have given much consideration for the properties of an optimal design.[4)] The easiest way to obtain optimal (required as in former three properties of experimental designs) size of choice sets is to use Sloane (2005). The website uses *oa.N.k.s.t.* name to denote an orthogonal array (a particular class of OMEP) with N runs, k attributes, s levels for each attribute, and strength t (the number of options excluding 'opt-out').[5)] To get the design of choice sets that we desire, we should delete one of the attributes which is the fifth one. In addition, the four levels of the first three attributes should be collapsed into three levels. We make the first three four-level attributes (for 'A' option) into 3 three-level attributes by changing 3s to 0s in the first attribute, 3s to 1s in the second attribute, and 3s to 2s in the third attribute. In order to generate the 'B' option, we add the number generator (1,1,1,1) to the A option. The resulting design is shown in Table 1.

4) They consider the properties of level balance (equal frequency), orthogonality (independency of the levels of each attribute) and minimal overlap (the probability that an attribute level appears itself in each choice set should be as small as possible).

5) No initial design which fits in the structure of our choice sets is given in Sloane. Thus, we have to reformulate the choice sets from the initial design in the Sloane into the manageable choice sets. We decide to use the table of oa.16.5.4.2 (a resolution 3 FED with 16 rows with five attributes each with four levels) from the Sloane website.

Table 1. Optimal Choice Set of Pairs for Profiles and Attributes

Profile	Option A				Option B			
	Att1	Att2	Att3	Att4	Att1	Att2	Att3	Att4
1	0	0	0	0	1	1	1	1
2	0	1	1	1	1	2	2	2
3	0	2	2	2	1	0	0	3
4	0	1	2	3	1	2	0	0
5	1	0	1	2	2	1	2	3
6	1	1	0	3	2	2	1	0
7	1	2	2	0	2	0	0	1
8	1	1	2	1	2	2	0	2
9	2	0	2	3	0	1	0	0
10	2	1	2	2	0	2	0	3
11	2	2	0	1	0	0	1	2
12	2	1	1	0	0	2	2	1
13	0	0	2	1	1	1	0	2
14	0	1	2	0	1	2	0	1
15	0	2	1	3	1	0	2	0
16	0	1	0	2	1	2	1	3

The ‘Att1’ indicates the level of attribute 1 and the remaining ‘Atts’ are in the order of attributes described in the survey. For each attribute variable, the lowest level is shown as 0 and next level is 1, 2, and 3. In the left side the levels of each attributes are reformulated from the Sloane’s website. In order to comprise the pairs of choice, we made B option by adding the number generator as explained. The number module that we use for generating B option is shown in Table 2.

Table 2. The number modules of four-level attributes

+	0	1	2	3
0	0	1	2	3
1	1	2	3	0
2	2	3	0	1
3	3	0	1	2

2. Choice of Attribute and Their Levels

We chose four attributes such as ‘cancer incidence rate’, ‘survival rate’ in 5 years after cancer treatments, ‘total treatment costs’ and ‘monthly insurance premium.’

In selecting the levels of ‘cancer incidence rate’ attribute, we referred to Annual Report of Cancer Registration Project of Ministry for Health and Welfare (2007) and Yang *et al*. (2005). In here, the given cancer incidence rates imply the ‘average incidence rate of cancers’ (new cancer cases/100,000 persons/year). For survival rate, we extracted the values from Korea Cancer Registration Statistics of National Cancer Center (2007), Berrino *et al*. (2007), and NCI SEER Report (2010). In estimating ‘total treatment costs’ levels, we calculated the weighted average value based upon respective treatment costs of cancers listed in cancer registration statistics and the number of patients in each cancer group. Here, we showed the total treatment costs which all included patients’ copayment and reimbursement from NHIC by assuming that the coinsurance rate for all uncovered parts would be around 37%.

Finally, the estimation process of monthly insurance premium is as follows. Since 58.5% of total cancer treatment costs (both covered and uncovered parts) are for 5 most prevalent cancers (Stomach, Lung, Liver, Colon and rectum, and Breast) and the estimated additional annual insurance premium amount for those 5 major cancers is 272,495 KRW (USD 236.95[6)]), we got 465,804 KRW by dividing 272,495 KRW

6) Author’s calculation based on the annual average USD vs. KRW exchange rate in base year of 2011 (USD 1= 1,150 KRW).

by 58.5%. With this value, we had around 39,000 KRW of monthly insurance premium. Based upon maximum and minimum total treatment costs, we calculated upper and lower bounds of monthly insurance premium levels using same method.

With the completed survey questionnaire, we conducted 'web-based survey' for 30 days (November 1-30, 2011) with 3,600 respondents who were randomly selected from the panel of private research company in Korea (Hankook Research, Co.), which has the biggest size of respondents from the general population. We double- checked the representativeness of these selected respondents through the comparison of preceding statistics such as Economically Active Population Survey (EAPS) issued by the National Statistical Office.

Along with four attributes for discrete choice experiments, we added questions to figure out the socio-economic characteristics and any antecedent variables of respondents. Based upon the antecedent variables, we are able to stratify the estimation results of marginal willingness to pay into several subgroups in terms of gender, income, education, and so forth. Survey instrument adopted in this study is available in Appendix for perusal of the interested readers.

Ⅲ. Econometric Methods

Given several alternatives of choices, each individual chooses one that leads to the highest level of his/her own utility. A random utility model of the consumer choice can be described as below

$$U_{ij} = V_{ij} + \epsilon_{ij} \qquad (1)$$

where U_{ij} represents the indirect utility function of individual i for good j, V_{ij} deterministic component and ϵ_{ij} reflects the unobservable factors. An individual i will choose j over other alternative of k if

$$V_{ij}+\epsilon_{ij}> V_{ik}+\epsilon_{ik} \text{ or } V_{ij}-V_{ik}>\epsilon_{ik}-\epsilon_{ij} \tag{2}$$

Given that error terms are unknown, the probability of individual's choice of alternative j can be shown as below

$$\Pr[U_{ij}> U_{ik}]=\Pr[\epsilon_{ik}-\epsilon_{ij}< V_{ij}-V_{ik}] \tag{3}$$

For the empirical purpose, we assume that the deterministic component part of indirect utility function is an additive linear function of several types of attributes and observed characteristics written as $V_{ij}=\beta' X$. Note that a vector of X is defined over attributes and observable characteristics and β will be empirically estimated.

Given the distribution of individual error terms, this study adopts the most widely used discrete choice model, which is McFadden's conditional logit (CL) model often known as multinomial logit model. In this model, we impose individual error terms as Weibull distributions which are IID. The probability that an individual i makes a choice of j among k alternatives can be expressed as follows.

$$P_{ij}=\frac{\exp(V_{ij})}{\sum_{k=1}^{K}\exp(V_{ik})} \tag{4}$$

where $V_{ij}=\beta' X$. Here, a vector of X represents attributes and observed individual characteristics. The inclusion of the individual characteristics or socio-economic components in the estimation leads to a 'Hybrid' conditional logit models. Based on the estimated coefficients from Hybrid CL, the MWTP can be calculated by computing the "marginal rate of substitution" (hereafter MRS) between attributes of interest and the cost factor.7) This 'value ratio' is also identifiable between nonmonetary elements of utility.

Ⅳ. Empirical Results

In the survey, the respondents are asked to choose more than one discrete choice option, resulting in multiple observations for each individual. The number of observations in data set depends on the number of respondents, the number of choice sets faced by each respondent and the number of alternatives in each choice set. Therefore, the data set constructed from the survey should be estimated by panel data analysis such as fixed-effect models. For each pair-wise comparison of choice set (total of 16 choice sets will be provided for each respondent), the respondent is asked to make a choice among three alternatives (A, B, or opt out). Since we treat each choice set faced by individual and three alternatives for each choice set as separate outcomes, there are 48 possible outcomes for each individual. Therefore, the number of total samples estimated will be 3,600 (total number of respondents) *48 = 172,800.

Table 3 shows the summary statistics of the whole samples studied in the paper. The respondents are asked to indicate their salary or income amounts among the 8 categorized interval levels. The average monthly income level of respondents is calculated by taking mid-point value for each category interval, resulting in around 1.89 million KRW.

7) From the regression equation of $\ln\left(\frac{1-y_i}{y_i}\right)=\beta_0+\beta_1 X_1+\beta_2 X_2$, $dy/dX_1=\beta_1 y(y-1)$ and $dy/dX_2=\beta_2 y(y-1)$. And $(dy/dX_1)/(dy/dX_2)=[\beta_1 y(y-1)]/[\beta_2 y(y-1)]$, so $dX_2/dX_1=\beta_1/\beta_2$, which means we can calculate the marginal rate of substitution between attributes of our interest by taking the ratio of the respective estimated coefficients.

Table 3. Descriptive Statistics

Variable	Mean
Age (years)	38.4 (10.4)
Female (yes=1, no=0)	0.49 (0.49)
Years of Education Completed (years)	14.1 (2.5)
Currently Employed (yes=1, no=0)	0.69 (0.46)
Currently Married (yes=1, no=0)	0.67 (0.48)
Monthly Income (in 10,000 KRW)	188.6 (187.9)
Sample Size (persons)	3,600

Notes: The standard deviations are in the parentheses.

The main results from the conditional fixed effects logit models are shown in Table 4 by controlling for four attributes discussed above. All of the estimated coefficients except the cancer incidence rate are statistically significant and the joint null hypothesis of all coefficients are being zero is rejected as well based on the log likelihood chi-squared statistic.

Table 4. Results from Conditional Fixed Effects Logit Model

Variable	Coefficients	S. E.	S. E. with cluster
Cancer incidence rate	0.0001937	0.0002570	0.0002818
Survival rate	0.0369322**	0.0013097	0.0019694
Annual treatment cost	0.0000491**	0.0000130	0.0000192
Insurance premium	-0.0000400**	0.0000000	0.0000000
Log likelihood	-9581.006		
LR Chi-squared stat	494.6		
McFadden R^2	0.0916		
Sample size (obs)	172,800		

Notes: Robust standard errors are clustered by individual. *: p<0.05, and **: p<0.01.

At the first glance, the positive sign of annual treatment costs does not seem to support for the theoretical validity of the model. However, we put two explanatory variables (total treatment costs and monthly insurance premium) related to the measures of cost from cancer treatment in our basic empirical model. Thus, it is not much surprising that we observe the opposite signs between total treatment costs and monthly insurance premium.[8] If we consider simultaneously the effects of the survival rate and treatment cost on the respondents' utilities, the effect of survival rate seems to dominate that of treatment cost. Given that the coefficients of total treatment costs and monthly insurance premium are opposite directions, we are able to calculate the positive MWTP between those two variables, which is sensible.

Now, we want to estimate the MWTP across the several attributes based upon the regression results shown in Table 4. The MRSs are calculated by the negative ratio of any two coefficients. Therefore, the MWTP for obtaining one additional survival rate in terms of one percentage point will be 923 KRW from (0.0369322/－0.00004), which interprets that the average respondents are willing to pay extra insurance premium of 9,230 KRW every month in return for increasing 5-year survival rate by 10 percentage points.[9]

Next, the MWTP between treatment costs and monthly insurance premium shows 12,275 KRW[10], showing general population is willing to pay additional 12,275 KRW of monthly premium for fully covering one-year cost related to the cancer treatment. Given that average monthly insurance premium of 44,400 KRW in 2011, people are willing to pay about 28% more to fully cover one-year cost related to the cancer treatment.

On the analysis of revealing individuals' preferences, we need to consider the issue

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8) Furthermore, it is also possible that the respondents perceive the amount of treatment cost as the quality levels when they hypothetically receive cancer treatment.

9) Given that average monthly insurance premium of 44,400 KRW in 2011, people are willing to pay more about 20.8% than they are paying now in order to increase their expected survival rate by 10 percentage points.

10) Since the scale of treatment cost is 10,000 KRW, the original ratio of 1.2275 is rescaled into 12,275 KRW.

of heterogeneity of observed and unobserved components that may affect individuals' choices. First, we consider the systematic observed heterogeneity for each individual. It is obvious that different individuals report different values or rank among different level of attributes and alternatives depending on their various socio-economic backgrounds or other relevant factors. This systematic observed heterogeneity can be easily incorporated into the Hybrid CL model (see Table 5).

Second, we need to examine the nature of unobserved heterogeneity (i.e. distribution of error terms in the utility function). The key assumption of conditional logit models is the independence of irrelevant alternatives (IIA), which comes from the assumption of IID of constant variance. In empirical analysis, the systematic unobserved components are likely to differ across individuals so they affect the individuals' choice behaviors. In order to relax the IIA assumption in this study, we cure unobserved heterogeneity of each individual by clustering each individual's residuals in estimation.[11)]

With socio-economic variables, we incorporate the interaction terms between observed individuals' characteristics (gender, income, education, age, work, and marital status) and four attributes.[12)] The inclusion of interaction terms between individuals' characteristics and attributes can allow the estimated coefficients of each attribute to vary across subgroups. Since our major interest is to estimate MWTP between survival rate and monthly insurance premium, we consider the interaction term only for the monthly insurance premium variable.

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11) STATA 11.0 allows the researchers to put a clustering command in the conditional logit. The third column in Table 4 shows the standard errors after clustering by each individual. Even though the size of standard errors is slightly increased compared to the unadjusted standard errors, the t-statistics is not significantly changed and most importantly the significance levels of each coefficient have not changed at all.

12) It is understood that socio-economic variables cannot be incorporated into separate explanatory variables in the CL estimation because there is no variation of those variables within groups defined over each choice set.

Table 5. Results from Hybrid Conditional Fixed Effects Logit Models

	Model Ⅰ	Model Ⅱ	Model Ⅲ	Model Ⅳ	Model Ⅴ	Model Ⅵ
Cancer incidence rate	0.0002098 (0.0002820)	0.0000001 (0.0003387)	-0.0001937 (0.0002818)	0.0001996 (0.0002820)	0.0001977 (0.0002817)	-0.0001938 (0.0002818)
Survival rate	0.0371148** (0.0019708)	0.0371592** (0.0023655)	0.0369328** (0.0019696)	0.0369995** (0.0019692)	0.0369778** (0.0019664)	0.0369336** (0.0019697)
Treatment cost	0.0000503** (0.0000192)	0.0000807** (0.0000232)	0.0000491** (0.0000192)	0.0000495** (0.0000192)	0.0000494** (0.0000192)	0.0000491** (0.0000196)
Insurance premium	-0.0000336** (0.000000)	-0.0000427** (0.000000)	-0.0000396** (0.000003)	-0.0000381** (0.000000)	-0.0000449** (0.000000)	-0.0000408** (0.000004)
Female* premium	-0.0000130** (0.000000)	No	No	No	No	No
Income* premium	No	0.0000115* (0.0000001)	No	No	No	No
College* premium	No	No	-0.0000000 (0.0000004)	No	No	No
Age* premium	No	No	No	-0.000009 (0.000005)	No	No
Employment* premium	No	No	No	No	-0.0000007 (0.0000005)	No
Marriage* premium	No	No	No	No	No	-0.0000001 (0.0000004)
Log likelihood	-9534.4	-6392.9	-9580.8	-9562.9	-9569.0	-9580.6
LR Chi-squared	502.9	375.9	494.6	496.9	502.9	494.6
McFadden R^2	0.0960	0.1062	0.0916	0.0933	0.0927	0.0916
Sample size	172,800	172,800	172,800	172,800	172,800	172,800

Notes: Robust standard errors are in parentheses, clustered by individual. Income dummy variable indicates one if individual's income is at top 20% level and otherwise is zero.
*: p<0.05, and **: p<0.01.

Table 5 presents the empirical results from the various types of Hybrid CL estimation depending on the respondents' characteristics. The interaction term is added to the basic model one by one and the results are shown in separate columns. Model I includes interaction term between 'female-gender dummy' and 'monthly insurance premium' in order to capture the possible difference in the respondents' attitudes on valuing survival rate from cancer treatment by gender groups. The estimated coefficients from cancer incidence rate, survival rate in 5 years after treatment, and total treatment costs substantially do not change compared to the results from the basic model that only includes four attributes variables. Interestingly, the size of insurance premium is shown to be quite different between male and female indicating relatively lower willingness-to-pay by female group than male counterpart. The MWTP between survival rate and monthly insurance premium of male is 1,104 KRW, which is calculated from $-(0.0371148/-0.0000336)$. Compared to this amount, the MWTP of female is shown to be 796 KRW from $-\{0.0371148/[(-0.0000336)+(-0.000013)]\}$, indicating to be lower by 28 percent than male's one.

In a similar way, the MWTP between total treatment costs and monthly insurance premium can be calculated separately by gender groups. For the male group, the MWTP is calculated as 14,970 KRW. The MWTP of female is calculated as 10,793 KRW which is lower by 28 percent than male counterpart.

Model II includes the interaction between indicator of high income and monthly insurance premium to examine the effect of individuals having high income on the MWTP for monthly premium. Here, income is defined as 'high income' if monthly income is more than 4 million KRW shown to be top 20% income level. People of high income are willing to pay about 27% more than low income counterparts.

The result from including indicator of 4-year college diploma is presented in the Model III. However, the estimated coefficient of interaction term is not statistically significant, which indicates that educational attainment is not a significant factor affecting the respondents' choice behavior.[13)]

[13)] In many cases, we stratify the group into several subgroups with their education levels completed such as HS (high school) dropout, HS diploma, some College, 4-year College, and Postgraduates, etc. Since, in our dataset, very small portion of respondents (240 persons) have less than HS, while 1,296 with HS diploma and 2,064 with some College or 4-year College, we dichotomize our sample with two subgroups for convenience sake.

Table 6. Results of Conditional Fixed Effects Logit Models

	Model Ⅰ		Model Ⅱ				
Variable	Male	Female	20th percentile	40th percentile	60th percentile	80th percentile	100th percentile
Survival rate	0.0370776** (0.0027734)	0.0372463** (0.0028054)	0.0243455** (0.0063243)	0.0386560** (0.0044038)	0.0373001** (0.0047064)	0.0402030** (0.0062021)	0.0424884** (0.0055277)
Insurance premium	-0.0000397** (0.000001)	-0.0000439** (0.000001)	-0.0000459** (0.000001)	-0.0000428** (0.000001)	-0.0000360** (0.000001)	-0.0000308** (0.000001)	-0.0000414** (0.000001)
Log likelihood	-4705.7	-4824.9	-782.1	-1913.2	-1756.7	-936.9	-899.7
LR Chi-squared stat	268.3	239.3	31.2	127.1	131.9	47.5	88.3
McFadden R^2	0.1223	0.0695	0.0328	0.0854	0.1458	0.1261	0.1744
Sample size	87,840	84,960	13,248	34,272	33,696	17,568	17,856

	Model Ⅲ		Model Ⅳ			
Variable	HS graduates	College graduates	20-29 years old	30-39 years old	40-49 years old	50-59 years old
Survival rate	0.0361442** (0.0031823)	0.0383392** (0.0026377)	0.0381784** (0.0040134)	0.0431903** (0.0037491)	0.0307048** (0.0037695)	0.0361476** (0.004333)
Insurance premium	-0.0000397** (0.000001)	-0.0000423** (0.000001)	-0.0000340** (0.000001)	-0.0000422** (0.000001)	-0.0000386** (0.000001)	-0.0000465** (0.000001)
Log likelihood	-3509.7	-5453.4	-2386.9	-2475.4	-2718.1	-1954.8
LR Chi-squared stat	181.2	291.5	135.6	175.1	105.1	91.5
McFadden R^2	0.0756	0.0981	0.1007	0.1413	0.0685	0.0655
Sample size	62,208	99,072	43,488	47,250	47,808	34,272

Notes: Robust standard errors are in parentheses, clustered by individual.
*: $p<0.05$, and **: $p<0.01$.

The next three columns show estimated coefficients from the remaining three models which include three dummy variables of age, employment, and marital status in Models IV, V, and VI, respectively. The bottom line is that each interaction term by monthly premium is not statistically significant and inclusion of those variables does not substantially change coefficients of other attributes.

Table 6. Continued

	Model Ⅴ		Model Ⅵ	
Variable	Workers	Non-workers	Married	Non-married
Survival rate	0.0375846** (0.0023166)	0.0357055** (0.0037314)	0.0359421** (0.002366)	0.0389334** (0.0035543)
Insurance premium	-0.0000401** (0.000001)	-0.0000396** (0.000001)	-0.0000400** (0.000001)	-0.0000399** (0.000001)
Log likelihood	-6600.9	-2962.6	-6365.5	-3213.9
LR Chi-squared stat	382.7	128.1	309.3	193.4
McFadden R^2	0.1008	0.0689	0.0924	0.0903
Sample size	120,672	52,008	114,912	57,888
	Model Ⅶ		Model Ⅷ	
Variable	Payers	Dependents	Professional Occupations	Other Occupations
Survival rate	0.0385364** (0.0024724)	0.0355623** (0.0033508)	0.0321188** (0.0044094)	0.0380084** (0.0021927)
Insurance premium	-0.0000369** (0.000003)	-0.0000448** (0.000004)	-0.0000317** (0.000006)	-0.0000417** (0.000003)
Log likelihood	-5689.6	-3604.7	-1603.4	-7968.4
LR Chi-squared stat	333.9	170.4	81.1	419.6
McFadden R^2	0.1204	0.0636	0.1057	0.0897
Sample size	105,984	63,072	29,376	143,424

Notes: Robust standard errors are in parentheses, clustered by individual. *: $p<0.05$, and **: $p<0.01$.

However, the simple inclusion of interaction dummy variables indicating various levels of socio-economic conditions may not capture two important aspects. Firstly, it is the possibility that each observed characteristics can differently affect the individuals' decisions depending on their socio-economic status. The results in Table 5 are calculated under the assumption that the effect of each attribute on the individuals' preferences is the same regardless of individuals' various backgrounds.

Secondly, it is that we have the limitation for breaking down the income level in more details since the previous models only allow the dichotomous dummy variables. Therefore, we conducted the same conditional logit for each separated groups for our empirical purposes and Table 6 will show the results of conditional fixed effects logit models for them.[14)]

Model I shows the results between gender groups. While the MWTP of females for obtaining additional survival rate in terms of ten percentage points will be 8,484 KRW (21% less) with that for males is 10,271 KRW. The estimated gap does not substantially change between the whole group (in Table 5) and separated group approaches.

Model II shows the results after specifying the respondents' income in five different levels. The MWTP is monotonically increasing with income levels except for the highest income group. This can be interpreted by the distribution of private insurance that people already hold in the market. The average number of private insurance is almost uniformly 1.9 for people up to the 80th percentile income levels, while the highest income group has about 2.3. The people in that category seem to possess complementary private insurance for national health insurance. Thus, they do not want to spend much extra money to buy more benefited national health insurance.

Model III shows the MWTPs for two groups (high school and college graduates) are 9,104 and 9,064 KRW, which, in the same as the results in Table 5, the significant gap across educational attainment does not exist.

Model IV provides the results after specifying age in four different levels. The MWTP is shown to be monotonically decreasing as the people become older. When people are relatively young, they pay more careful attention to their uncertain health conditions in the future.

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14) Since we are mainly interested in the size of MWTP of insurance premium related to the hypothetically increased survival rate, we report only survival rate and insurance premium. In this model, we can allow the effect of each attribute to be different between groups that we are interested in.

Model V shows the results between employed and unemployed groups. The MWTP of people having paid jobs in the labor market for obtaining additional survival rate in terms of ten percentage points will be 9,373 KRW. The MWTP for people having no jobs are calculated as 9,017 KRW. Contrary to the previous results from Table 3, the slight gap across working status seems to exist.

Model VI provides the results between married and non-married groups. Contrary to the results in Table 3, the significant gap across marital status seems to exist.

Model VII presents the results estimated separately between payer and dependent groups.[15] The payers' MWTP is estimated 10,440 KRW, while dependents reveal just 7,930 KRW, indicating lower by 24 percent than their counterpart.

Model VIII shows the results from separate job categories between top management or professionals vs. sales or services. It is shown that people who work in high-skilled jobs are more willing to pay relatively much higher amount of money for their health treatment than people having low-skilled occupations.

V. Discussion and Conclusion

The paper fully utilizes the discrete choice experiments in order to estimate the size of MWTP of insurance premium for the general cancer treatment in Korea. Using Hybrid conditional logit model for controlling unobserved heterogeneity does not change the size of MWTP. Furthermore, the MWTP size does not change substantially after controlling socio-economic variables.

The authors consider the effect of several individual and socio-economic variables such as gender, income level, college education, age, work, and marital status on the size of MWTP of insurance premium for increasing cancer survival rates. Those

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15) Regardless of medical insurance types, we are able to distinguish people who are paying the insurance premium from ones who are dependents covered by the medical insurance. Therefore, it is meaningful to calculate separately MWTP between payers of medical insurance or head of family and dependents covered by insurance.

socio-economic variables tend to affect the size of MWTP except for the educational level of the respondents. Most interestingly, the MWTP is monotonically decreasing as the people become older. When people are relatively young, they tend to pay more carefully attention on their future unexpected health conditions. We also found out that the size of MWTP for insurance payers is shown to be substantially higher than their dependents.

Even though the basic purpose of this study is to identify the determinants of MWTP of insurance premium, it automatically aims at showing reasonable amount of insurance premium adjustment that the government and health administrators can take in reflecting dynamics of health care market including the cost hike. In this sense, our study can do much toward creating a new type of research in helping implement government policies.

With these results, comparison of the precedent studies is hardly likely because unfortunately there is only one quantitative research[16] concerning this issue. And it simulates and estimates the increased burden of insurance premium under the various hypothetical conditions of changes in premium hike along with adjustments of governmental subsidies in financing the national health insurance systems. Unlike our method, this study investigates the additional monthly premium payments at both individual and familial levels depending upon the various numeric values of targeted increase in health insurance expenditures along with governmental subsidy hikes with 20%, 30%, or 40%, respectively. Besides, it considers average amount of premium from the income categories regardless of their any other socioeconomic status such as of being in private health insurance. It presents that each individual should incur ranging 12,519 to 23,429 KRW depending on their insurance types, in which all of our estimates are included. Our result reflects ‘the willingness to pay’, which literally means the amounts they are eager to incur after taking all possible factors into consideration while others do not.

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[16] Lee, S., Kim, C., Lee, J., Lee, E. (2009). A Strategic Development Research on Financial Stability and Coverage Expansion of National Health Insurance, Welfare State Society, Korea.

This study, however, still cannot overcome several limitations. First of all, it fails to reflect dynamics of technological progress in medical sector, which in many cases can lead to higher health care costs. It is not necessarily true to one to one match between medical cost and survival or success rate, but relatively bigger dependency in medicine can make people prefer higher level of technology as long as it is under the coverage of health insurance. Secondly, people have a tendency to choose 'the best' way of treatment if they are in devastating situation with relatively low survival or success rate so that they tend to reveal upward biased MWTP. But at the same time we can imagine that the discrepancy also exists between a group of people with disease currently and another group with no disease in terms of revealing their WTP. Thirdly, the methodology used by this study follows in the tradition of DCE raised by Ryan (2008). In fact, it has been criticized that it does not account for the uncertainty in the calculation of the marginal welfare valuations and estimates represent the certainty equivalents. When uncertainty is recognized in the estimation, the values will be lower than shown in this study.

조창익은 미국 뉴욕시립대학교에서 경제학 박사학위를 받았으며, 현재 한림대학교 경제학과 부교수로 재직 중이다. 주요 관심분야는 보건경제, 건강행태 등이며, 현재는 응급피임약 정책, 보건산업 R&D 투자, 골다공증 등을 연구하고 있다. (E-mail: cjo@hallym.ac.kr)

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Appendix: Survey Questionnaire on DCE

Attributes	Description
Cancer Incidence Rate	It means the average annual incidence rate of all types of cancers (per 100,000 persons). The level values of this attribute are 177, 242, and 291, respectively.
Survival Rate	It means the average survival probability in 5 years after treatments of cancer. The level values of this attribute are 46%, 52%, and 66%, respectively.
Total Annual Treatment Costs	It means the average annual treatment costs which include total direct costs such as in- and out-patient costs plus drug costs, regardless of types of payers. The level values of this attribute are 27.0, 37.0, and 47.0 (in million KRW).
Monthly Insurance Premium	A respondent will be asked how much s/he is willing to pay additionally for health insurance premium, assuming that a respondent diagnosed of any type of cancer in the future will be fully covered by NHIC (National Health Insurance Corporation) in cancer treatment without any coinsurance or copayment. The level values of this attribute are 'pay additional KRW 31,000 per month,' 'pay additional KRW 36,000 per month,' 'pay additional KRW 41,000 per month,' and 'pay additional KRW 46,000 per month,' respectively.

Note: The names of respective attributes shown in the empirical results are in the parentheses.

Example of Discrete Choice Set

Generally speaking, we will consider price of product, affordability, color of product, usage, quality of product, and so forth whenever we are planning to purchase something. In the decision-making process, we occasionally face trade-off among the factors that you take into account. For example, you need to be able to pay more if you want to purchase high-quality product otherwise you can pay less for low-quality one.

Our study is very similar to this purchasing behavior, which is designed to elicit your preference. You will be given two choice sets (A and B). The respective values such as cancer incidence rate, survival rate, and treatment cost in options A and B are all hypothetical. In Option A, my cancer incidence rate is '177/100,000 persons' and the 5-year survival rate after cancer treatment is 52%. I have to incur around 37 million KRW annually for cancer treatment. On this basis, I have to pay extra 36,000 KRW of monthly insurance premium to get full coverage of cancer treatment.

If you think neither A or B would be preferable, please choose 'Neither.'

Choice set # 1.	Option A	Option B
Cancer Incidence Rate	177	242
Survival Rate	52%	66%
Total Annual Treatment Costs	37 Million KRW	47 Million KRW
Monthly Insurance Premium	Extra 36,000 KRW/month	Extra 41,000 KRW/month
Which option would you choose? A or B? ( )A , ( )B, ( ) Neither		

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이산선택실험법을 이용한 우리나라 일반인의 암질환 치료 보장성 강화를 위한 건강보험료의 한계지불의사금액 추정

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본 연구는 이산선택실험법을 이용하여, 일반인들이 암질환의 치료에 관련된 제반 사항에 대한 의사결정을 하는 데에 영향을 미치는 요소가 무엇인가를 알아보고, 나아가 암질환의 치료효과를 높이기 위해 추가적으로 지불하는 건강보험료의 한계지불의사금액을 추정하는 데에 목적을 두고 있다. 19세부터 60세까지의 3,600명의 일반인을 대상으로 한 설문을 바탕으로, 통상적인 조건부 고정효과 로짓모형에 다양한 사회경제적 요인변수를 추가한 이른바 hybrid 조건부 로짓모형을 이용한 분석의 결과, 암질환 치료 5년 이후의 생존율을 10%p를 보장받는 경우, 현재 지불하는 월건강보험료보다 약 20.8% 더 지불할 의사가 있음을 확인하였다. 또한, 연령, 교육수준, 소득수준, 건강보험 지불형태, 직업형태 등을 보다 세분화한 분석을 통하여 특히 연령과 건강보험지불형태 및 직업형태에 따라 한계지불의사금액에 현저한 차이가 발생함을 확인하였다. 이상의 결과를 이용하여 특히 인구고령화 등으로 건강보험재정이 날로 악화되는 상황에서 건보재정의 확충과 함께 주요 암질환에 대한 보장성의 강화를 위해 과연 어느 정도의 건강보험료 조정이 가능할 것인가를 판단하고 이를 정책에 반영하는 데에 근거가 되는 의미 있는 연구로서의 역할을 할 것으로 본다.

주요용어: 이산선택실험, 한계지불의사, 보험료, 암질환 치료