Measuring Willingness to Pay for CO_2 Information on Consumption Goods in Korea

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Abstract

Recently, Korean government recommends that consumption goods producers voluntarily attach CO2 label on their final products. The label provides information about the CO2 emitted during the process of production. By labeling CO2 emission amount, producers implicitly express their intention to participate the low-carbon certificate program which is currently under consideration by Korean government. Producers also expect that the label would attract consumers in the market through the consumers' willingness to pay for CO2 reduction. In this respect, this paper intends to estimate the consumers' willingness to pay for the information about the CO2 level which would further provide the potential willingness to pay for the CO2 reduction. For this purpose, we analyzed selected non-durable consumption goods including milk and vegetable oil by employing Conjoint Ranking Method.

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1. Introduction

1.1. Motivation

There are many policy instruments, for instance, prohibitions, tradable permits, taxes and tax exemptions, and fees etc., in the context of prevention of environmental degradation and improvement of environmental quality. In early business history, compulsory regulations called the commands and controls, traditional approaches such as prohibitions and permits could be effective because manufacturers dominated the markets with their supply power. Afterward, Pigouvian tax and market-based tradable permits have received attention from researchers and policy makers. Today, some companies voluntarily disclose information about their pollution control. Voluntary approaches providing information on their participation in environmental protection programs also became an important tool as the balance of power has shifted from manufacturers to consumers. Tietenberg (1998) characterized it as the third wave of action to environmental, and Kolstad (2011) described the actions of firms as a little more puzzling. Why would a firm voluntarily undertake something like pollution control, spending money without being required to do so and with no apparent benefit to the firm? Whatever the motivations, the use of "voluntary" approaches to environmental protection is becoming more common and eco-labeling is a notable example. Eco-labeling is a market-based technique for conveying information about consumers' demands for environmental protection (Bruce and Laroiya, 2007). A wide range of eco-labels are used in several countries, providing consumers with environmental information related to products displayed eco-labels.

The global community has responded to climate change by adopting and implementing the United Nations Framework Convention on Climate Change (1992) and

Kyoto Protocol (1997). The convention declared as its ultimate objective, the stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system (Oh. et al, 2011).

In 2009, Korean government declared greenhouse gas reduction target, 30% off on Business As Usual (BAU) basis and 4% off from the year 2005 emission level, to meet these international communities' requirements. Carbon Labeling is implemented as a part of policy in some countries, recommending consumption goods producers or service providers voluntarily attach CO_2 label on their final products. There are several examples of carbon labeling programs around the world, including 'Carbon Reduction Label' in United Kingdom, 'Carbon Declaration' in Sweden, 'Carbon Conscious Product Label' in United States and 'Carbon Footprint Label' in Japan, etc.

The first appearance of carbon-labeled products in Korea was on April 15, 2009, that provides information about their CO_2 life-cycle assessment emissions. By labeling CO_2 emissions, producers implicitly express their intention to participate in the low-carbon certificate program which is currently under consideration by Korean government. They also expect that the label would attract consumers in the marketplace because the consumers add a value to pollution managements.

1.2. Literature

There are a number of studies on labeling policy to improve environmental quality and conserve natural resources, especially, to examine the effect of label by using various models. Table 1 shows several examples of literatures concentrated on different eco-labels. They conducted empirical tests in the context of that many empirical studies have attempted to measure willingness to pay for environmental management. Some of them estimated and analyzed willingness to pay for a variety of eco-label associated with food safety such as environmentally friendly agricultural products and fresh sea foods as well as consumption goods.

Table 1. Examples of Empirical Studies related to Eco-labeling

	Main Objectives	Method or Model
Moon et al. (2008)	agricultural products produced by environmental friendly process	Ordered Probit Model
Blamey et al. (2000)	the difference of between "Labeled Treatment" and "Generic Treatment"	CVM
Bjørner et al. (2004):	consumers' MWTP for the 'Nordic Swan' label	Panel Mixed Logit Model
Johnston and Roheim (2006)	consumers' preference on the eco-labeled fresh seafood	Contingent ranking experiment Rank-ordered logit Model
Schumacher (2010)	the determinants of the demand side for eco-labeled products	Probit Model
Do and Kwak (2004)	WTP for eco-labeled products	CVM
Kim and Shin (2010)	the eco-friendly consumer characteristic and consumer purchasing behavior of carbon footprint labeled products	ANOVA Binary Logit Model

Moon et al. (2008) tried to estimate willingness to pay for agricultural products produced by environmentally friendly process by using ordered probit model, and compared its difference between eastern and western residential districts in Berlin, Germany. It revealed that willingness to pay of the dweller in western is higher than in eastern. Blamey et al. (2000) analyzed the difference between the labeled treatment and the generic treatment. The former, the labeled approach, assigns alternative-specific descriptors to each option, while the generic approach removed the policy names (CVM). Bjørner et al. (2004) measured the consumers' MWTP for the 'Nordic Swan' label which is eco-label in Northern Europe (Panel Mixed Logit

Model). Johnston and Roheim (2006) estimated the consumers' preference on the eco-labeled fresh seafood which means no-overfishing (Rank-ordered, Conjoint Method). Schumacher (2010) compared the determinants of the demand side for eco-labeled products, green good, with dirty good (Probit model). Do and Kwak (2004) estimated the WTP for eco-labeled products (CVM). Kim and Shin (2010) investigated the eco-friendly consumer characteristics and consumer purchasing behaviors of carbon footprint labeled products (ANOVA, Binary Logit Model).

2. Objectives

The purposes of this paper are twofold. The first objective we have is to identify that “Have consumers in Korea willingness to pay for CO_2 reduction information?”, and “How much do consumers’ willingness to pay for effort of producer?” The second is to investigate that “Can CO_2 labeling affect consumers’ choice?” in the context of policy effectiveness. This study tried to test for potential policy effectiveness of CO_2 labeling, although the introduction of CO_2 labeling policy is in early stage.

We first estimated the consumers' willingness to pay for the information about the life-cycle CO_2 emission level on consumption goods. A Life-Cycle Assessment (LCA), also known as Life-Cycle analysis, eco-balance, and cradle-to-grave analysis is a technique to assess environmental impacts associated with all the stages of a product's life from-cradle-to-grave - i.e., from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling.[4] Then we tried to compare the consumers’ total willingness to pay with and without CO_2 labeling in each good to achieve second aim.

[4] "Defining Life Cycle Assessment (LCA)", US Environmental Protection Agency. 17 October 2010. Web.

Some kinds of non-durable consumption goods, fresh milk and soybean cooking oil, are selected for this study, since they are familiar to consumers and are able to be specified by attributes easily. Whereas in the case of energy-using durable goods, for example, televisions, laptops and mobile phones, the identification of attributes is a very difficult job, because they have a lot of functional characteristics. Services including flight service and rail transportation service also have the categorization problem, due to a great variety of attributes depended on transport routes. As a consequence, non-durable goods would be considered appropriate objectives for this study.

Furthermore, this paper made an attempt to compare the estimation results of between different models, Rank Ordered Logit model with contingent ranking experimental data and Conditional Logit model with convert to the choice data. Because survey respondents are required to rank among various choice groups in this paper, convert process which transform “rank 1” to “the most wanted alternative” is needed to apply choice model.

3. Methodology and Estimation Model

3.1. Methodology and Data

Contingent ranking experiment which is a kind of experimental methods based on stated preference was employed to analyze. It is better suited for valuing multidimensional environmental trade-offs in many aspects than Contingent Valuation Method (CVM) that is used to estimate willingness to pay for single-attributed goods or assess a single-alternative. Because CVM is inappropriate to apply for more general situations which have multi-attributes or multi-alternatives (Streever et al., 1998), it is employed to consider for multi-attributes of objectives and respondent's payoff (Mackenzie, 1993; Adamowicz et. al., 1994; Kwak et. al., 2006).

Contingent ranking is an alternative method to contingent valuation proposed in the early eighties (Rae 1983). The method is implemented much in the same way as contingent valuation. However, the method differs from contingent valuation in that the respondent in the experiment is asked to rank order a large number of alternatives with combinations of environmental goods and prices as compared to the two alternatives given in the referendum format of contingent valuation (Bergland, 1995). The contingent ranking method has met with mixed responses (Cummings, Cox, and Freeman 1986, Smith and Desvousges 1986, Lareau and Rae 1989). The implementations of contingent ranking experiments have typically involved the ranking of large numbers of alternatives which often appear very similar to the respondent. The cognitive task of arriving at a complete ranking is often experienced as a difficult and demanding task. The final statistical model of the stated rankings is often poor which results in questionable price estimates (Bergland, 1995).

Today, contingent ranking experiment is used when researchers focus on institutional property rights design, market-based incentive design, measuring preferences for non-market goods and understanding elements of conflict and cooperation. It needs to survey that require respondents to rank among various choice groups from the least preferred to the most preferred one. The data on the complete ranking of all the alternatives is then analyzed using a random utility function framework. The estimation is often done with the econometric technique of Beggs, Cardell, and Hausman (1981), which is essentially a multi-nominal logit model of the rank order of the random utility level associated with each alternative. Implicit attribute prices or welfare change measures are then calculated from the parameter estimates of this logit model (Bergland, 1995).

3.1.1. Survey Design

Most of all, because it is crucial to identify attributes of objectives, fresh milks and soybean cooking oil, respectively. In the case of fresh milk, typical traits such as capacity, nutrition, package, brand, price and CO2 label could impact on consumers' purchase. These characteristics also effect on soybean cooking oil choice.

Table 2 shows that how attributes of fresh milk and soybean cooking oil are classified. There are 200ml, 340ml, 500ml, 1L and 1.8L, etc. in capacity of fresh milks, but consumers are more likely to familiar with 1L fresh milk with paper pack. Fresh milk is representative by three major companies' brand, Seoul, Maeil and Namyang, those who have a significant market share and higher price. And there are also private brand commodities made by major supermarkets with a lower price. When people go to supermarkets, they are faced with many kinds of milks containing a number of nutrition such as potassium, vitamins and calcium. For simple classification of attributes, this study assumed that there are four brands of 1L fresh milk with paper pack and other attributes are constant. In addition, it was assumed that a range of price levels in the real milk market, from the lowest to the highest, are considered as four different levels (1,500 KRW, 1,800 KRW, 2,100 KRW and 2,500 KRW), since price is an influential variable in consumer purchase. Finally, it is regarded to whether CO_2 label is attached or not in respect of main topic. Attributes and levels of milk, then, resulted in (2×42) different combinations, that is 32 alternative sets. In case of soybean cooking oil, attributes were identified as three brands (CJ, Haepyo and Otugi) with four price levels (2,600 KRW, 3,000 KRW, 3,500 KRW and 4,200 KRW) by the same way. It's attributes and levels lead to (2×3×4) different combinations. We got 16 alternatives in fresh milk and 12 alternatives by applying an orthogonal design in order to reduce the number of them.[5]

Table 2. Identification of Attributes

	Fresh Milk	Soybean Cooking oil
CO2 label	Attached	
	Not attached	
Brand	Seoul Milk	CJ
	Maeil Milk	Haepyo
	Namyang Milk	Otugi
	Home Plus Milk	-
Price	1,500 KRW	2,600 KRW
	1,800 KRW	3,000 KRW
	2,100 KRW	3,500 KRW
	2,500 KRW	4,200KRW

[5] SPSS 18.0 was used for orthogonal design.

Figure 1. Examples of Suggested Alternative Sets

Question: Please rank your preference from 1 to 5 including the "no purchase" choice.
(Rank 1 to the most preferred one and rank 5 to the least preferred one)

A-1:	A-2:	A-3:	A-4:	A-5:
CO_2 label: Yes	CO_2 label: No	CO_2 label: Yes	CO_2 label: No	No-Purchase
Brand: 3	Brand: 2	Brand: 4	Brand: 1	
Price: ₩2,100	Price: ₩1,800	Price: ₩2,500	Price: ₩2,100	Price: ₩0

B-1:	B-2:	B-3:	B-4:	B-5:
CO_2 label: Yes	CO_2 label: Yes	CO_2 label: No	CO_2 label: No	No-Purchase
Brand: 2	Brand: 1	Brand: 2	Brand: 3	
Price: ₩4,200	Price: ₩2,600	Price: ₩2,600	Price: ₩2,600	Price: ₩0

Given the number of attributes and their levels, sixteen choice sets in case of fresh milk and twelve sets in soybean cooking oil are produced, and they were blocked in sets containing four alternatives and no-purchase (see Figure 1).

Survey questionnaires asking respondents to rank among various choice groups from the least preferred to the most preferred one were made. In order to relieve burden that they have to answer to rank, survey questionnaires consist of set of alternatives and each set is made of five alternatives including no choice. Despite all these efforts to could relieve respondents' burden, rank could be affect by how to arrange alternatives. Therefore, four types of survey questionnaires were formed and each type consists of several different set of alternative combination to reduce bias from grouping alternatives. For example, The type Ⅰ questionnaire has four different set: the set 1 includes from alternative 1 to 4 with no choice(not purchase), the set 2 includes from alternative 5 to 8 with no choice, the set 3 has from alternative 9 to 12 with no choice, the set 4 includes alternative from 13 to 16 with no choice. The type Ⅱ questionnaire also has four different set, but it is not exactly same from type Ⅰ: the set 1 covers alternative 2 to 5 with no choice, the set 2 contains alternative from 6 to 9 with no choice, the set 3 covers from alternative 10 ~ 13 with no choice, the set 4 covers alternative from 14 to 16, and 1 with no choice.

3.2. Survey Delivery

Consumer survey was conducted in September 2011 by the web-survey system of Korea Rural Economic Institute (KREI). Survey panel was composed of 309 people dwelling Seoul Metropolis, majority of the panel were housewives. Four different types of questionnaires were randomly given each individual of the panel. The web-survey system was designed to require respondents to answer at more than 90 percent of the given questions.

3.2. Estimation Model

3.2.1. Rank Ordered Logit Model

To begin with, rank ordered logit model which is useful to deal with ordinal rank was employed, since ranks are ordinal rather than cardinal and the ranks given by each respondent are not independent. Rank ordered logit model is able to address both the ordinal nature of the data and the lack of independence between observations for each respondent (Johnston and Roheim, 2006). Rank ordered logit model begins with Random Utility Model (RUM)[6].

Individual i 's indirect utility obtained by taking alternative j in a given combination (C) is expressed as:

$$U_{ij} = V_{ij}(Z_{ij}, S_i) + e_{ij} \tag{1}$$

Where V_{ij} is vector of deterministic part, Z_{ij} is vector of alternative's attributes, S_i is vector of individual's socio-economic characteristics and e_{ij} is stochastic part.

If the consumer compares alternative j to alternative k, she will prefer alternative j to alternative k when

$$\Pr(j \mid C_i) = \Pr\{V_{ij} + e_{ij} > V_{ik} + e_{ik}\} = \{V_{ij} - V_{ik} > e_{ik} - e_{ij}\} \tag{2}$$

We assume that the standard independence of irrelevant alternatives (IIA) for the multinomial logit model is assumed to hold at each level of ranking. The probability that the consumer i chooses alternative j is given by:

[6] For the original formulation of the RUM see McFadden (1978).

$$pr(j|C) = \frac{\exp(V_{ij})}{\sum_{k \in C} \exp(V_{ik})} \tag{3}$$

If individual i 's observed ranking of j = 1, 2, 3, ... , J alternatives is given by R_i = (R_1, R_2, R_3, ..., R_J), the resulting model allows us to specify the probability of R_i using the logistic distribution as (Beggs, Cardell, and Hausman, 1981).

Within a rank-ordered, random utility framework (Beggs, Cardell, and Hausman, 1981), a respondent assigns the highest rank to the carbon labeled product that provides the highest level of utility, based on (2) above. Lower ranks are then allocated successively, based on (2) and the anticipated utility from each product. The rationale of the model is that individual respondents compare all the alternatives, select their most preferred (independent of the rankings of the remaining alternatives), and then rank their next alternative out of the remaining subset of choices. This process is iterated until all options are ranked (Johnston and Roheim, 2006). Probability L_i that individual i 's ranking of j =1, 2, 3, ... , J alternative by the process is given as (5);

$$L_i = \prod_{j=1}^{J-1} \left[\Pr(j|C) \right] = \prod_{j=1}^{J-1} \left[\frac{\exp(V_{ij})}{\sum_{k=1}^{J} \exp(V_{ik})} \right] = \prod_{j=1}^{J-1} \left[\frac{\exp(Z_{ij}\beta)}{\sum_{k=1}^{J} \exp(Z_{ik}\beta)} \right] \tag{4}$$

Where deterministic indirect utility function $V_i(Z_j) = Z_{ij}\beta$ is a linear function of attribute vector without constant term by above (1) .

For an independent sample of N individuals, ranking one set of alternatives per individual, the log-likelihood function is given by following;

$$\ln L = \sum_{i=1}^{N} \ln L_i = \sum_{i=1}^{N} \sum_{j=1}^{J-1} (Z_{ij}\beta) - \sum_{i=1}^{N} \sum_{j=1}^{J-1} \left\{ \ln \sum_{k=1}^{J} \exp(Z_{ik}\beta) \right\} \tag{5}$$

The maximum-likelihood estimates of β are those that maximize the predicted probability of the observed sets of ranks. The log-likelihood function is globally concave and provides unique β estimates of which are consistent, asymptotically normal, and asymptotically efficient (Johnston and Roheim, 2006).

3.2.2. Conditional Logit Model

In addition, Conditional logit model was also used so as to compare with the results of rank-ordered model. For getting available data indicating choose one in choice experiment, it was necessary to convert from respondents' rank 1 into the most preferred one under the assumption that each individual preferences do not change.

The probability that the individual i chooses alternative j likes as above (3) and the log-likelihood function is given by;

$$\ln L = \sum_{i=1}^{N}\sum_{j=1}^{J}\left\{Y_{ij}\Box\ln\left[pr(j|C)\right]\right\} = \sum_{i=1}^{N}\sum_{j=1}^{J}\left\{Y_{ij}\Box\ln\frac{\exp(V_{ij})}{\sum_{k\in C}^{J}\exp(V_{ik})}\right\} = \sum_{i=1}^{N}\sum_{j=1}^{J}\left\{Y_{ij}\Box\ln\frac{\exp(Z_{ij}\beta)}{\sum_{k\in C}^{J}\exp(Z_{ik}\beta)}\right\} \quad (6)$$

Where deterministic indirect utility function $V_i(Z_j) = Z_{ij}\beta$ is a linear function of attribute vector without constant term as above (1), and the maximum-likelihood estimation was used to estimate coefficients of each attribute.

3.2.3. Estimation of MWTP

The Observable deterministic part (V_{ij}) in indirect utility function can be described as of a linear function of attribute vector $Z = (Z_L, Z_{B1}, Z_{B2}, Z_{B3}, Z_{B4}, Z_P)$ =(*Carbon label*, *Brand1*, *Brand2*, *Brand3*, *Brand4*, *price*) without constant term.

$$V_{ij} = \beta_L Z_{L,ij} + \beta_{B1} Z_{B1,ij} + \beta_{B2} Z_{B2,ij} + \beta_{B3} Z_{B3,ij} + \beta_{B4} Z_{43,ij} + \beta_P Z_{P,ij} \tag{7}$$

Where $Z_L, Z_{B1}, Z_{B2}, Z_{B3}, Z_{B4}, Z_P$ are attribute vector and β are parameters that have effect on individual utility.

Marginal willingness to pay for each attribute can be described as a negative ratio between the each characteristic parameter and the monetary parameter, which can be calculated by Roy's Identity easily:

$$MWTP_{z_L} = (\partial V / \partial Z_L) / (\partial V / \partial Z_p) = -\beta_L / \beta_p$$

$$MWTP_{z_{B1}} = (\partial V / \partial Z_{B1}) / (\partial V / \partial Z_p) = -\beta_{B1} / \beta_p$$

$$MWTP_{z_{B2}} = (\partial V / \partial Z_{B2}) / (\partial V / \partial Z_p) = -\beta_{B2} / \beta_p$$

$$MWTP_{z_{B3}} = (\partial V / \partial Z_{B3}) / (\partial V / \partial Z_p) = -\beta_{B3} / \beta_p$$

$$MWTP_{z_{B4}} = (\partial V / \partial Z_{B4}) / (\partial V / \partial Z_p) = -\beta_{B4} / \beta_p \tag{8}$$

4. Estimation Results

4.1. Fresh Milk

The estimates of the coefficients in both rank ordered logit (ROL) and conditional logit (CL) for fresh milk as shown in Table 3[7]. All species coefficients by both models are statistically significant at the 0.05% level. The presence of a CO_2 label has a positive and statistically significant effect on consumer's preferences ($p < 0.01$).

Table 3. Estimation Results for Fresh Milk (1L)

		Rank Ordered Logit				Conditional Logit			
Attributes		Coef.	Std. Err.[a]	z	$P>\|z\|$	Coef.	Std. Err.[a]	z	$P>\|z\|$
CO_2 label		0.68392	0.03411	20.05	0.000	1.74929	0.09589	18.24	0.000
Brand Dummy	Seoul	6.34395	0.14413	44.01	0.000	8.64879	0.37797	22.88	0.000
	Maeil	6.06393	0.14071	43.09	0.000	7.38410	0.36440	20.26	0.000
	Namyang	6.14672	0.14096	43.61	0.000	8.22355	0.36863	22.31	0.000
	Home Plus	5.57294	0.14334	38.88	0.000	7.11732	0.35906	19.82	0.000
Price		-0.00138	0.00005	-27.06	0.000	-0.00324	0.00016	-19.78	0.000
Number of obs		5,903				5,903			
Loglikelihood		-6,841.21				-2196.74			
LR $\chi^2(6)$		5,264.12				1437.21			

[a] estimated coefficients are significant at the 0.05% level.

The estimated results reveal that Seoul milk has the highest marginal willingness to pay across the ROL and the CL. It was calculated as 4,582.45 KRW in the ROL and 2672.43KRW in the CL, whereas MWTP for Home Plus milk was the lowest, 4,025.53KRW and 2,199.22KRW in across the ROL and the CL, respectively. These results that consumer prefer Seoul milk to other brands are same in both of the ROL and the CL. It refers that Seoul is the most preferred milk brand.

[7] estimation was carried out with STATA 11 SE package

The marginal willingness to pay for CO_2 label is revealed as 494.02 KRW in the ROL and 540.52 KRW in the CL, respectively. These are higher than 10 percent in the ROL and 20 percent in the CL of brand attributes, and it refers to that consumer have a significant potential willingness to pay for carbon abatement effort of producers.

Because the ultimate goal of this paper is to examine that can CO_2 label statistically significant impact on consumers' choice not to just estimate the willingness to pay for CO_2 label, we have calculated the total willingness to pay and compared each brand with CO_2 label to other brands without CO_2 label. The total willingness to pay for Seoul, Maeil, Namyang and Home Plus, attached CO_2 label respectively are 5,076.47 KRW, 4,874.20 KRW, 4,934.01 KRW, 4,519.55 KRW in the ROL. When compared to without CO_2 label, it for Home plus milk with the label is higher than Maeil or Namyang milk without the label, but still lower than Seoul milk. According to the comparison, it might be concluded that consumers' fresh milk choice could be finitely altered in order to consider climate change, since CO_2 label effect on their marginal utility.

Table 4. Estimated MWTP for each attribute of Fresh Milk (1L)

		Rank Ordered Logit		Conditional Logit	
Attributes		Coef. (Std. Err.)[a]	MWTP (US$)[b]	Coef. (Std. Err.)[a]	MWTP (US$)[b]
CO_2 label		0.68392 (0.03411)	494.02KRW ($0.43)	1.74929 (0.09589)	540.52KRW ($0.47)
Brand	Seoul	6.34395 (0.14413)	4,582.45KRW ($3.98)	8.64879 (0.37797)	2,672.43KRW ($2.32)
	Maeil	6.06393 (0.14071)	4,380.19KRW ($3.80)	7.38410 (0.36440)	2,281.65KRW ($1.98)
	Namyang	6.14672 (0.14096)	4,439.99KRW ($3.86)	8.22355 (0.36863)	2,541.03KRW ($2.21)
	Home Plus	5.57294 (5.57294)	4,025.53KRW ($3.50)	7.11732 (0.00016)	2,199.22KRW ($1.91)

[a] estimated coefficients are significant at the 0.05% level.
[b] 1,150KRW=1US$

4.2. Soybean Cooking Oil

The estimates of the coefficients in both rank ordered logit (ROL) and conditional logit (CL) for Soybean Cooking oil as shown in Table 5[8]. All coefficients by both models are statistically significant at the 0.05% level. The presence of a CO_2 label has a positive and statistically significant effect on consumer's preferences ($p < 0.01$).

Table 5. Estimation Results for Soybean Cooking oil (0.9L)

		Rank Ordered Logit				Conditional Logit			
Attributes		Coef.	Std. Err. [a]	z	P>$\|z\|$	Coef.	Std. Err. [a]	z	P>$\|z\|$
CO_2 label		0.83762	0.03946	21.23	0.000	2.54569	0.12343	20.62	0.000
Brand Dummy	CJ	6.53950	0.15505	42.18	0.000	8.44631	0.40309	20.95	0.000
	Haepyo	6.53907	0.15354	42.59	0.000	8.66433	0.40064	21.63	0.000
	Otugi	6.02318	0.14987	40.19	0.000	7.34248	0.37655	19.5	0.000
Price		-0.00110	0.00004	-30.7	0.000	-0.00241	0.00011	-21.01	0.000
Number of obs		4,375				4,375			
Loglikelihood		-5,180.57				-1,527.90			
LR χ^2(6)		3,661.49				1,265.55			

[a] estimated coefficients are significant at the 0.05% level.

The estimated results reveal that marginal willingness to pay for CJ cooking (5,932.60 KRW) oil was the highest in the ROL, while it for Haepyo (3,599.64 KRW) was higher than CJ (3,509.06 KRW) in the CL. It for Otugi was the lowest, calculated as 5,464.19 KRW in the ROL and 3,050.47 KRW in the CL.

These results that consumer prefer Seoul milk to other brands' milk are same in both of the ROL and the CL. It refers Seoul is the most preferred milk brand.

The marginal willingness to pay for CO_2 label is revealed as 494.02 KRW in the ROL and 540.52 KRW in the CL, respectively. These are higher than 10 percent in the ROL

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[8] estimation was carried out with STATA 11 SE package

and 20 percent in the CL of brand attributes, and it refers to that consumer have a significant potential willingness to pay for carbon abatement effort of producers.

The total willingness to pay for soybean cooking oil also was computed and compared each brand with CO_2 label to other two brands without CO_2 label. The total willingness to pay for CJ, Haepyo and Otugi attached CO_2 label are 6,692.48 KRW, 6,692.09 KRW and 6,224.08 KRW in the ROL, and 4,566.68 KRW, 4,657.26 KRW and 4,180.90 KRW in the CL, respectively. It for any brands is higher than not attached when compared to without CO_2 label, regardless of given models. In other word, it indicates that soybean cooking oil attached label would be more attractive to consumers.

Table 6. Estimated MWTP for each attribute of Soybean Cooking oil (0.9L)

		Rank Ordered Logit		Conditional Logit	
Attributes		Coef. (Std. Err.)[a]	MWTP (US$)[b]	Coef. (Std. Err.)[a]	MWTP (US$)[b]
CO_2 label		0.83762 (0.03946)	759.89KRW ($0.66)	2.54569 (0.12343)	1,057.62KRW ($0.92)
Brand	CJ	6.53950 (0.15505)	5,932.60KRW ($5.16)	8.44631 (0.40309)	3,509.06KRW ($3.05)
	Haepyo	6.53907 (0.15354)	5,932.20KRW ($5.16)	8.66433 (0.40064)	3,599.64KRW ($3.13)
	Otugi	6.02318 (0.14987)	5,464.19KRW ($4.75)	7.34248 (0.37655)	3,050.47KRW ($2.65)

[a] estimated coefficients are significant at the 0.05% level.

[b] 1,150KRW=1US$

5. Concluding Remarks

5.1. Key findings

We have estimated the willingness to pay for CO_2 labeling and compared the ROL with the CL. Estimates of WTP for CO_2 label are statistically significant. In the case of fresh milk, MWTP for CO_2 label is calculated as 494.02~540.52 KRW ($0.43~$0.47) and is equivalent to 10.8 ~24.6% of the MWTP for brand attributes, and it in the case of soybean cooking oil is estimated as 759.89~1,057.62 KRW ($0.66~$0.92) and is equivalent to 12.7 ~34.7% of the MWTP for brand attributes. It appears from this analysis that CO_2 label has a significant effect on consumers' choice.

The estimation results yield several interesting implications for some respects.

To begin with, WTPs for carbon label were statistically significant in both models. It refers that consumers would potentially pay a premium for CO2 abatement endeavor. The willingness to pay for CO2 label is significant.

In addition, estimates of WTP for carbon label in the CL are higher than that in the ROL, whereas estimates of WTP for brands in the CL are smaller than that in the ROL. The ratio of WTP for carbon label to WTP for each brand in the CL is smaller than it in the ROL. This difference is due to model specification that the CL deals with choice experiment data, while the ROL handles with ranking data. It indicates that the CL focus on what consumers choose to buy one at first, on the other hand, the ROL also get interest in other alternatives and even no-purchase among the alternatives as well as something consumers have chosen at first. Therefore, the difference between WTP for label and WTP for brands in the ROL is larger than it in the CL.

Finally, this analysis results show that carbon labeling could impact on consumers' choice. It means that consumers' choice under his or her taste preference is able to be changed, considering whether the presence or absence of carbon label.[9]

5.2. Limitation

It could be some different with consumer behaviors in real market, since this study performed based on consumer survey data and consumer. It is needed to remember that the results based on stated preference are not free from the hypothetical bias. Further efforts are required to understand the factors that cause disparities between hypothetical and actual reported valuations (List and Gallet, 2001). Hypothetical estimation of MWTP is reported to be 2.59 times the predicted actual value (Murphy, et. al., 2005).

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[9] This result is a contrast to John and Reheim (2006) which analyzed on consumers' preference on the eco-labeled fresh seafood and revealed that consumers are not willingness to sacrifice their most-favored (by taste) goods to get less-favored species bearing a no-overfishing eco-label. However, it is similar to the findings of Bjørner et al. (2004) that marginal willingness to pay for environmental label ranges from 13% to 18% of the price of toilet paper..

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