Effects of HACCP and Eco Labels on Japanese Consumers' Choice of Milk

Hiroyuki Iwamoto [*], Yasutaka Yamamoto[*], Kazuo Sato[**] and Manabu Sawada[***]

Abstract

The purpose of this study is to examine the importance of the price, freshness, use of the HACCP label, and use of the Eco label (the latent attribute of the milk produced from the raw milk of dairy farms that comply with The Law, which protects the environment by legally enforcing manure treatment) in Japanese consumers' milk purchasing decisions. We employ Choice Modeling to quantify the welfare change associated with the change in the levels of these attributes for a sample of Japanese consumers taken in December 2000. We found that consumers have a positive perception of the HACCP label, the Eco-milk label, and the freshness of the milk.

Key words: Choice Modeling, Japanese Consumers, Milk

Contributed paper presented for the 47th Annual Conference of the Australian Agricultural and Resource Economics Society, Fremantle, The Esplanade Hotel, February 11-14, 2003.

---

[*] Graduate School of Agriculture, Hokkaido University, Sapporo 060-8589, Japan
[**] Rakunogakuen University, Ebetsu 069-8501, Japan
[***] Obihiro University of Agriculture Veterinary and Medicine, Obihiro 080-8555, Japan

1. Introduction

The safety of food is an issue of great concern for Japanese consumers. In June 2000, more than 10,000 people fell ill due to a large outbreak of food poisoning resulted from contaminated milk produced by one of the major dairy companies in Japan. Yet this poisoned milk carried the HACCP (Hazard Analysis Critical Control Point) certification label. This issue not only raised concerns about the attention given to food safety in Japan, but also resulted in criticism about whether the HACCP system in place at the time was appropriate as a certification of food safety.

One issue that has received much attention over the last few years in Japan's dairy sector is the enactment of "The Manure Treatment Law (MTL)" passed in 1999. MTL is scheduled to apply to dairy farmers in 2004. From 2004, dairy farmers are going to be prohibited from stacking manure without storage facilities. Applying MTL will be very costly to dairy farmers in Japan. While Japanese consumers might acknowledge the environmental value of MTL, it is unknown whether the raw milk production cost increases incurred to comply with MTL will be recovered through consumers' willingness to pay the extra cost due to acknowledging the environmental value of MTL.

It is said that Japanese consumers tend to prefer raw food (such as *Sashimi*, raw fish) and attach importance to the freshness of food more than consumers in developed countries other than Japan. In light of the above case, it is important to understand Japanese consumers' demand for various attributes, such as the safety and freshness of food.

The purpose of this study is to examine the importance of food safety certification and the freshness of food in Japanese consumers' milk purchasing decisions. Choice Modeling is chosen to quantify the welfare change associated with the change in the level of these attributes. Choice Modeling is a technique widely used in marketing literature to predict consumer choice[1].

The paper is structured as follows. The theoretical framework of Choice Modeling in milk purchasing decisions and an outline of the estimation procedure are presented in Section 2, and the data collection procedure is presented in Section 3. The empirical results are presented in Section 4. Summaries are given in Section 5.

2. Methodology

Choice Modeling is formulated with both a deterministic and random utility component. There is both a deterministic component (attributes and characteristics known by the researcher) and a random component (unknown attributes and characteristics) of a random utility model. For consumer *i* faced with *J* choices, the utility of choice *j* is (Greene 1997):

$$U_{ij} = V_{ij} + e_{ij}, \quad (1)$$

[1] Previous studies using Choice Modeling for food safety or quality of food include Sato *et al*. (2000), Kuperis *et al*. (1999), Quagrainie *et al*.(1998), Unterschultz *et al*.(1998). Sato *et al*. (2000) examined Japanese consumer preferences for the safety of rice. Kuperis *et al*. (1999) examined consumer preferences for recombinant somatotrophin (rBST)-treated milk in Canada. Quagrainie *et al*. (1998) used Choice Modeling to examine the potential effect of identified product origin and selected demographics on consumer choice of red meats in western Canada. Unterschultz *et al*. (1998) evaluated the Korean attitude towards Canadian beef relative to competing beef from the U.S. and Australia.

where V_{ij} is the indirect observable utility of individual *i* and the attributes of alternative *j*. The indirect observable utility of individual *i* and alternative *j* is:

$$V_{ij} = \beta' X_{ij}, \quad (2)$$

where X_{ij} is a vector of the attributes of alternative *j*.

The probability that consumer *i* will choose *j* is equal to the probability that U_{ij} is greater than the utility received from any other alternative in the set of alternatives. It is assumed that the *e* terms are independence-from-irrelevant alternatives (IIA) and distributed according to an extreme value (Gumbell) distribution (Ben-Akiva and Lerman 1985). The conditional logit model has been formulated for this case. Thus, the probability of individual *i* choosing alternative *j* is:

$$P_{ij} = \exp(\beta' X_{ij}) / \Sigma_j \exp(\beta' X_{ij}), \quad (3)$$

Where β' is a parameter vector to be estimated.

The factors of attributes considered in this study (price, freshness, HACCP label, and the Eco-milk label) are chosen because of their hypothesized importance in the consumer purchasing decision. The four milk attributes and their levels are presented in Table 1. The levels of each attribute were chosen to provide realistic ranges that could be measured in the actual retail market. Price was chosen as an attribute to provide a realistic comparison of milks and to allow for a monetary valuation of the other milk attributes. We selected a price range from 140 yen/liter to 160 yen/liter because this range represents realistic limits of

milk prices currently existing in the marketplace[2]. Freshness was chosen as an attribute to provide an indication of freshness in terms of days remaining before the expiry date. We chose a freshness range of eight days to five days remaining before the expiry date. The HACCP label was chosen as an attribute representing the food safety. The Eco-milk label was chosen as the latent attribute of the milk produced from the raw milk of dairy farms that comply with the MTL, which protects the environment by manure treatment.

It is assumed that the milk purchasing decision is based on constrained utility maximization, as reflected in the indirect utility function. This utility function is specialized as below

$$V_{ij} = \beta'_1 PRICE_j + \beta'_2 BD_j + \beta'_3 BHACCP_j + \beta'_4 BECO_j + CONST, \quad (4)$$

where *PRICE* denotes the price per liter for the milk presented in the choice set. Here, *BD* denotes the freshness of the milk presented in the choice set (days remaining before the expiry date), and *BHACCP* denotes a dummy variable indicating whether the milk presented in the choice set is labeled with the mark of HACCP certification (1 = Yes, 0 = No). Furthermore, *BHACCP* is intended to capture the difference in utility between the alternatives of choosing to purchase HACCP-labeled milk and the non-labeled milk. A dummy variable *BECO* indicates whether the milk presented in the choice set is labeled with the mark of Eco-milk certification (1 = Yes, 0 = No). Additionally, *BECO* is intended to capture the difference in utility between the alternatives of choosing to purchase

[2] As shown in the next data section, the actual marketplace chosen in this study is Sapporo City located in Hokkaido prefecture.

Eco-milk-labeled milk and the non-labeled milk. Also, *CONST* denotes a constant parameter in the model. The coefficients $\beta_1, \beta_2, \beta_3, \beta_4$ and *CONST* are coefficients to be estimated.

3. The Data

The data for this study were collected through a mail survey of residents of Sapporo City, situated in Hokkaido prefecture (Japan's northernmost island). The Choice Modeling questions (choice sets) are designed according to Zwerina *et al.*'s (1996) method. The use of this design allows for a smaller and more reasonable sample of Choice Modeling questions. The final design consisted of eight Choice Modeling questions and 24 choice scenarios. A sample Choice Modeling question is given in Figure 1.

This survey was designed using the "Remainder Postcard Strategy" (Mangione 1995) to maximize the response rate. The survey was distributed in December 2000. Based on the constituent list in Sapporo City, a random sample of 300 Sapporo households was selected and one hundred and forty seven households returned the survey, including 71 women and 27 men who completed it. Forty-nine individuals who did not answer all questions were excluded from this study.

Summarized statistics of the sample are reported in Table 2. The higher number of female respondents was expected. The cover letter included with the survey indicated that the person in the household who makes the majority of the food purchases should answer the questionnaire. Household food purchases

continue to be made primarily by women in Japan.

In summary, we conclude that the sample is reasonably representative of Sapporo residents in terms of age, household size and household income.

4. Empirical Results

The coefficients of the model described in Eq. (4) are estimated using TSP, Version 4.5. The results are given in Table 3. The chi-squared statistic shows that the model is highly statistically significant. The value of the adjusted ρ^2 (McFadden's adjusted R^2) is 0.280[3].

The estimated coefficients display the expected signs. The *PRICE* coefficient is negative and statistically significant, indicating that increasing price decreases the probability of a consumer purchasing milk. The *BD* coefficient is positive and is statistically significant at the 1% level, indicating that increasing freshness of milk increases the probability that a consumer will purchase milk. The coefficient of *BHACCP* is positive and is statistically significant at the 1% level, indicating that labeling the milk with the HACCP certification mark increases the probability of a consumer purchasing milk. The *BECO* coefficient is positive and is statistically significant at the 1% level, indicating that labeling the milk with the Eco-milk certification mark increases the probability of a consumer purchasing milk.

---

[3] Following Ben-Akiva and Lerman (1985), the calculation for ρ^2 is: $\rho^2 = 1 - [(L(\beta) - K) / L(0)]$, where $L(\beta)$ is a log-likelihood function of the unrestricted model, $L(0)$ is a log-likelihood function of the restricted (slope = 0) model, K is the number of coefficients in the unrestricted model.

Changes in consumers' economic welfare arising from the availability of HACCP-labeled milk, Eco-milk-labeled milk and alternative freshness options are calculated according to Blamey *et al*.'s (2000) method. This method calculates economic welfare as the compensating variation associated with a change in the level of a particular attribute. Labeling milk with the HACCP and Eco-milk certification marks can be viewed as a change in the perceived quality of milk. This method calculates the amount, *C*, by which a consumer would have to be compensated in order to be at least as well off as he or she was before labeling with the HACCP and Eco-milk certification marks. The change in economic welfare, *C*, is calculated as:

$$C = -1/\mu[\ln(e^{Vi0})-\ln(e^{Vi1})] = -1/\mu[V^{i0}-V^{i1}], \quad (5)$$

where:

μ = the marginal utility of money (the *PRICE* coefficient is used to represent the marginal utility of money)

V^{i0} = the indirect utility function in the base situation (i.e. *BHACCP* = 0, *BECO* = 0, *BD* = 8.)

V^{i1} = the indirect utility function when HACCP-labeled milk is available (i.e. *BHACCP* = 1, *BECO* = 0, *BD* = 8.).

Table 4 shows the estimated changes in welfare for the consumer in three situations. The base case (V^{i0}) is specified as the milk that has "no HACCP label," "no Eco-milk label," costs 150 yen/liter and has eight days remaining before the expiry date. In Situation 1, the other situations being equal, there is a change from the base situation (the milk has "no HACCP label") to the milk being

HACCP-labeled milk. In Situation 2, the others being equal, there is a change from the base situation (the milk having “no Eco-milk label”) to the milk being Eco-milk labeled milk. In Situation 3, the others being equal, there is a change from the base situation (the milk has eight days remaining before the expiry date) to the milk having seven days remaining before the expiry date.

In Situation 1, the consumer experiences a gain in welfare and appears to be willing to pay 165yen/liter (10% increase) to purchase HACCP-labeled milk. It implies that the consumer still has a positive perception of HACCP certification of milk safety even after the food poisoning outbreak in HACCP-labeled milk produced by one of the major Japanese dairy companies in June 2000.

In Situation 2, the others being equal, the consumer experiences a gain in welfare and appears to be willing to pay 167 yen/liter (11% increase) to purchase Eco-milk labeled milk. It implies that the consumer has a positive perception of Eco-milk labeled milk.

In Situation 3, the consumer experiences a loss in welfare and appears to be willing to pay 145yen/liter (3% decrease) to purchase milk that has seven days remaining before the expiry date. It implies that the consumer has a positive perception of the freshness of the milk.

Figure 2 shows the consumer’s welfare change in the parametric varying the freshness of milk. When the freshness of milk decreases, other factors being equal, the loss in welfare increases. The consumer appears to be willing to pay 113 yen/liter (25% decrease) to purchase milk that has zero days remaining before the expiry date. The premium for the HACCP label is offset by a welfare

loss when HACCP-labeled milk has less than five days remaining before the expiry date. The premium for the Eco-milk label is also offset by a welfare loss when Eco-milk-labeled milk has less than five days remaining before the expiry date.

5. Summary

The purpose of this study was to examine the importance of the price, freshness, use of the HACCP label, and use of the Eco label (the latent attribute of the milk produced from the raw milk of dairy farms that comply with the Law, which protects the environment by legally enforcing manure treatment) in Japanese consumers' milk purchasing decisions. Choice Modeling was used to quantify the welfare change associated with the change in the levels of these attributes for a sample of Japanese consumers taken in December 2000.

We found that consumers have a positive perception of the HACCP label, Eco-milk label, and the freshness of the milk. Consumers appear to be willing to pay as follows:

1) Extra 15 yen/liter (10% increase) to purchase HACCP-labeled milk
2) Extra 17 yen/liter (11% increase) to purchase Eco-milk-labeled milk.
3) Extra 5 yen/liter (3% increase) to purchase milk that is an extra one day fresher

The consumers' utility might be influenced by their socio-economic characteristics. Further studies of the effects on consumers' socio-economic

characteristics would be helpful in assessing how the attributes may influence the patterns on consumption of milk.

References

Ben-Akiva, M., and Lerman, S.R. 1985, *Discrete Choice Analysis: Theory and Application to Travel Demand*, MIT Press, London.

Blamey, R.K., Benett, J.W., Louviere, J.J., Morrison, M.D., Rolfe, J. 2000, 'A Test of Policy Labels in Environmental Choice Modelling Studies', *Ecological Economics*, vol. 32, pp. 269-286.

Greene, W.H. 1997, *Econometric Analysis 3rd ed*., Prentice Hall, New Jersey.

Kuperis, P.A., Veeman, M.M., and Adamowicz, W.L. 1999, 'Consumer's Responses to the Potential Use of Bovine Somatorophin in Canadian Dairy Production', *Canadian Journal of Agricultural Economics*, vol. 47, pp. 151-163.

Mangione, T.W. 1995, *Mail Survey Improving the Quality*, Applied Social Research Methods Series, vol. 40, Sage Publications, Newbury Park.

Quagrainie, K.K., Unterschultz, J., and Veeman, M. 1998, 'Effects of Product Origin and Selected Demographics on Consumer Choice of Red Meats', *Canadian Journal of Agricultural Economics*, vol. 46, pp. 201-219.

Sato, K., Iwamoto, H., and Demura, K. 2001, 'Anzensei ni hairyo shita saibai - houhou niyoru Hokkaido - sanmai no shijyo - kyosouryoku (Using Choice Based Conjoint Analysis to Assess Competitiveness of Chemical-free Hokkaido Rice)', Noringyo - mondai - kenkyu (*Journal of Rural Problem*), vol. 37, pp. 37-49.

Unterschultz, J., Quarainie, K.K., Veeman, M. and Kim, R.B. 1998, 'South Korean Hotel Meat Buyers' Perceptions of Australian, Canadian, and US Beef', *Canadian Journal of Agricultural Economics*, vol. 46, pp. 53-68.

Zwerina, K., Huber, J., and Kuhfeld, W.F. 1996, *A General Method for Constructing Efficient Choice Designs*, SAS Technical Support Documents, TS-650D, pp. 48-67 (http://www.sas.com/service/techsup/tnote/tnote_index6.html).

Table 1 Milk Attributes and Levels in the Choice Modeling Question

Milk Attribute	Levels
Price	140 yen/liter
	145 yen/liter
	150 yen/liter
	155 yen/liter
	160 yen/liter
Freshness	five days
	six days
	seven days
	eight days
HACCP Label	non-labeled
	labeled
Eco-milk Label[a]	non-labeled
	labeled

Note: [a] Eco-milk label denotes the latent attribute of the milk produced from the raw milk of dairy farms that comply with The Manure Treatment Law (MTL), which protects the environment by legally enforcing manure treatment.

Figure 1 Example of a Choice Modeling Question

Which milk would you buy if the 3 types of milk listed below were available? (CIRCLE ONE)

	1	2	3	4
Freshness	**5** days	**6** days	**6** days	
HACCP Label			□non-labeled□j	I would not buy any of them
Eco-Milk Label[a]	□non-labeled□j	□non-labeled□j	Eco-Milk	
Price	145 yen/liter	155 yen/liter	140 yen/liter	

Note: [a] Eco-milk label denotes the latent attribute of the milk produced from the raw milk of dairy farms that comply with The Manure Treatment Law (MTL), which protects the environment by legally enforcing manure treatment.

Table 2 Socio-demographics of the Respondents

	Sample average	Sapporo average
Age	45.3 years	43.8 years[a]
Sex（female rate）	72.5%	54.6%[a]
Household Size	2.9 persons	3.5 persons[b]
Household Income	7.82 million yen	7.30 million yen[c]

Source: [a] *Population Census 2000*, Sapporo city, 2000. [b,c] *National Survey of Family Income and Expenditures 1999*, Statistics Bureau, Japan, 1999.

Note: [b] Size of worker's household. [c] Annual income of worker's household.

Table 3 Conditional Logit Estimates

Variable	Definition	Coefficient[a]	Standard Error
BP	Price (yen/liter) p_j	-0.13114 **	0.01039
BD	Freshness (days) d_j	0.60921 **	0.05954
BHACCP	HACCP Label (1 if labeled, 0 otherwise) h_j	1.90159 **	0.13096
BECO	Eco-milk Label (1 if labeled, 0 otherwise) e_j	2.26693 **	0.13556
CONST	Constant	15.05930 **	1.25946
n(Choice Set)	784		
$L(,)$	-1086.9		
$L(\beta)$	-778.1		
Chi-squared (d.f. = 5)	617.6		
ρ^2	0.284		
adjusted ρ^2	0.280		

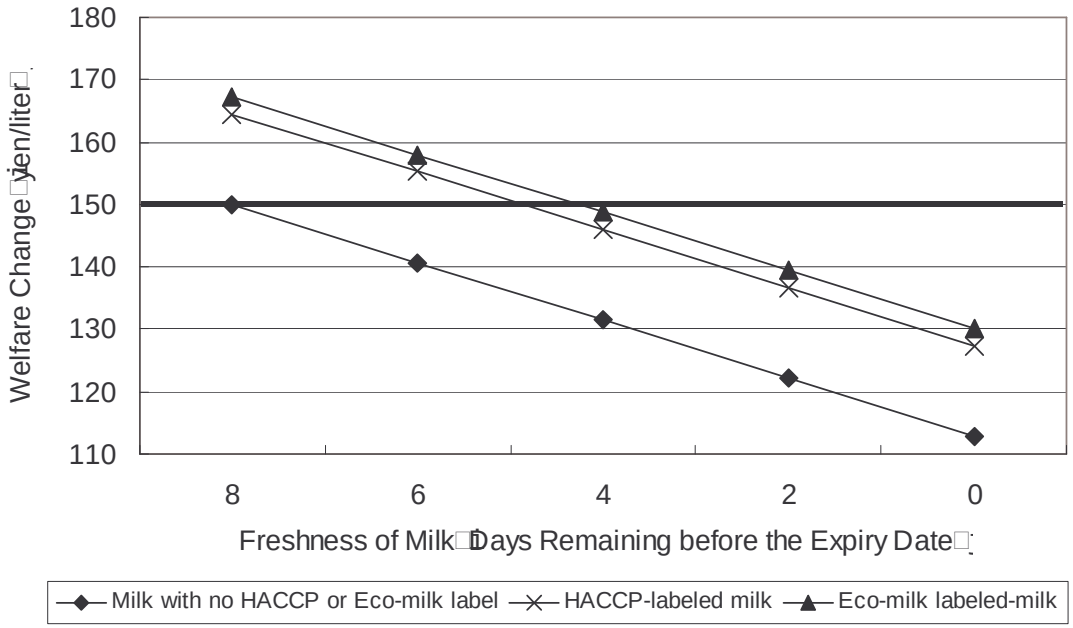
NOTE: [a] "*" denotes statistically significant at the 5% level and "**" denotes statistically significance at the 1% level.

Table 4 Welfare Changes

Situation	Base Situation	Situation 1	Situation 2	Situation 3
Freshness	eight days	eight days	eight days	seven days
HACCP Label	non-labeled	labeled	non-labeled	non-labeled
Eco-milk Label[a]	non-labeled	non-labeled	labeled	non-labeled
Price (yen/liter)	150 yen/liter (100%)	165 yen/liter (110%)	167 yen/liter (111%)	145 yen/liter (97%)

Note: [a] Eco-milk label denotes the latent attribute of the milk produced from the raw milk of dairy farms that comply with The Manure Treatment Law (MTL), which protects the environment by legally enforcing manure treatment.

Figure 2 Welfare Change in the Parametric Varying the Freshness of Milk



Note: Eco-milk label denotes the latent attribute of the milk produced from the raw milk of dairy farms from complying with The Manure Treatment Law (MTL), which protects the environment by legally enforcing manure treatment.