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Japanese Consumers' Perceptions on and Willingness to Pay for Credence Attributes Associated with Canola Oil

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In this study we found that Japanese consumers value the conventional health claim "low in saturated fat" more than the relatively newer claims, such as "high in oleic acid." In addition, consumers do not prefer oil with genetically modified ingredients or oil that is not domestically produced, but they are willing to pay extra for "organic" or "functional food" features. We also found that the scope and source of information on these credence attributes may also affect consumers' choices and willingness to pay and that the effects may not be completely consistent with what one would expect.

Key Words: canola oil, choice-based conjoint, credence attributes, Japanese consumers, willingness to pay

JEL Classifications: D12, Q13

Japan has long been one of the largest canola seed–importing countries in the world, and its annual import in 2004 is estimated to be 2.1 million tons (Richards). In addition to the conventional oil attributes (e.g., price, package size), Japanese consumers have developed demand for many new quality and safety attributes (Chen, Shi, and Akune). Consumers' health concerns will likely be part of an important progression that will affect the future of canola export to and oil production in Japan (McCluskey et al.; Curtis, McCluskey, and Wahl; Hori, Shepard, and Mutou). Eating healthy and nutritiously has gained unprecedented focus in recent years in Japan, and consumers are paying more attention to attributes that are not conventionally considered. Subsequently, many companies are moving towards developing specialty oils with added properties to improve taste as well as the health effects and nutritional content. For example, Nissin (one of Japan's largest food producers) has developed a special "Balance Oil," a mix of canola, corn, and flax oil, with the claim that it helps the body absorb less fat.

Given the importance of the Japanese market for international canola trade, a better understanding of consumers' preference towards canola oil in Japan is essential to predict future market trends on canola and canola oil with different traits. The information may also be useful in guiding private or public investments in the development and use of various types of technology to improve canola oil attributes

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Table 1. Design Variables and Their Corresponding Levels

	Levels				
Attributes	1	2	3	4	5
Nutrition information	Low in saturated fat	Rich in oleic acid	Rich in alpha-oleic acid	Rich in vitamin E	
GM seeds	Yes	No			
Certified	FOSHU certified	JAS certified*	Not specified		
Imported	Yes	No			
Price	298	398	498	598	698

* There is a restriction in the design process that when the product has a JAS label (organic), it will not also be labeled as GM.

that are both accepted and valued by consumers. In this study, Japanese consumers' assessment of various attributes associated with bottled canola oil and their attitudes toward issues related to food safety and nutrition are examined. The attributes studied in the paper include nutrition claims, the country of origin label, label on genetically modified (GM) ingredients, and two types of certificates (functional food and organic food). Because the effects of these attributes cannot be examined by consumers either before or after a short period following consumption, the attributes are usually classified as credence attributes (Antle). This study is unique in that it analyzes Japanese consumers' attitudes towards, willingness to pay for, and possible tradeoffs among these credence attributes in one integrated occasion and therefore allows comparison of the relative importance of these attributes.

Economic theory suggests that information is crucial in the context of products with credence attributes (Mizerski). It is generally recognized that information must be provided and endorsed by certain authorities for it to be effective in assisting consumers' decision making (Caswell). This highlights the importance of a third party that guarantees the truthfulness of the information. However, studies have shown that different agencies that provide and guarantee product information and the amount of information provided may have different impacts on consumers' choices (Rousu et al.; Roosen, Lusk, and Fox; Noussair, Robin, and Ruffieux). Thus, one important aspect of this study is to investigate how the source (who offers the information) and scope (how much) of information on canola oil's credence attributes may affect consumers' choices.

Procedures and Survey Design

A choice-based conjoint survey is developed to elicit consumers' stated perceptions and willingness to pay (WTP) for canola oil. Before we implemented the survey, sufficient focus group discussions and pretests were conducted to ensure the feasibility and validity of the survey questionnaire. Focus group discussions indicated that in addition to the price variable, the following credence attributes were important in the consumers' decision-making process and should be included in the final survey design: saturated fat content, oleic acid content, alpha-linoleic acid (AL acid) content, vitamin E content, GM content, certified organic, certified functional food, and domestically produced.[1] These attributes and their associated levels used in the survey are given in Table 1.

Two types of information contexts were

[1] There has been a growing public awareness of trans fatty acid (TFA) content in processed oil products. We chose not to include the TFA attribute into the design of choice experiment for the following reasons. First, although the biological and dietary processes involved with saturated fatty acids (which is included in the design) and TFA are quite different, when used in processing food (especially baking), these two types of fatty acids have very similar properties. Second, vegetable oils, typically canola oil, are usually considered to be very low in TFA. Within the context of canola oil, choices are naturally characterized with the "low in TFA" attribute.

created in the survey. The first context is related to the source of information. For the text page presented to consumers containing information about the credence attributes of the products, we included a title box suggesting that "here is some information about vegetable oils provided by. . . ." In addition to the case in which no specific source is identified for the information, we alternated four major types of sources: scientists, manufacturers, government agencies, and consumer groups. These information sources were also identified and confirmed by focus group discussion. The other context is the scope of information. We had the following three scenarios: full information on all credence attributes used to describe oil products, full information without information regarding the GM technology, and full information without information regarding AL acid. The second two scenarios were created based on discussion with focus groups: GM involves a great deal of uncertainty to most consumers, and the benefits of AL acid are not known to a significant proportion of consumers (about 60%). Combining these two context effects, we have 15 different types of choice environment in terms of the variation in information. Appendix 1 lists the information provided to consumers before they enter the next stage of the survey.

Each choice set in the choice experiment contains three alternatives, with the first two alternatives described by the attributes given previously and the last alternative described as "buy none of the oil given in option A and option B." Appendix 2 displays an example of one of the choice sets. Following other similar studies (Hu et al.; Swait and Adamowicz; Roe and Teisl), each respondent was randomly assigned with eight choice sets determined by a main effect fractional factorial design. The order of the eight tasks for each individual is randomized to avoid the ordering effect. The survey is composed of five sections. The first section is used to remove those participants who have never purchased any oil products. Section 2 explores consumers' perceived levels of various credence attributes and the relative importance of these credence attributes together with other search or experience attributes, such as price and packaging. Section 3 contains the choice experiment. Section 4 of the survey collects respondents' general perceptions on food safety and their knowledge of canola oil. Also collected in this section are respondents' information acquisition habit, such as whether they read a label and how they obtain product information. The final section collects respondents' demographic information.

The actual survey was conducted from May to July 2004 in four Japanese cities: Tokyo, Kanagawa, Saitama, and Chiba. These areas are commonly known as the metro-metropolitan Tokyo areas. The population of this area is 14 million people, which makes up more than 30% of the total households in the nation and may also reflect the diversification of the Japanese population. Surveys were mailed to 1,050 households whose addresses were determined by a two-stage cluster sampling applied to a digital telephone directory record. A second mailing was sent to households that did not reply within 4 weeks after the first mailing was sent. In total, 430 respondents completed the survey, and the overall response rate was 41%. Given the recent popularity of media coverage and public interest in issues related to food safety and quality, this high response rate is not surprising. This in turn may also provide support that this study is representative. Among the 430 returned questionnaires, 403 were determined to be useable for the analysis. Table 2 reports descriptive statistics of some key demographic features of the sampled consumers. The statistics showed oversampling of female consumers. This, however, is typical in surveys on food products, because most households have females as the main grocery shopper in Japan. The sample also slightly favors older individuals, because the average age observed is 57.1 years. This is partially because minors were not surveyed or were screened off in the random dialing process.

Model

Suppose the utility of individual n choosing alternative i (out of the three available prod-

Table 2. Descriptive Statistics of Key Demographic Features in the Sample*

Gender (411)

Male	Female
23.4%	76.6%

Income (395) in Japanese Yen

0 to <2M	2M to <4M	4M to <6M	6M to <8M	8M to <10M	10M to <12M	12M to <14M	14M and above
7.1%	23.5%	23.3%	11.6%	13.2%	10.4%	4.1%	6.8%

Age (392)

Mean	Std. Dev.	Min	Max
57.1	12.46	19	88

* Numbers in parentheses are actual numbers of respondents who answered the corresponding question.

ucts in each choice set) can be expressed based on a random utility framework:

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

where V_{ni} is the deterministic portion of the utility function and e_{ni} is the error term of the utility representing the uncertainties an analyst may have on U_{ni} (the choice set indicator t is ignored to simplify notation). In most applied studies, the deterministic portion V is specified as a linear combination of product attributes in vector X_{ni}; i.e., $V_{ni} = X_{ni}\beta$. Although this linear specification of the utility function may miss higher-order correlations or interaction effect among variables in X_{ni}, it is supported by the orthogonal nature of the designed attributes. If the error terms are assumed to follow an iid maximum Gumbel distribution, the probability of individual n choosing alternative i can be expressed by a standard conditional logit (CL) model:

$$(2) \quad P_{ni} = \frac{\exp(\mu X_{ni}\beta)}{\sum_j \exp(\mu X_{ni}\beta)}$$

where the scale parameter μ is inversely proportional to the standard deviation of the model and often assumed to be one in a standard CL model (Louviere, Hensher, and Swait).

The design of the questionnaire for this study allows systematic variation of the amount of information on two credence attributes for oil: the AL acid and the usage of GM seeds in production. Some respondents will not see information describing either the AL acid or the GM ingredients. The absence of additional information is expected to affect consumers' valuation of corresponding attributes in the choice experiment. The vector X_{ni} in Equation (2) can be modified as:

$$(3) \quad X_{ni} = (BUYNO,\ OLE,\ VE,\ AL,\ GM,\ JAS,\ FOS,\ IMP,\ PRICE,\ AL{*}ALab,\ GM{*}GMab)$$

where *BUYNO* is an alternative specific constant (ASC) for the third alternative in the survey. *OLE, VE,* and *AL* are a set of dummy variables indicating whether the product is "high in oleic acid," "rich in Vitamin E," or "rich in AL acid," respectively (with a dummy variable for "low in saturated fat" normalized). *GM, JAS, FOS,* and *IMP* are dummy variables indicating whether the product is "genetically modified," "JAS certified for organic," "FOSHU certified for functional food," or "imported." *PRICE* is the price variable. Two dummy variables, *ALab* and *GMab,* are defined as information scope variables indicating the information on the AL acid or on the GM ingredients is not given. Variable *AL*ALab* is the interacted variable between variable *AL* and *ALab,* and variable *GM*GMab* is the interaction between variable *GM* and dummy variable *GMab.*

The impacts from information provided by different organizations can be implemented by creating interaction effects between information source context variables and the ASCs of the first two alternatives in a choice set (the

third is a no-choice alternative).[2] A similar approach can be used to examine the impact from consumers' demographic characteristics. Let A1 and A2 be the ASCs for the first two alternatives in a choices set; let variables *SCI, MANU, GOV,* and *CONS* be dummy variables representing information from scientists, government agencies, producers, and consumer groups, respectively (the normalized category is "no recommendation source is specified"); and let *DEMO* be a vector of a group demographic variables (*DEMO* = (gender, age, household size, number of children, education, income)). The vector X_{ni} can be further written as:

$$X_{ni} = (BUYNO,\ OLE,\ VE,\ AL,\ GM,\ JAS,\ FOS,\ IMP,\ PRICE,\ AL{*}ALab,\ GM{*}GMab,\ A1{*}SCI,\ A1{*}MANU,\ A1{*}GOV,\ A1{*}CONS,\ A2{*}SCI,\ A2{*}MANU,\ A2{*}GOV,\ A2{*}CONS,\ A1{*}DEMO,\ A2{*}DEMO). \tag{4}$$

To capture the possibility that the information source context and demographic variables may affect consumer choices in a different way, a Heteroskadastic extreme value (HEV) model is proposed to examine whether these factors affect the variance of consumers' choices (Bhat). The HEV model also relaxes the IIA property implied by the CL model by assuming independent but not identical error structures among the random utilities associated with alternatives. The HEV model is made operational through parameterizing the scale parameter μ in Equation (2).[3] In particular, we specify:

$$\mu = \exp(Z_n\gamma) \tag{5}$$

where Z is a vector consisting of the following variables: (*SCI, MANU, GOV, CONS, DEMO*).[4] The choice probabilities can be derived by substituting Equation (5) and X_{ni} vector given in Equation (3) into Equation (2). Table 3 lists the variables to be used in the empirical analysis and their descriptive statistics. Given the panel nature of the data and t (each person faced $T = 8$ choice sets in total), the log-likelihood function of the HEV model can be written as:

$$LL = \sum_{n=1}^{N}\sum_{t=1}^{T}\sum_{i=1}^{J} c_{nti}\ln\frac{\exp[\exp(Z_n\gamma)X_{nti}\beta]}{\sum_{j}\exp[\exp(Z_n\gamma)X_{ntj}\beta]} \tag{6}$$

where $c_{nti} = 1$ if individual n chose alternative i in the tth choice set; otherwise $c_{nti} = 0$.

Results

Attitude and Perceptions

At the beginning of the survey, we asked consumers to assess the importance of a series of attributes when making purchasing decisions in a 1 to 4 Likert scale, with 1 representing "very important," 2 "somewhat important," 3 "not very important," and 4 "not at all important." Consumers were also allowed to express their uncertainties of a particular attribute by indicating "I don't know or am not sure." Figure 1 depicts the percentage of consumers who feel a particular attribute is important in their purchasing decision making. The number in the parentheses following each attribute is the total number of responses in that category. For each attribute, responses in

[2] Context variables can also be specified to interact with other attributes variables instead of the alternative specific constant. This, however, will create many new variables to estimate. The model was estimated, but none of the interacted terms were significant.

[3] More precisely, this model is often referred to as a fixed-effect HEV model (Louviere, Hensher, and Swait) because it allows effects from explanatory variables, including individual-specific or alternative-specific variables, to be explicitly reflected in the variance of the random portion of the indirect utility. A random-effect HEV model may also be estimated; however, the fixed-effect HEV model provides more insights into consumer behavior than does the random-effect model. Given the current formulation, the likelihood function of a fixed-effect HEV model still takes a closed form and no numerical approximation is required for evaluation.

[4] An additional variable capturing the possible learning or fatigue effects in consumers' choices was also included, but the coefficient was not significant. This variable is defined by the sequence number of choice sets (1–8). A positive coefficient would indicate a learning effect, and a negative coefficient would indicate a fatigue effect (Bradley and Daly).

Table 3. Descriptive Statistics of Variables Used in the Analysis*

Variable	Definition	Mean	Std. Dev.
BUYNO	Dummy variable for no-choice option	0.3333	0.4714
OLE	Dummy variable for oleic acid	0.1673	0.3733
VE	Dummy variable for vitamin E	0.1671	0.3731
AL	Dummy variable for alpha-linoleic acid	0.1661	0.3722
GM	Dummy variable for GM content	0.3326	0.4712
JAS	Dummy variable for organic	0.1669	0.3729
FOS	Dummy variable for functional food	0.3325	0.4711
IMP	Dummy variable for imported	0.3354	0.4722
PRICE	Continuous variable for price (in thousand Yen)	0.3071	0.2424
MALE	Dummy variable for being male	0.2342	0.4235
AGE	Continuous variable for age	57.0847	12.4582
HSIZE	Continuous variable for household size	3.1284	1.2203
CHILD	Continuous variable for number of children	0.4736	0.8764
EDU	Continuous variable for years of education	12.8033	2.0800
INCOME	Continuous variable for income (in million Yen)	6.6858	3.7160
SCI	Dummy variable for scientists provided information	0.1771	0.3818
MANU	Dummy variable for manufacterers provided information	0.1756	0.3805
GOV	Dummy variable for government provided information	0.2168	0.4121
CONS	Dummy variable for consumer groups provided information	0.2184	0.4132
ALab	Dummy variable for absence of AL acid information	0.2953	0.4562
GMab	Dummy variable for absence of GM information	0.3328	0.4712
N = 403			

* Variables MALE, AGE, HSIZE, CHILD, EDU, and INCOME are included in vector DEMO in the body text.

the first two categories were combined indicating "important." The "don't know" responses and missing responses were dropped from Figure 1. It is interesting that the price is not the most important attribute. Among these attributes, the top three that Japanese consumers think the most important in their purchase decision making, on average, are whether the product uses GM seeds (84%), type of oil (81%), and the price level (80%). This confirms the value of examining the tradeoffs consumers make in their choices with respect to the GM and other attributes. The least-considered attributes are the packaging size (60%) and whether the product can be traced back to farmers (50%); these attributes are not included in the design of the choice experiment.

The survey also asks consumers how risky they perceive a series of practices or situations to be and whether or not they believe these circumstances have harmful effects on human health. Figure 2 shows the results. Similarly, consumers' perceptions were self-evaluated by a 1 to 4 Likert scale, with 1 representing "almost no risk" and 4 representing "high risk." Responses 3 and 4 were subsequently combined to form a category representing "risky," and the "don't know" response was dropped from Figure 2. The highest ranking among the concerns is bovine spongiform encephalopathy (BSE); 87% of the consumers believe that it is risky for human health. Hormones and GM are the next two issues of greatest concern; 82% and 81% of consumers consider them to be risky. The aspect of least concern with regards to harmful health effect is the salt and sugar content in food; only 53% of the consumers think it is risky.

Estimation Results

A CL model with the underlying utility given in Equation (4) was initially estimated. However, it is known that results from the conventional CL model may prune to the restrictive IIA property. A Hausman and McFadden's χ^2 test (Hausman and McFadden) was conducted

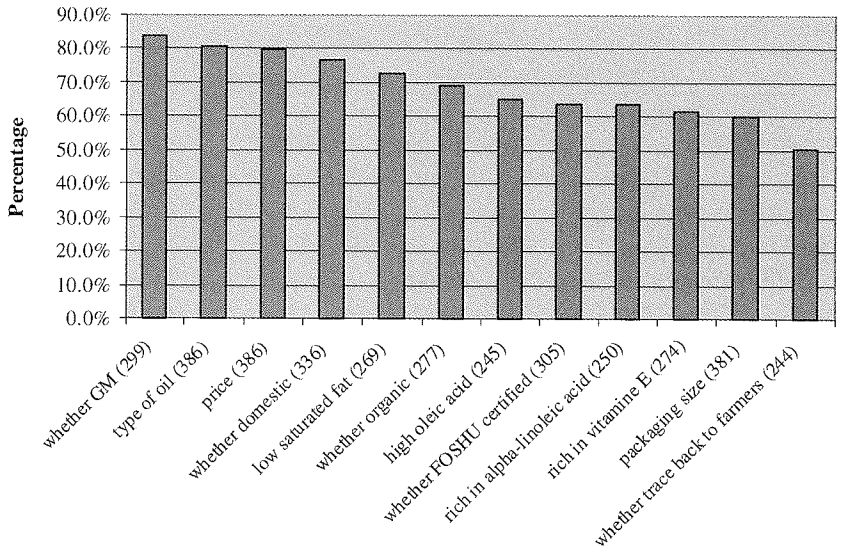

Figure 1. Percentage of Consumers Who Feel Each Attribute Is Important for Their Purchase Decision Making

to test for the validity of the IIA assumption. A test statistic of 82.915 was obtained after the first alternative was dropped from the analysis, and the statistic suggests a strong rejection of the null hypothesis that IIA holds. The HEV model was subsequently estimated, which relaxed the assumption of IIA. Results of both models are reported in Table 4. Before interpreting the results, a nonnested Akaike information criterion (AIC) test was conducted to compare the fit of the HEV and the CL models. The likelihood functions at convergence for these two models are −2894.899 and −2889.475, respectively. The AIC statistics for these two models are 5819.789 and 5818.950 and therefore indicate that the HEV outperforms the CL model. The results of these two models give a consistent interpretation of the tradeoffs consumers made among various credence attributes. Because the HEV

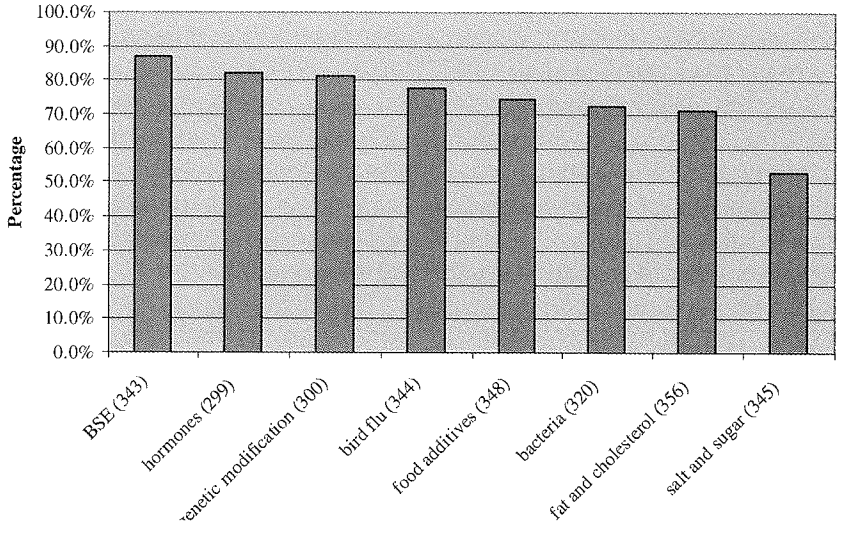

Figure 2. Percentage of Consumers Who Feel Each Factor Is Risky for Human Health

Table 4. Results from Conditional Logit and HEV Model

	Conditional Logit		HEV Model	
Variables	Coefficients	Std. Error	Coefficients	Std. Error
BUYNO	−1.083***	0.1543	−0.939***	0.1258
OLE	−0.118	0.0913	−0.108*	0.0563
VE	−0.223***	0.0804	−0.195***	0.0583
AL	0.003	0.0940	0.022	0.0398
GM	−1.842***	0.0832	−1.754***	0.0967
JAS	0.287***	0.0869	0.253***	0.0722
FOS	0.607***	0.0617	0.602***	0.0537
IMP	−0.887***	0.0688	−0.806***	0.0657
PRICE	−1.203***	0.2512	−1.189	0.2111
A1*MANU	−0.244**	0.1174	—	—
A1*GOV	−0.238**	0.1083	—	—
GM*GMab	—	—	0.210**	0.0835
Scale parameters				
GOV			0.302***	0.0755
CONS			0.239***	0.0643
MALE			−0.151**	0.0720
LL	−2894.899		−2887.243	
adj-ρ2	0.171		0.195	

** and *** represent significance at the 5% and 1% significance level, respectively.

model fits the data better than the CL model, the interpretation will focus on the HEV model.

Variable *BUYNO* (ASC for the no-choice alternative) is significant and negative, indicating that overall consumers have strong intentions to buy either of the two oil products compared with buying neither of them.[5] The impacts of dummy variables *OLE* (high in oleic acid), *VE* (rich in vitamin E), and *AL* (rich in AL acid) to consumers' utilities have to be interpreted against the omitted category "low in saturated fat." Variable *AL* is not significant, and variable *OLE* is only marginally significant. This indicates that Japanese consumers do not see the attribute "risk in AL acid" as being more important than the attribute "low in saturated fat" and they may see attribute "rich in oleic acid" to be less important, but the difference was not strongly supported by statistical evidence. On the other hand, variable *VE* is negatively significant, which in turn shows that Japanese consumers do not value benefits from the claim that "this product is rich in vitamin E" as much as the "low in saturated fat" claim. This has implications to current marketers in the Japanese oil market. It may appear to be difficult to directly compare the effect of labeling claims on different credence oil attributes. However, through the formulation of this study, it seems that Japanese consumers do view different credence attributes differently. If a particular oil product is qualified to be labeled both as "rich in Vitamin E" and as "low in saturated fat," the manufacturer may choose to attach a label design focusing on saturated fat only and save space on the product label for other valuable information.

Given the negative significant coefficient of variable *GM* (whether containing GM ingredients), when a product is made from GM oil seeds, Japanese consumers will lower their purchasing intentions for that product. In this sense, this paper confirms the finding in most studies on consumers' attitude toward GM food that, in general, consumers hold a negative view on the use of GM technology or the

[5] An alternative approach is to interact context variables with the third alternative ASC. The implied result is identical.

presence of GM ingredients in their food products.[6] The two types of certificates—the JAS organic certificate and the FOSHU functional food label—are both associated with a significant positive coefficient. This suggests that when these labels are used on a product, Japanese consumers' purchasing intentions for the product will be higher when holding other factors constant. Variable *IMP* (whether imported) has a significant negative coefficient, indicating that Japanese consumers discount the value of an imported product. In general, Japanese consumers have been consistently found to be quite negative toward imported food (Stroppiana and Riethmuller). Knowing that their products are necessarily disvalued by Japanese consumers when compared with domestic products, oil importers should be more incisive on what to put on a product label. If these importers know the market well and respond accordingly, such as using strategies involved in labeling credence attributes discussed previously, then they may be better positioned to compete with domestic producers in areas other than on the country of origin attribute.

So far the discussion has focused on the effects of product credence attributes. The coefficients of these attributes are kept in the model regardless of whether they are significant or not. Through the use of back-step fitting techniques, the information context and demographic interaction terms are included in the model only when they have significant coefficients. Variable *GM*GMab* is strongly significant and positive in the HEV model. This interaction shows the impact of information on the evaluation of the GM attribute. The negative coefficient of this interaction variable indicates that when holding other factors constant, Japanese consumers view the GM attribute even more negatively when additional information about the GM technology is given. This result is somewhat surprising given that the information provided in this study is rather neutral or even slightly supportive of the GM technology (see Appendix 1). We would expect that Japanese consumers would be less negative to the GM attribute when this additional information is given.

One direct explanation of this finding is that the additional information causes an alarmist effect on consumers' choices. Unlike most other credence attributes, GM may often be associated with a great deal of uncertainties, including effects on human health and the environment, as well as ethical issues. Wohl noticed that for some consumers, any information about GM, positive or negative, may be treated as an alarming signal and therefore decrease consumes' purchasing intentions for GM foods. Alternatively, the negative effect of information on the GM attribute may be explained by a phenomenon referred to as *information overflow*.

There is an emerging body of literature on internet-based marketing that has discovered that too much information on products may challenge consumers' processing ability, thus increasing the overall mental and transaction cost (Urban). Indeed, contrary to the fundamental nonsatiation assumption in economics, more items with nonnegative utilities may not always be welcomed by consumers. Built on an actual commodity trading practice, List discovered that "more is less," depending on traders' characteristics. This evidence, including the results in this paper, supports the conclusion that future economic analysis on consumer behavior should also take into consideration the analysis of consumers' psychological and mental status (McFadden).

In the CL model, information source dummy variables are directly interacted with the ASCs and the only significant variables are *A1*MANU* (ASC for the first alternative interacted with manufacturers provided information context variable) and *A1*GOV* (ASC for the first alternative interacted with government provided information context variable). The

[6] There are also numerous reported studies showing that consumers may be actually quite heterogeneous in terms of their perceptions of GM ingredients (Li et al.; Hu et al.; Lusk et al.). However, it is also true that an "average" consumer in a developed nation (represented by the mean demographic characteristics of samples) usually has a negative view of GM ingredients. Heterogeneity is an important issue in understanding consumer perceptions but not the direct focus of this study.

Table 5. Marginal Values of Attributes (in Yen)*

Variables	CL Model	HEV Model
BUYNO	−924.13	−800.89
	(−928.29, −919.97)	(−803.28, −798.50)
OLE	—	−96.03
		(−97.59, −94.47)
VE	−197.13	−171.41
	(−199.69, −194.58)	(−173.21, −169.61)
AL	—	—
GM without information	NA	−1341.88
		(−1349.05, −1334.71)
GM with information	−1611.34	−1525.67
	(−1622.53, −1600.16)	(−1533.71, −1517.62)
JAS	251.69	220.87
	(248.70, 254.68)	(218.64, 223.09)
FOS	532.32	523.24
	(528.36, 536.28)	(520.18, 526.30)
IMP	−744.30	−700.25
	(−779.72, −768.87)	(−704.01, −696.48)

* 5% confidence intervals are presented in the parentheses.

HEV model differs from the CL model in that it gives another type of behavioral interpretation for information context and demographic variables. Variables *GOV* and *CONS* (information from consumer groups) are both positive and significant in the scale function specification. Recognizing the fact that the scale function is inversely proportional to the standard deviation of the model, compared with the case in which no specific source of information is identified, information from the government or consumer groups will lower the standard deviation of the model. In other words, Japanese consumers make more consistent choices when information is given by the government and consumer groups, and therefore our model predicts these choices better (with less error). Variable MALE is the only significant demographic variable in the scale function. It has a significant negative coefficient, which in turn indicates that variances in male consumers' choices are greater than those among choices made by females. This finding is supported by other studies as well (Roe, Hwang, and Teisl). The implication of these scale parameters is that as oil product information sources, government agencies and consumer groups can focus more on the direct impact of information on consumers' direct choices and worry less about the potential stochastic impacts on different choice alternatives because consumers' choices are more consistent under these circumstances.

Estimated WTP

Table 5 reports the implied marginal values in both the CL and the HEV models. The 95% confidence interval estimates of these marginal values are obtained through a simulation process described by Krinsky and Robb with 5,000 replications. For the HEV model, because the interaction variable *GM*GMab* is significant, the marginal value of the attribute GM is calculated when the additional information on the GM technology is present or absent. In general, the marginal values given under these two models are consistent. Because our focus is the HEV model, interpretation of these results are based on the HEV model. The marginal value for variable *BUYNO* indicates that holding other factors constant, Japanese consumers are willing to pay approximately 800 Yen to have the opportunity to purchase canola oil. This is a reflection of the fact that canola oil is a commonly consumed food item in Japan. Not being able to purchase or no desirable product alternative to purchase incurs a loss in utility. Compared

with the attribute "low in saturated fat," Japanese consumers are willing to pay less for the other two types of credence attributes: "rich in oleic acid (*OLE*)" and "rich in vitamin E (*VE*)." Also, the value associated with the attribute "high in AL acid (*AL*)" is not different from that of the attribute "low in saturated fat" (marginal value of AL is not significant). These, from another perspective, demonstrate that Japanese consumers in general may still value the more conventional health attribute—low in saturated fat—more than the recently discovered beneficial attributes.

The usage of GM seeds in production introduces the largest effect on marginal value changes (−1,342 to −1,526 Yen). Given the price ranges for oil products specified in this study (298 to 698 Yen), Japanese consumers are willing to pay more than twice as much as they pay for a regular bottle of oil to avoid the GM oil. This dislike of oil with the GM attribute is persistent for the consumers as well. As shown in the HEV model, this adverse opinion of GM technology cannot be mitigated by additional information on the technology, even when the information is neutral or slightly supportive. When more information is given, consumers discount the value of GM even more. On the other hand, consumers are willing to pay 221 Yen for the organic attribute and 523 Yen for the functional food attribute. Generally, policy makers or producers may use the term "organic" as an indication that a product is free of GM ingredients. If that is the case, it is clearly shown in this study that the magnitude that consumers value the presence and absence of GM ingredients is quite different: oil with the presence of GM ingredients is discounted disproportionately compared with the positive impact the absence of GM ingredients has on consumers. This finding on asymmetric values is also consistent with some very recent results obtained in different countries (Hu, Veeman, and Adamowicz). Finally, as shown in Table 5, although comparable in all other attributes as a domestic product (holding other factors constant), Japanese consumers will discount the value of that product by about 700 Yen if a product is imported.

Summary and Conclusions

This study aims at understanding Japanese consumers' attitudes and preferences for canola oil with credence attributes. It is found that among other credence attributes identified in this analysis, such as nutrition content, Japanese consumers treat whether the product uses GM seeds in production as the most important factor in making their purchasing decisions, a decision that outweighs how they evaluate the price attribute. Japanese consumers are also very sensitive, as they have been traditionally, to whether the product is produced domestically; it is the fourth important attribute following GM, type of oil, and price. As for the potential risk of several concerns in a broader sense, consumers perceived BSE as more risky than any other factors. GM also ranks high with Japanese consumers, as the third most important risk factor concerning health risk media. The least concerning factor is the salt and sugar content in food.

Through a structured survey and follow-up economic models, we are able to identify tradeoffs Japanese consumers make among various credence attributes and the marginal values associated with these attributes. It is consistent in two models included in this study that, holding other factors constant, consumers are not willing to give up their chance of purchasing a bottle of canola oil. The value of a label "low in saturated fat" is relatively high when compared with other labels, such as "rich in Vitamin E" or "rich in oleic acid." The usage of GM seeds in oil production incurs a large loss of value for consumers, and certificates, either an organic food certificate or a functional food certificate, are valued positively by consumers. However, if "organic" is treated as a synonym for "free of GM ingredients," this study reports a strong asymmetric pattern of values put on these two attributes. The value of imported oil is strongly discounted by Japanese consumers. Knowing this disadvantage, exporters to the Japanese market should strive to develop other attributes that will increase the value of their products to compensate for the loss.

The scope of information, as represented by how much information is given to consumers on various oil credence attributes, was found to be effective in altering consumers' choices. A striking result is that a significant loss of utility will occur if more neutral or slightly positive information on the GM ingredients is provided. This may be of concern to

marketers who attempt to increase consumers' acceptability by providing more information. It seems that Japanese consumers have an alarmist feeling attached to GM information and therefore view it negatively. Impacts from the information source contexts are significant. When information is supplied by the government or consumer groups, Japanese consumers may become more consistent in their choices and therefore lend more credibility to researchers who are analyzing their behavior.

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Appendix 1. Information Preceding Choice Tasks

In the next several questions, you may find that you need extra information before you can give answers that best reflect your actual preference. Suppose this information about vegetable oils is *provided by (fill in one of the following sources: food scientists; vegetable oil producers' association; the Japanese government; and Japanese consumers' association).** Please read the information carefully as you may find it useful. You may also come back to this page any time later in the survey.

1. High intakes of **saturated fatty acids** contained in general vegetable oil are associated with increased blood cholesterol levels and increased risk of heart disease.
2. Although high intake of dietary fats may be a health hazard, certain fats are essential for good nutrition and health (e.g., **oleic and alpha-linoleic acid**).

3. Some research has found that **alpha-linoleic acid reduces the stickiness of blood cells and thereby reduces the risk of clot formation (thrombosis).

4. **Oleic acid** is known for its ability to reduce blood cholesterol levels and therefore decrease the overall risk of heart disease.
5. **Vitamin E** is beneficial in the prevention and treatment of atherosclerotic disease.

***6. **Genetic modification** is recombining other organisms' DNA in plant genes artificially. It can be used to make a plant produce a new trait or prevent it from producing a trait. For example, it may be used for strengthening plants' tolerance to agricultural chemicals or pests or increasing the content of a particular nutrient.

7. **FOSHU** is a food label certified by the Ministry of Welfare and Labor to indicate that the food contains medically and detetically enhanced ingredients and that it is good for health.
8. **Organic JAS** 有機 JASマーク JAS is a food label affixed on organic crops or processed foods made of them. Organizations registered with the Japanese Ministry of Agriculture, Forestry, and Fisheries inspect and authorize producers and processors.

* If no specific source of information is specified, then this italic section is left out.
, * These two pieces of information may not appear in the list, depending on different scenarios.

Appendix 2. Sample Choice Task

Now suppose you are shopping for a bottle of vegetable oil. The following choices are the ONLY ONES AVAILABLE to you in the grocery store. The oil you buy is WELL PRESENTED (i.e., no damaged bottle, etc.). Please examine each choice below and choose by circling ONE AND ONLY ONE of the three options.

	Canola oil A	Canola oil B	
Health information	Low in Saturated Fat	Vitamin E Enriched	
Derived from GM canola seeds	No	No	
Certificates	有機 JASマーク JAS		Buy neither of these
Domestic or imported	Domestic	Imported	
Price, 600 g	398 Yen	498 Yen	
CIRCLE ONE ONLY:	1	2	3