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Bargains or Rip-offs? Reference Price Effects in Conjoint Stated Demand

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This study incorporates reference point effects into a stated choice survey of consumer demand for food with credence attributes. Parametric tests can be applied to the utility function to examine the existence of reference price effects. Results are consistent with prospect theory in that consumers exhibit strong and nonlinear reference price effects, with cheaper prices receiving less decision weight than higher prices. The underlying utility function is concave over lowered prices and convex over increased prices, with diminishing sensitivity in both domains. The study, however, did not find experience or consumers' attitudes to be significant in explaining reference price effects.

Key words: canola oil, conjoint, prospect theory, reference price effects

Introduction

Since its introduction, Kahneman and Tversky's prospect theory (Kahneman and Tversky, 1979; Tversky and Kahneman, 1991) has been an intriguing research area in economics. One of the key constructs of prospect theory is the reference point effects. Although fruitful insights on consumers' judgment and decision making have been provided by research that draws conclusions from reference point effects, there are very few studies that directly apply and test reference point effects in a setting where consumers are not (as in Kahneman and Tversky's original work) in a highly controlled or monitored lab situation (e.g., Holt and Laury, 2002).

In the recent experimental economics literature, research has been conducted to test whether reference point effects may occur in actual market transactions (List, 2003, 2004). In the marketing literature, past research has investigated the effect of reference prices or the sticker price effects (Winer, 1986; Chang, Siddarth, and Weinberg, 1999; Bell and Lattin, 2000). On one hand, these studies have demonstrated the wide existence of reference point effects, but on the other hand, they are based on the fact that if required, the target products are marketable or can be made available to the market. Buschena (2003); Cherry, Crocker, and Shogren (2003); and Cherry, Kroll, and Shogren (2005) pointed out that it is difficult to test prospect theory with competing theories in the field of agricultural and resource economics. This is because a great majority of the goods are either not marketable (e.g., recreation) or do not exist on the market (e.g., new products). Actual observations from the market will be difficult in these situations, and

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to overcome this challenge, data will need to be collected in a hypothetical environment. This study attempts to examine reference point effects in a hypothetical survey that considers products with new attributes.

The survey used in this study is different from an interactive bidding game but follows the choice-based conjoint (CBC) approach commonly employed in marketing as well as agricultural and environmental/resource economics literature (e.g., Adamowicz et al., 1998; Grafton et al., 2003). In a CBC survey, stated preference questions are developed and consumers are asked to indicate their choices by comparing several options. Here we focus on reference price effects introduced by the survey. Based on consumers' reference price level, the price of a product described in the survey may generate deviations from the reference level. The results show that the deviations generate very different responses from consumers, depending on whether the price is lower or higher than the reference level. Furthermore, these reference price effects are found to have a nonlinear impact on the utility function. However, we do not obtain strong evidence that experience or the perception of the importance of price have a significant impact on reference price effects, as recorded in some studies (Hu, Adamowicz, and Veeman, 2006; List, 2003, 2004).

Data are derived from a recent survey of Japanese consumers' perceptions and purchasing intentions for canola oil with potential credence attributes. Some of these attributes are not currently available on the Japanese market. By incorporating the increasingly appreciated reference point effects into the demand analysis of food with (new) credence attributes, this study offers a means to extend the application of predictions from psychology research in economics.

The next section provides a review of the theory involved, followed by presentation of the empirical models and data description. Results are then summarized, and the final section highlights concluding remarks.

Theory

Consumers are dynamic maximizers (Goette, Huffman, and Fehr, 2004; Tu, 2004). Built upon the assumption of a globally concave function, expected utility (EU) theory is developed to describe utilities that extend to multi-periods and multi-scenarios. However, there are numerous examples showing consumers do not always follow the "rational" behavior implied by their EU, such as the well-known "St. Petersburg Paradox" (Camerer, 2005). In their seminal 1979 paper, Kahneman and Tversky introduced "prospect theory" to address these behavioral "abnormalities" with the assistance of psychology. Prospect theory confronts EU theory by raising the possibility that the underlying utility function may be neither globally concave (Camerer, 2005) nor defined context-free (Cubitt, Munro, and Starmer, 2004). A major division of prospect theory is the reference point effects, which produce the so-called S-shaped value function (Laibson and Zeckhauser, 1998).

Prospect theory, and many of its later variations, is initially established over choices involving risky outcomes, such as lotteries. Novemsky and Kahneman (2005) note that Thaler (1980) was among the first to attempt to extend predictions of prospect theory into riskless decisions. Thaler showed that under the endowment effect, traders' willingness to pay for an item was much smaller than the amount they were willing to accept if they were asked to forfeit the same item. This is a phenomenon well documented in the environmental/resource economics literature (e.g., Boyce et al., 1992; Plott and Zeiler, 2005). These types of analyses link reference point effects directly to the specification of the utility function. Essentially, the utility function measures the level of satisfaction a choice may bring to an individual, while the value function in prospect theory describes the perceived value of the outcome of an action. Both functions are increasing functions of "wealth" or "benefit" resulting from a choice. Therefore, it is logical to postulate that the utility function mimics the properties of the value function.

Two additional types of evidence strengthen the postulation that the utility function and the value function may share similar properties. First, Carmon, Wertenbroch, and Zeelenberg (2003) concluded that even when there is no actual transition of the ownership of the product (i.e, choices are made implicitly in the minds of consumers), reference point effects still persist. This finding directly applies to the situation this study seeks to examine: Consumers are presented with different products in the hypothetical survey, but they do not have to assume the actual consequences of their choices (this does not mean they necessarily behave differently than otherwise). Second, as reported by Bell and Lattin (2000), in situations where only the product price changes (but do not involve both buying and selling by one consumer), individuals may still respond in a manner close to the predictions of reference point effects. Following Kopalle and Mullikin (2003), the reference price is the consumers' perceived price before they are exposed to any product or make any choices. In other words, the reference price is the price consumers think the product is worth before they enter the survey.

In the survey, products with different prices are introduced. After seeing the price, it is assumed that consumers compare this offered price with their reference price. If the offered price is higher than the reference price, consumers may feel it is a loss in terms of the attractiveness of price. Conversely, if the price offered is lower than the reference price, a gain in the appeal of price may be created. Given this framework, an alternative conjecture is that when consumers observe a difference in the introduced price and their ex ante reference price, they may interpret the discrepancy as being due to their mistaken perception rather than the introduced price being a bargain or a rip-off (holding quality constant). The current survey does not provide direct information to distinguish this difference in perception. However, given the repeated nature of this type of survey where each consumer makes multiple choices among products with varying quality and prices, we assume a reference price will likely be maintained rather than adjusted according to one of the introduced prices. In addition, the target product used in the survey is commonly consumed canola oil, which may help to alleviate this error-correction type of behavior.

Parallel to reference point effects, it is reasonable to hypothesize that in addition to the price itself, a consumer's utility function is sensitive to whether an offered price is lower (therefore a gain for the consumer) or higher (a loss for the consumer) than his or her reference price as well. In particular, the utility may:

- H_1: be less sensitive to increases in price gain than to increases in price loss;
- H_2: be nonlinear over price gain or loss, concave over price gain, and convex over price loss; or
- H_3: be diminishing in response to both price gain and loss.

These properties can be built into a testable utility function. However, there also exists some evidence that the reference point effects (including reference price effects) tend to be less prominent when market participants are familiar with the product in question (Hu, Adamowicz, and Veeman, 2006; List, 2003, 2004). This effect also can be evaluated through the well-defined utility function.

Empirical Models

The analyses are based on a random utility model (RUM) framework. In RUM, an indirect utility function can be defined over attributes of the product in question (including price) and characteristics of the decision maker. Reference price effects can be introduced into the basic indirect utility function suggested in RUM. For an individual consumer i, the utility associated with product j can be written as:

$$(1) \qquad U_{ij} = \mathbf{X}_{ij}\boldsymbol{\beta} + P_{ij}\beta_p + \mathbf{e}_{ij},$$

where $\mathbf{X}_{ij}$ is a vector that summarizes the non-price attributes of product j faced by individual i associated with $\boldsymbol{\beta}$, an unknown vector of parameters. P_{ij} is the price of the product with unknown parameter β_p, and $\mathbf{e}_{ij}$ is a vector of errors. If the price of a generic product to which consumers refer can be represented by RP, then the reference price for each individual consumer can be written as RP_i. If $RP_i > P_{ij}$, a gain in the appeal of price to the consumer is generated, and $PGain_{ij} = RP_i - P_{ij}$. If, on the other hand, $P_{ij} > RP_i$, then a loss in the attractiveness of price is produced: $PLoss_{ij} = P_{ij} - RP_i$. If $RP_i = P_{ij}$, or a consumer has no preexisting perception of what the price should be, then $PGain_{ij} = PLoss_{ij} = 0$.

Based on these definitions, indirect utility (1) can be extended to:

$$(2) \qquad U_{ij} = \mathbf{X}_{ij}\boldsymbol{\beta} + P_{ij}\beta_p + PGain_{ij}\beta_g + PLoss_{ij}\beta_l + \mathbf{e}_{ij}.$$

This structure may be denoted as the linear reference price model. It is expected that $\beta_g > 0$ and $\beta_l < 0$ for gain and loss, respectively. Although curvature properties on reference price effects under this utility function cannot be directly tested, one would expect that $|\beta_g| < |\beta_l|$ if H_1 holds.

Nonlinear reference price effects in the utility function may be introduced by predefining the shape of the function. Kopalle and Mullikin (2003) and MacNair and Holmes (1998) used several structured utility functions to incorporate reference price effects such as logarithmic, exponential, or a combination of these. The overall conclusion is that a quadratic function is less likely to be rejected, or outperforms other functional forms (Kopalle and Mullikin, 2003). Therefore, a quadratic function may be further adopted in this study.

Defining $PGain2_{ij} = (PGain_{ij})^2$ and $PLoss2_{ij} = (PLoss_{ij})^2$, the utility function can be modified as follows:

$$(3) \qquad U_{ij} = \mathbf{X}_{ij}\boldsymbol{\beta} + P_{ij}\beta_p + PGain_{ij}\beta_g + PLoss_{ij}\beta_l + PGain2_{ij}\beta_{g2} + PLoss2_{ij}\beta_{l2} + \mathbf{e}_{ij}.$$

In this formulation,[1] the three properties of the utility function on reference price effects can be rewritten in terms of the parameters of (3):

(3.1) $$H_1: |\beta_{g2}| < |\beta_{l2}|,$$

(3.2) $$H_2 \text{ and } H_3: \beta_g > 0, \ \beta_l < 0, \ \beta_{g2} < 0, \text{ and } \beta_{l2} > 0.$$

H_1 is derived by taking the second derivative of U_{ij} with respect to $PGain_{ij}$ and $PLoss_{ij}$ and comparing the magnitude. For H_2 and H_3, if the four parameter requirements are simultaneously satisfied, then both H_2 and H_3 will be true. This is because $\beta_g > 0$ and $\beta_{g2} < 0$ will guarantee the utility function is an inverted U-shaped parabola with zero and $-(\beta_g/\beta_{g2})$ as intercepts on the gain axis. This curve is concave and diminishing in price gain. Similarly, with $\beta_l < 0$ and $\beta_{l2} > 0$, a U-shaped parabola is defined in the loss domain with zero and $-(\beta_l/\beta_{l2})$ as intercepts on the loss axis. This will lead to a convex portion of the utility function that is also diminishing in sensitivity to loss. For comparison, the following utility function with log of reference price variables[2] is also estimated:

(4) $$U_{ij} = \mathbf{X}_{ij}\boldsymbol{\beta} + P_{ij}\beta_p + LPGain_{ij}\beta_g + LPLoss_{ij}\beta_l + \mathbf{e}_{ij}.$$

Since this function imposes the curvature restriction by taking the logs, the only testable property is H_1, which suggests $|\beta_g| < |\beta_l|$.

If one wishes to assume the error term $\mathbf{e}_{ij}$ is i.i.d. following a maximum extreme value type I distribution (Hu, 2005), the probability of individual i choosing option j based on $\mathbf{X}_{ij}$ can be expressed in a conditional logit (CL) model. Furthermore, recent development of the discrete choice literature has favored the use of a mixed logit (MixL) model to capture the heterogeneities embedded in the weights (the coefficients) of explanatory variables in the utility function.

In a MixL model, covariates can be specified to explain the magnitudes of reference price effects. Two variables are selected for this purpose. The first is a proxy of an individual's shopping experience, denoted as *Experience*. The second variable indicates whether an individual thinks price may not be an important factor in making a purchasing decision, denoted as *Unimportant*. The following structure can be specified for the coefficients of reference price effects:

(5) $$\beta_k \sim F(\mu_k, \sigma_k), \quad k = p, g, l, g2, l2,$$

where

(5.1) $$\mu_k = \gamma_{k0} + \gamma_{k1}Experience + \gamma_{k2}Unimportant.$$

In this specification, F is a distribution function with unknown mean μ and standard deviation σ. The mean can be further explained by the two covariates; γ's are unknown parameters. If more experienced consumers or those consumers who do not think price

[1] For simplicity, coefficients in (3) are expressed in the same way as in (2). This, however, does not mean the estimated values are restricted to be the same across different specifications. The same note applies to equation (4).

[2] The gain or loss of the attractiveness of price may take the value of zero. When taking the log, zeros are maintained and only nonzero values are logged. Since no positive price gain or loss is less than one in the sample, this method maintains the ordering of reference price effects.

Table 1. Descriptive Statistics of Key Demographic Variables

Variable	Mean (Std. Dev.)	Variable	Mean (Std. Dev.)
Male[a]	0.234 (0.424)	Annual Income[b] (yen)	6,685,794 (3,716,009)
Age (years)	57.084 (12.458)	Education[b] (years)	12.803 (2.080)

[a] Dummy variable = 1 for male.
[b] Collected as categorical variables.

is a relatively important factor in their decision making are less likely to exhibit reference price effects, both γ_{k1} and γ_{k2} are expected to reduce the magnitude of β_k through the reparameterization of μ_k. A similar specification can be used for other product attribute variables (e.g., Kopalle and Lehmann, 1995; Hu, Adamowicz, and Veeman, 2006). There is no theory guiding what distribution should be assumed for F. However, the most popular are normal distribution when no parameter sign restriction is in place and lognormal distribution when a parameter is restricted to be on either side of zero (Hensher and Greene, 2003).

Data

Data were obtained from a mail survey conducted in Japan in the summer of 2004. The target population was households in one of the most populated areas in the country: Tokyo-Kanagawa-Saitama-Chiba. Conducting a survey in this diversified and densely populated region proved cost-effective and may also help increase sample representativeness. Households selected were randomly chosen by a two-stage cluster sampling approach from a digitally maintained telephone book record (including address). Of the 1,050 surveys mailed, 430 were returned after the initial mailing and a post card reminder. The high response rate is an assurance that the topic covered by the survey is of interest to many households. Data from the 430 returned survey questionnaires were first processed to remove invalid and illegible entries. This procedure left 403 usable responses for further analysis.

Table 1 reports several key demographic statistics of the sample. As observed from these statistics, females are over-sampled. However, this is common for surveys on food products, as the survey screens out non-grocery shoppers, who are more likely to be male (Hu, Veeman, and Adamowicz, 2005). Another feature of the sample is that older individuals are over-sampled; this is because minors were asked not to fill out the survey.

The content and format of the survey were tested intensively by focus groups prior to mailing. The first two sections are the key components for the purpose of this study. In the first section, respondents were asked about their general vegetable oil preference and their evaluation of the importance of several canola oil attributes to their purchase decisions. In particular, respondents were asked to recall the features of their most often-purchased plain canola oil, including the price. The price recorded serves as the reference price (RP) for each individual. For respondents who were not certain about the price they normally paid for canola oil, their RP is treated as missing.

Table 2. Canola Oil Attribute Variables and Their Levels

Attribute Variable	No. of Levels	Categories
Nutrition Claim	4	low in saturated fat; rich in oleic acid; rich in alpha-linoleic acid; rich in vitamin E
GM Information	2	yes; no
Certification	3	FOSHU certified; JAS certified; not specified
Origin	2	domestic; imported
Price (yen)	5	298; 398; 498; 598; 698

In the second section of the survey, alternative canola oil products were presented in the context of choice sets. Each choice set contains three alternatives, and respondents were asked to choose only one out of these three products. Within each choice set, there are two products described by oil attributes, but the last alternative is an option that allows respondents to choose neither of the first two alternatives. Canola oil attributes used in the survey were predetermined by focus group discussions and only center on the credence attributes, including nutrition claims, GM information, certification, and origin. Price is also included as a crucial attribute. These attributes and their measures used in the survey are summarized in table 2.

There are four types of nutrition claims considered: (*a*) low in saturated fat, (*b*) rich in oleic acid, (*c*) rich in alpha-linoleic acid, and (*d*) rich in vitamin E. For the "genetically modified" (GM) information, the product may be labeled either as using GM oilseeds or not. For the certification attribute, FOSHU is a functional food certification system managed by the Japanese Ministry of Welfare and Labor, and JAS is an organic food certificate issued by the Ministry of Agriculture, Forestry, and Fisheries. The JAS certificate is not given for oil using GM oilseeds.

The function of the substances in nutrition labels, the implication of GM oilseeds, and definitions of the certificates were fully explained to respondents in an information sheet before they made their choices. Other attributes were normalized in the choice sets by asking respondents to assume all other attributes not listed were the same across different products. After the attributes and number of alternatives in a choice set had been determined, (hypothetical) products in choice sets were then created by a fractional factorial design using these attributes. To limit the burden for each respondent, blocking was used in the design procedure generating eight choice sets for each individual respondent. Specifically, each respondent made a series of eight choices in the survey.

It is clear from table 2 that all attributes relevant in this conjoint experiment, excluding price, are credence attributes. This makes our analysis significantly different from previous studies using either lottery purchases or goods focused on only search or experience attributes. In respondents' choices, the price given may be either higher, the same, or lower than respondents' reference prices, thereby creating gains and losses of the attractiveness of prices to the respondents in addition to the price effect itself. If the last alternative (no-choice) is selected by a respondent, then the actual price is zero. For those respondents whose RP is missing, we assume the choice experiments do not trigger any reference price effect. This is not an unreasonable assumption given that respondents were asked to provide a price they know or guess to be their most frequent

Table 3. Definitions of Variables and Their Descriptive Statistics

Variable	Definition	Mean	Std. Dev.
Buyno	Dummy variable = 1 for the no-choice option	0.333	0.471
Ole	Dummy variable = 1 if rich in oleic acid	0.167	0.373
VE	Dummy variable = 1 if rich in vitamin E	0.167	0.373
AL	Dummy variable = 1 if rich in alpha-linoleic acid	0.166	0.372
GM	Dummy variable = 1 if GM oilseeds used	0.333	0.471
FOSHU	Dummy variable = 1 if certified as functional food	0.333	0.471
JAS	Dummy variable = 1 if certified as organic food	0.167	0.373
Imp	Dummy variable = 1 if imported	0.335	0.472
Price [a]	Continuous variable for price (in yen)	47.417	146.836
PGain	Continuous variable for price gain (in yen)	55.934	105.512
PLoss	Continuous variable for price loss (in yen)	37.406	87.703
PGain2	*PGain* squared (in yen)	14,260.277	35,560.099
PLoss2	*PLoss* squared (in yen)	9,090.119	29,220.241
LPGain	Log of price gain	1.516	2.308
LPLoss	Log of price loss	1.056	2.055
Experience	Dummy variable = 1 if respondent often purchases canola oil	0.966	0.182
Unimportant	Dummy variable = 1 if respondent thinks price is not an important factor	0.184	0.388

[a] The *Price* variable only includes cases where no gain or loss effects are generated.

purchase price for plain canola oil. If the answer is still missing, an RP is then not established for that individual. Since each of the 403 respondents in the sample made eight choices, a total of 403 × 8 = 3,224 choices were made. Based on our definition of reference price and associated price gain and loss, 35.1% of the choices (i.e., 1,133) involved a cheaper price (or a gain to the respondents) and 21.3% involved a higher price (or a loss to the respondents). The remaining 43.6% of the choices did not trigger either gain or loss. The definitions and descriptive statistics of the reference price variables and other attribute variables used in the econometric analysis are summarized in table 3.

Results

Initially, the price variable in its original form was used in the estimation; however, it was found to have fairly strong correlations with the reference price effect variables, especially with the two nonlinear reference price variables. This multicollinearity issue caused understatement of the significance of coefficients and predicted counterintuitive signs. Although it is natural that the two nonlinear reference price variables are expected to have high correlation with their linear counterparts, an adjustment to the price variable is necessary. Define dummy variables PG_i and PL_i equal to unity if individual i experiences gain or loss of the appeal of price, respectively. Then the price variable can be replaced by the transformation: $(1 - PG_i)(1 - PL_i)P_i$. When there is no gain or loss involved in a choice, $PG_i = PL_i = 0$ and the coefficient associated with the transformed price is the coefficient of price without reference price effect. This transformed price has minimal correlation with the reference price variables and is reported in table 3.

Table 4. Conditional Logit (CL) Results of Specifications With and Without Reference Price Effects

Variable	Without RP Coefficient / (Std. Error)	Linear RP Coefficient / (Std. Error)	Log RP Coefficient / (Std. Error)	Quadratic RP Coefficient / (Std. Error)
Buyno	-1.014***	-0.548***	-0.539***	-0.547***
	(0.151)	(0.106)	(0.137)	(0.119)
Ole	-0.104	-0.135	-0.135	-0.143
	(0.091)	(0.091)	(0.090)	(0.091)
VE	-0.205**	-0.224***	-0.223**	-0.231***
	(0.080)	(0.080)	(0.080)	(0.080)
AL	0.031	-0.009	-0.011	-0.021
	(0.093)	(0.092)	(0.091)	(0.092)
GM	-1.827***	-1.785***	-1.789***	-1.786***
	(0.083)	(0.081)	(0.081)	(0.082)
FOSHU	0.276***	0.317***	0.308***	0.317***
	(0.087)	(0.086)	(0.086)	(0.086)
JAS	0.648***	0.656***	0.649***	0.650***
	(0.059)	(0.059)	(0.059)	(0.059)
Imp	-0.874***	-0.847***	-0.852***	-0.849***
	(0.069)	(0.068)	(0.068)	(0.068)
Price	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
PGain		0.271e-04		0.002**
		(0.000)		(0.001)
PLoss		-0.001***		-0.004***
		(0.000)		(0.001)
PGain2				-0.674e-05**
				(0.266e-05)
PLoss2				0.801e-05***
				(0.279e-05)
LPGain			0.014	
			(0.023)	
LPLoss			-0.052**	
			(0.024)	
No. Observations	403	403	403	403
Log Likelihood	-2,899.602	-2,897.199	-2,894.539	-2,886.504
Adjusted ρ^2	0.169	0.170	0.171	0.173

Note: Single, double, and triple asterisks (*) denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Coefficient Estimates

Table 4 reports the estimated parameters of the simple CL model without reference price effects and the models with linear, log, and quadratic reference price effects. All four models are strongly significant and they produce consistent predictions for all attribute variables. We first briefly interpret these attribute variables. *Buyno* is a dummy variable for the no-choice option. The negative sign associated with its coefficient indicates, holding other factors constant, having to choose this option will introduce negative utilities to consumers.

Dummy variables *Ole*, *VE*, and *AL* correspond to the nutrition claims for "rich in oleic acid," "rich in vitamin E," and "rich in alpha-linoleic acid," with "low in saturated fat" omitted from estimation. The oleic acid and alpha-linoleic acid claims are not significant across all four models. The claim for "rich in vitamin E" is significant but negative in the four models. These findings are interesting since in focus group discussions respondents mentioned they strongly value the help in reducing blood cholesterol level offered by oleic acid, the usefulness in reducing blood clot formation from alpha-linoleic acid, and the nutrition content of vitamin E. However, as implied by the model results, consumers do not make a distinction between these attributes and the more commonly observed claim "low in saturated fat" on canola oil products.[3] Moreover, consumers even value the claim "rich in vitamin E" as less important than the "low in saturated fat" claim. These results suggest producers in Japan may be able to promote their canola oil products equally well by only describing their products as "low in saturated fat," rather than expending resources necessary to qualify their products for the other nutrition claims.

The variable *GM* is negative and statistically significant in each of the four models (table 4), which suggests Japanese consumers are generally negative toward the idea of using GM oilseeds in canola oil production. Given the controversies that have surrounded GM technology in recent years, this concern is commonly addressed in related studies (e.g., Hu, Veeman, and Adamowicz, 2005). The two certificates, "functional food" (*FOSHU*) label and "organic food" (*JAS*) label, are both highly valued by Japanese consumers—reflecting the trend of consumer demand for healthier and more natural foods. The "imported" variable (*Imp*) is significantly negative in the four models. The result found here supports the conclusion that "country-of-origin" labels are important, since Japanese consumers strongly support their domestic products. Finally, all four models reveal *Price* has a negative impact on consumers' utility: the higher the price, the less desirable the product, where the price variable itself reflects simply the price offered in the conjoint experiment.

The linear reference price model is marginally better than the model without reference price effects based on the log-likelihood test (test score of 4.81 compared with the critical value of 4.61 based on the 10% significance level). However, as discussed earlier, the linear effect model may not be the best model since it cannot incorporate the curvature properties of the reference price effect. The likelihood-ratio test suggests the log reference price model is significantly better than the model without the reference price effect, and based on a nonnested likelihood-dominance test, the log model is also significantly better than the linear reference price model. This finding supports the conclusion that reference price effects are likely to be nonlinear. In this logged reference price effects model, although the increase of the attractiveness of price (*PGain*) is not significant, the shape of the utility function over the loss of attractiveness of price (over *PLoss*) conforms to the predictions of reference point effects—i.e., it is convex over losses and diminishing in scale, and therefore proves hypotheses H_2 and H_3 over the loss domain. Nevertheless, in spite of the fact that the logarithm transformation conveniently ensures the shape of the utility function over gains and losses, these curvature properties of reference price effects may simply be an artifact of this specific functional form.

[3] In fact, canola oils are naturally low in saturated fat. These results on the relationship among the nutrition claims may also be observed if consumers are not certain about these nutrition claims. However, all information related to these attributes was given immediately before the choice experiment. Although this effect is not officially tested in this study, we expect it is not a significant cause of the current results.

Table 5. Mixed Logit (MixL) Model Results Incorporating Reference Price Effects

Random Parameters			Non-random Parameters		
Variable	Coefficient	Std. Error	Variable	Coefficient	Std. Error
Mean of Random Parameters:			*Ole*	−0.365**	0.136
Buyno	−1.522***	0.224	*AL*	−0.099	0.133
VE	−0.490***	0.121	*JAS*	0.550***	0.129
GM	−3.888***	0.260	*Price*	−0.002***	0.001
FOSHU	1.078***	0.090	*PGain*	0.004**	0.002
Imp	−1.906***	0.148	*PLoss*	−0.007***	0.002
Std. Deviation of Random Parameters:			*PGain2*	−0.984e-05**	0.401e-05
sd_Buyno	2.358***	0.172	*PLoss2*	0.131e-04***	0.401e-05
sd_VE	0.931***	0.180			
sd_GM	3.122***	0.241	No. Observations =	403	
sd_FOSHU	0.568***	0.174	Log Likelihood =	−2,336.447	
sd_Imp	1.798***	0.160	Adjusted ρ^2 =	0.330	

Note: Single, double, and triple asterisks (*) denote statistical significance at the 10%, 5%, and 1% levels, respectively.

The more flexible quadratic model, as in table 4, has the highest model fit among all four competing specifications based on corresponding likelihood-ratio or likelihood-dominance tests. All four variables related to reference price effects are significant. With this knowledge on hand, the MixL model is applied to pinpoint whether there exist heterogeneities among respondents' perceptions of canola oil attributes, and particularly whether experience and perception may help to explain these reference price effects. A large number of MixL models with different specifications were estimated to search for the best-fit model. In these specifications, the price coefficient and all reference price effect coefficients were given lognormal distributions, and other coefficients were assumed to have normal distributions. In particular, the two variables *Experience* and *Unimportant* are specified as covariates for the four reference price coefficients. Despite the wide range of specifications used, the two covariates were not found to be significant in explaining any of the reference price effects. The MixL model with the best fit is presented in table 5. In this model, none of the price or the reference price coefficients are specified as random.

The MixL model shows a dramatic improvement of model fit based on its log-likelihood function. Although the magnitudes of coefficients are not comparable across models without adjusting the implicit scales in each model (Swait and Louviere, 1993), signs of all mean coefficient estimates are consistent with the linear models. The only exception is that the oleic acid variable (*Ole*) becomes significant in the MixL model. Significant standard deviation estimates of the random coefficients suggest that when purchasing canola oil, there are strong heterogeneities associated with Japanese consumers' perceptions on the relative importance of attributes including "rich in vitamin E," using GM oilseeds, FOSHU certification, and whether the oil is domestically produced.

Checks of the implied shape of the utility function in both the quadratic CL model and the MixL model over reference price effects can be performed by testing the three hypotheses suggested in (3.1) and (3.2). First, to examine the relative weights respondents attach to the gain or loss of the attractiveness of price of the same magnitude ($PGain_{ij}$ = $PLoss_{ij}$), the following restriction can be tested: $|\beta_{g2}| = |\beta_{l2}|$. The MixL model was

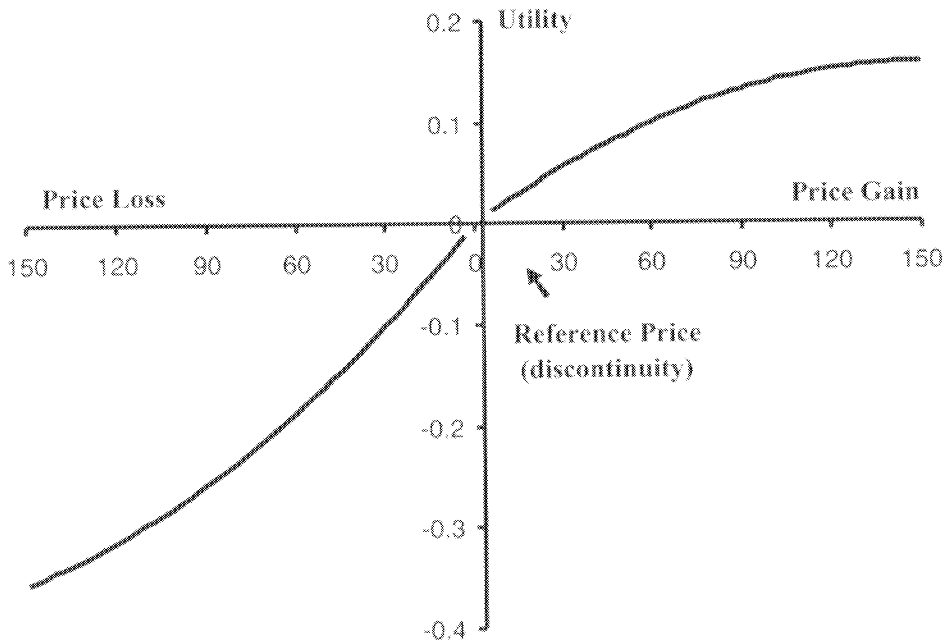

Figure 1. Graphic representation of reference price effects

reestimated with this restriction, and the implied Wald test statistic with one degree of freedom is 21.12, which strongly rejects the restriction. Therefore, given the same magnitude, the loss of attractiveness of price will incur more decrease in utility than the increase to utility introduced by a gain—a conclusion consistent with the theory of reference point effects (Laibson and Zeckhauser, 1998). Second, to examine the curvature properties of the utility function over the reference price, the signs of the four individual parameters suggested in (3.2) are checked. As clearly observed from table 4, these four conditions are all satisfied.

Confirming these parameters makes it possible to sketch the underlying utility curve over price gains and losses. Figure 1 illustrates this utility curve based on results reported in table 5. The three predictions of reference point effects can be visually observed in figure 1. First, the absolute measure of utility is greater for loss than for gain of the attractiveness of price with the same distance to the reference point (origin). Second, the utility function is concave over gains and convex over losses. Third, the utility function is diminishing in sensitivity in both the gain and loss domains. It is also noteworthy that the utility curve is discontinuous around the reference point. This is because no price gain or loss can be defined when the price is at the reference price level. When gain or loss approaches zero, the response of the utility function to price will be given by the coefficient of the regular price variable, and therefore a jump is introduced around the reference point. In their original work, Kahneman and Tversky (1979) describe this discontinuity in their value function as well.

Another relevant note to the quadratic reference price utility function is that due to the nature of the quadratic form, utility over gain will eventually be decreasing when the gain is large enough (around 160 yen in this study). Similarly, when the loss is large enough (around 230 yen), the utility over loss will become increasing. Although this may be argued as one drawback of modeling the nonlinear reference price effect using a quadratic function, it may be partially explained by the assimilation and contrast theory outlined by Hovland, Harvey, and Sherif (1957). The theory predicts that when a given measure and the perceived measure differ moderately, the discrepancy will have the greatest impact on behavior, but the influence will begin to decrease when the discrepancy becomes extreme. Kopalle and Lehmann (1995) offer empirical support for this theory. Consequently, the quadratic reference price model indicates that when the gain or loss of the attractiveness of price becomes large, respondents may become hesitant to accept the gain or loss, and therefore the model discounts their impact in the decision-making process.

Marginal Values

The economic significance of incorporating reference price effects into the analysis can be shown by deriving the marginal values of various attributes of canola oil. Following Hu et al. (2004), these values are calculated by taking the total differential of the indirect utility function with respect to all attributes including the price variables and equating the marginal change of utility to zero. These values may also be interpreted as the marginal willingness to pay for an attribute (Train, 2003). Both the conditional and mixed logit models with the quadratic reference price effects are considered. In each model, marginal values can be presented under three conditions: (*a*) no reference price effects (neutral price), (*b*) with price gain, and (*c*) with price loss. Based on equation (3), the total differentiation of the utility function (suppressing indexes i and j) is given by:

$$(6)\qquad dU = \boldsymbol{\beta} d\mathbf{X} + \beta_p dP + (\beta_g + 2 * PGain * \beta_{g2})dPGain + (\beta_l + 2 * PLoss * \beta_{l2})dPLoss.$$

It is not difficult to see (setting $dU = 0$) that the marginal values of attributes under neutral price and price loss are

$$-\frac{\beta_x}{\beta_p} \quad \text{and} \quad -\frac{\beta_x}{\beta_l + 2 * PLoss * \beta_{l2}},$$

respectively, where β_x is the coefficient of a non-price attribute $\mathbf{X}$.

The marginal value of $\mathbf{X}$ under price loss is a measure that simultaneously considers the price loss effect in addition to the values under neutral price. This expression is a nonlinear function of *PLoss* and is not continuous, making it difficult to determine how the marginal values will change following changes in the magnitude of loss of the attractiveness of price. However, based on the estimated coefficients reported in the "Quadratic RP" column of table 4 and those reported in table 5, one can conclude that the marginal values under price loss are generally increasing with *PLoss*. Intuitively, when the introduced price is higher than the reference price, consumers' overall marginal utility of money becomes less than when no such difference is observed. The increase in the marginal utility of money suggests that the magnitude of the value of an attribute (to the consumer), either desirable or undesirable, will be exaggerated. Since *PLoss* is given by $P - RP$, this implies either an increase in introduced price or a decrease in reference price or a combination of both types of movement may increase the marginal value of attribute $\mathbf{X}$. Likewise, the increase in the importance of attribute $\mathbf{X}$ in the utility will also increase its marginal value.

Using a similar approach, the marginal value of attribute **X** when a gain in the appeal of price is involved can be derived from (6):

$$-\frac{\beta_x}{\beta_g + 2 * PGain * \beta_{g2}}.$$

The interpretation is very similar to that for the price loss effect, except an increase in the attractiveness of price will decrease the derived marginal values. However, the definition of the variable *PGain* is $RP - P$. This implies an interpretation similar to the price loss scenario. Specifically, an increase in the introduced price or a decrease in the reference price or a combination of both effects will lead to an increase in the magnitude of the marginal values of the attributes. An increase/decrease in importance of attributes in the utility function will increase/decrease their marginal values, respectively. Finally, although only marginal values are discussed in this study, the full consumer surplus using the compensating variation approach follows a similar interpretation.

To address the issue that the welfare measures are not independent from the levels of the price term in the model, several approaches have been outlined in the literature. McFadden (1999) suggested using a simulation approach to approximate expected welfare measures when the money term is not linear in a utility function. Morey (1999) and Morey, Sharma, and Karlstrom (2003) proposed dividing the utility function into several stages based on the money term and calculating welfare measures for each stage. Herriges and Kling (1999), however, did not find significant variation in welfare implications using different approaches. In this study, marginal effects are calculated based on the sample average of price, price gain, and price loss.

Table 6 reports these marginal values in terms of the price of the products in Japanese yen. Standard deviations are approximated by simulation with 10,000 iterations following the approach outlined by Hu, Veeman, and Adamowicz (2005). The standard deviations are generally large for these marginal values. This is because in both models, the price terms are in the denominator of the ratios; thus simulation may generate very small price coefficients and therefore lead to large marginal values. We focus on the mean of the 10,000 simulation replicates. Marginal values based on the CL and MixL models are in general consistent with some comparisons that differ moderately. Train (1998) asserted that the welfare implications from the CL and MixL models need not be completely consistent.

In all situations, values associated with various nutrition claims are relatively small compared with the other attributes. The presence of the GM label on a canola oil product generates the largest negative value to Japanese consumers. The two types of certificates (FOSHU for functional foods and JAS for organic foods) are associated with large positive values. On the other hand, imported oil (*Imp*) may bring a large negative value to consumers. Marginal values based on neutral price (without gain or loss) are not dramatically different from those under the assumption of price gain. This is because although price gains are strongly significant in the models, their associated coefficients, evaluated at the sample mean price level from the conjoint design, are not significantly different from that of the price variable when no gain is incurred. Nevertheless, marginal values under the condition of price loss are appreciably less than those under either neutral price or price gain. These implied marginal values in the three situations demonstrate the potential differences in consumer welfare analysis when different price effects are considered.

Table 6. Marginal Values With and Without Considering Reference Price Effects (in Japanese yen)

	Neutral Price		Gain in Attractiveness		Loss in Attractiveness	
Variable	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
CL Model:						
Buyno	−561.50	743.16	−326.01	15,000.04	−202.17	198.48
Ole	−154.07	400.59	−78.07	4,292.00	−56.06	96.30
VE	−243.96	562.88	−114.66	7,084.47	−89.21	119.88
AL	−20.21	353.18	4.77	2,086.21	−8.96	40.94
GM	−1,893.67	4,332.32	−1,057.49	42,255.60	−687.96	801.29
FOSHU	388.32	1,008.18	151.44	9,182.11	122.40	168.42
JAS	688.06	1,405.66	375.83	15,572.95	251.09	296.24
Imp	−901.67	2,266.56	−508.99	19,874.36	−327.06	395.42
MixL Model:						
Buyno	−808.50	1,571.27	−804.89	22,728.87	−249.19	56.69
Ole	−201.68	524.23	−180.28	4,021.30	−62.16	27.60
VE	−259.37	617.60	−236.93	4,923.91	−79.98	28.35
AL	−63.30	451.88	−64.50	1,191.57	−20.29	22.59
GM	−2,083.86	3,615.23	−1,958.76	47,531.50	−637.24	155.72
FOSHU	558.56	980.64	508.21	12,425.56	170.92	44.65
JAS	282.40	334.46	254.25	7,196.75	86.12	30.05
Imp	−1,029.89	1,966.33	−959.54	24,063.49	−315.61	78.06

Conclusions

Along with the "cognitive revolution," the role played by psychological factors in conventionally defined economic behavior has moved to the forefront of research in many areas. This trend has been especially strengthened by new approaches and concepts resulting from laboratory and field market transactions. However, given these approaches as they are currently being developed, one cannot use them to solve questions raised surrounding goods that are either not marketable (e.g., environmental goods) or have not yet been introduced into the market (e.g., new food). In these circumstances, the stated-preference approach is probably the only widely accepted way to collect data.

This study offers an approach to incorporate reference point effects into an analysis using stated-preference data. It is found that a gain or loss based on an individual's reference price has an important impact on the underlying utility function which closely resembles the predictions given in the theory of reference point effects. Furthermore, the implied economic values for various product attributes are drastically different based on reference price effects. This study did not find factors such as market experience or the perceived importance of price in decision making to be able to explain reference price effects well. This result, however, may be case-sensitive, and additional similar research may be justified in the future.

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