Heterogeneity in consumer preferences for food safety label in Thailand

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Abstract

Food scandals have not only eluded consumers' confidence in food safety, but also threaten sustainability of food industry and trades. Food safety label is one of tools that several governments and firms use to cope with this issue. It has been used as a means to verify the credence attribute (food safety) and to reduce asymmetric information between suppliers and consumers. In case of Thailand, in 2005, the government introduced a food safety label for "good practices" in fresh produce products ("Q mark" from the Ministry of Agriculture and Cooperative). After Q mark, other labels linked to improved food safety standards have been introduced to Thai markets, for instance, top private brands that are considered as high quality and safety brand and label claiming "Safe Produce". Nevertheless, little is known about Thai consumer preferences for food safety labelling and brands. This study aimed to evaluate Thai consumers' relative value of food safety label and brand as well as other relevant fresh produce attributes using a discrete choice experiment approach. A sample of 350 Thai consumers was surveyed in Bangkok in 2013. Data was analysed using error component random parameter logit (RPL-EC) and latent class (LC) models to capture heterogeneity in consumer preferences. Our results suggested that Thai consumers are willing-to-pay more for food safety label and brand but they have high heterogeneity in their preferences. There is high social desirability for food safety label. We conclude by discussing the implications of our findings for businesses and policy makers.

Keywords: food safety label, choice experiment, willingness-to-pay, error component random parameters logit, latent class model

Topic: Consumer behavior: preference analysis

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Introduction

Consumers' tastes have effect on their preferences and purchasing decision (food choice). However, consumers do not have the same taste for the same product, that is, there is heterogeneity in consumers' preferences toward product, which could lead to differences in demand and willingness-to-pay (WTP) for it. Hence, the study on consumer preferences and WTP cannot overlook the importance of incorporating heterogeneous taste of consumers in modelling and analysis. Several studies showed that heterogeneous taste affects consumer preferences for food products and food labels (e.g., Alfnes, 2004; Caputo *et al.*, 2013; Lusk *et al.*, 2003; Ortega *et al.*, 2011; Tonsor Olynk, *et al.*, 2009; Tonsor *et al.*, 2005; Uchida *et al.*, 2014; Van Loo *et al.*, 2011; Van Loo *et al.*, 2014; Van Wezemael *et al.*, 2014).

Many of these studies were performed in North America and Europe (e.g., Caputo *et al.*, 2013; Tonsor, Olynk, *et al.*, 2009; Van Loo *et al.*, 2014) while only few studies were done in developing countries, such as, in Asian countries. Ortega *et al.* (2011) conducted a study on Chinese consumer preferences for food safety attribute in pork and found that although Chinese consumers in general are concerned about food safety, they differ in preferences and WTP for different types of food safety program. Chinese consumers have the highest WTP for a government certification program, followed by third-party certification, a traceability system, and a product-specific information label. Results from latent class and random parameter logit analysis indicated that Chinese consumers' preferences are heterogeneous. This confirms that consumers differ in their preferences even for food safety labelling. So far, no published study examines Thai consumers' heterogeneous tastes toward food labels, therefore, our study aims to fill this gap in the literature.

In Thailand, the government have been trying to implement food safety assurance system (FSAS) and to introduce food safety labels since 2004. The "Q mark" (issued by The National Bureau of Agricultural Commodities and Food Standard, ACFS) is a label introduced in 2005 (ACFS, 2011). Soon after, Q mark has become the dominant food safety label for fresh produce in Thai markets. After Q mark, other labels linked to improved food safety standards have been introduced in Thai markets. Currently, food safety is communicated to Thai consumers using three main types of signals. (1) Certification labels, guaranteed either by governmental authority (e.g., Q mark) or by a third-party private certification body (e.g., ThaiGAP, a private standard). (2) Private Brands that are considered

as both high quality and controlled safety brands, e.g., "Royal Project" ("โครงการหลวง") and "Doctor's Vegetables" ("ผักด็อกเตอร์"), in which most of products are GAP and GMP/HACCP certified. (3) Label producer/vendor own-label claiming "Safe Produce" ("ผักปลอดสารพิษ"), which is only a claim made by farmers and/or distributors that the product is safe without implementing any independently controlled food safety standard. This situation may confuse consumers and at the same time highlighted that consumers prefer food safety labels differently.

In order to address the market and policy concerns related to food safety labelling, policy makers need additional information on Thai consumer preferences to understand the relative value of a food safety label, compared to existing brands and labels, as well as to other important fresh produce quality attributes. Furthermore, studies on consumers' preferences and willingness-to-pay (WTP) for different attributes of fresh produce, including brands & labels, are important for stakeholders (i.e. producers and firms) to be taken into account when they make a decision on production or marketing activities. Because the importance of heterogeneity in consumer preferences, we incorporated this topic into our study; therefore, our study will contribute to literature on consumers' heterogeneous preferences as well.

In this study, we will briefly discuss the results from discrete choice experiment data from the survey that elicited Thai consumers' WTP for different food safety labels on fresh produce. Although several techniques could be employed to measure WTP, we chose to use a discrete choice experiment because it is the most flexible technique to analyse the value of food attributes (e.g., Alfnes, 2004; Burton *et al.*, 2001; Loureiro & Umberger, 2007), particularly in situations where market data are non-existent or unreliable (Tonsor, Schroeder, *et al.*, 2009). Furthermore, it is more consistent with Lancaster theory of consumer choice and random utility theory than other stated preference methods (Carlsson *et al.,* 2007; Lusk & Schroeder, 2004). The advantage of choice experiment is that it simulates real-life purchasing situation and allows the researchers to combine different product attributes that may or may not already exist in the market (Lusk *et al.*, 2003; Tonsor, Olynk, *et al.*, 2009). In this way, it forces respondents to really trade off one attribute against another (James & Burton, 2003). Nevertheless, a main concern when using this technique is the potential presence of hypothetical bias (Alfnes *et al.*, 2006; Lusk & Hudson, 2004; Neill *et al.*, 1994), a problem that is common to all the stated preferences WTP elicitation techniques. This problem could be limited by using cheap talk before the experiment (Silva *et al.*, 2011). Cheap talk is a script

explaining to the respondent the problem of hypothetical bias prior to administration of a hypothetical question. The premise behind this technique is that one might be able to reduce or eliminate hypothetical bias by simply making respondents aware of it, regardless of its underlying cause.

Objectives of this study are three-fold. First, to investigate Thai consumer preferences and willingness-to-pay (WTP) for food safety label and relevant attributes of fresh produce. Second, to examine whether consumer share the same pattern of preferences for fresh produce with food safety label. Finally, to compare the results of two of the most commonly used models in examining heterogeneous preferences of consumers, RPL (with error component) and LC models.

The paper is structured as follows. Theoretical and econometric models are described in section 2. In section 3, experimental design, survey procedure and data are described. Estimation procedure and empirical model are shown in section 4. Section 5 presents the estimation results while discussion and conclusion are provided in section 6 and 7, respectively.

Theoretical framework and econometric models

Theoretical framework

Choice experiments are theoretically grounded in the Lancaster's theory of consumer choice (Lancaster, 1966) and econometrically based on the Random Utility Model (RUM) (McFadden, 1974; Thurstone, 1927). The underlying idea is that utility of goods can be segregated in utility of different attributes of a product and consumers make choice based on preferences attributes of the goods. RUM posits the existence of a latent construct (unknown part), that underlies choice behaviour in the utility function under the assumptions that consumers are rational; and they make choices to maximize their utility subject to their budget constraint (Marschak, 1960; McFadden, 1974).

Choice experiments are based upon the assumption that individual i receives utility (U) from selecting option j in choice situation t. Utility is represented by a deterministic ($\beta'_i.X_{ijt}$) and a stochastic component (ε_{ijt}), and is specified as:

$$U_{ijt} = \beta'_i X_{ijt} + \varepsilon_{ijt} \tag{1}$$

where X_{ijt} is a vector of observed variables relating to alternative j and individual i in choice situation t, β_i is a vector of coefficients of these variables for person i representing that

person's taste, and ε_{ijt} is an unobserved error term that is independent and identically distributed (iid) extreme value type I (Gumbel). It is considered as a panel data model where individual i is the cross-sectional elements and choice situations t for each individual is the time-series component (Alfnes, 2004).

Different random utility models can be derived by making different assumptions about the composition and distribution of the unobserved factors $f(\varepsilon_{ijt})$ based on different assumptions on consumer preferences. One possibility is to assume that consumers have homogeneous preference (e.g., multinomial logit, MNL model); another is to assume preference heterogeneity among consumers (e.g., random parameter logit, RPL and latent class, LC) (Train, 2003).

In the preliminary analysis, we analysed data using MNL and RPL models and found that the latter performed better than the former; therefore, our respondents likely have heterogeneous taste. The question raised here is what type of preference heterogeneity should be incorporated into the analysis. In applied economic research to account for differences in consumer preferences through stated choice experiments, two approaches have been increasingly used (Tonsor, Olynk, *et al.*, 2009).

First approach is to assume a continuous distribution of the parameters to introduce heterogeneity (consumer preferences distribute continuously), such as, in random parameter logit model (RPL). Later on, several studies (e.g., Caputo *et al.*, 2013; Scarpa *et al.*, 2007; Scarpa *et al.*, 2005; Van Loo *et al.*, 2014) incorporate an error component term into the RPL model (RPL-EC) in order to account for correlation across utilities over alternatives in addition to consumers' taste variation (Train, 2003). Scarpa *et al.* (2005) and Scarpa *et al.* (2007) suggested that the RPL-EC is suitable for analysing discrete choice data, especially in the case that one alternative always appears in every choice situation (such as, "opt-out" or no-buy option). Hence, the utilities of purchasing options are likely to be correlated between themselves than to those of no-buy option.

Second approach is to assume that heterogeneity across individuals follow a discrete distribution, therefore should be modelled using a latent class model (LC). LC assumes individuals can be implicitly sorted into a set of latent classes (groups) where preferences are homogeneous in each class, but heterogeneous across classes (Boxall & Adamowicz, 2002). Benefit of LC model is that it does not require any assumption on the distribution of the parameters (Greene & Hensher, 2003).

Therefore, in this paper, we employ two econometric models that capture taste variation based on different assumption of preference distribution, namely, error component random parameter logit (RPL-EC) and latent class (LC) models.

Error Component Random Parameter Logit (RPL-EC)

The RPL-EC model considers the possible correlations among the utilities for different alternative because of the presence of no-buy option in all choice tasks. Even though option A and B (purchasing options) changed in all choice tasks, option C (no-buy option) was always presented; therefore, our respondents always experienced it. The utilities of purchasing options, hence, are likely to be correlated between themselves than with the no-buy option (Caputo *et al.*, 2013). The possible way to capture this correlation in the estimation is to let purchasing options share extra zero mean error component in their utility structure whereas this component is missing from the utility of no-buy option (Scarpa *et al.*, 2005). Hence, the main difference between typical RPL and RPL-EC models are as follows. Typical RPL model accounts only for consumers' taste variation by allowing the coefficient of attributes and levels to vary randomly across individuals and to deviate from the sample mean. While RPL-EC model accounts both for consumers' taste variation and for correlation across utilities by allowing the additional variance of utility of purchasing alternatives to be different from the no-buy option.

Application of the general random utility of Equation (1) in the RPL-EC model is:

$$U_{ijt} = \beta_i{'}X_{ijt} + \mu_i{'}Z_{ijt} + \varepsilon_{ijt} \tag{2}$$

where X_{ijt} and Z_{ijt} are vectors of observed variables relating to alternative *j*, β_i is a vector of structural taste parameters, μ_i is a vector of random terms with zero mean, and ε_{ijt} is iid extreme value. The coefficients vary over decision makers in the population with density *f(β)*. The density is a function of parameters *θ* that represents, for instance, the mean and covariance of the *β*'s in the population, hence, *β* varies over decision makers. The terms in $\mu_i{'}.Z_{ijt}$ are error components that, along with ε_{ijt} define the stocahastic portion of utility. Therefore, the unobserved (random) portion of utility is $\eta_{ijt} = \mu_i{'}Z_{ijt} + \varepsilon_{ijt}$, which can be correlated over alternatives (Train, 2003), in this case, purchasing alternatives (option A and B).

In a choice experiment, respondents provide a sequence of choice responses, thus, a panel data approach is used to allow for correlation among individual preferences in a sequence of choice decisions. In order to estimate maximum likelihood of the RPL-EC model,

we specify the probability of each individual's sequence of selections. The probability is a weighted average of the logit formula evaluated at different values of βi, with the weights given by the density (Train, 2003). Because of its lack of a closed form solution, the parameters of the model are estimated by simulated maximum likelihood estimation technique according to Train (2003).

Latent Class (LC)

Latent Class simultaneously assigns each individual into latent classes probabilistically (depending on the individual's observable socio-economic and/or attitudinal and behavioral characteristics) and identifying utility parameters of each latent classes. While the number of classes is endogenously determined by the data.

Application of the general random utility of Equation (1) in the LC model is:

$$U_{ijt|s} = \beta_s´X_{ijt} + \varepsilon_{ijt|s} \tag{3}$$

where β_s is a class specific vector of coefficients invariant across individuals in the same class, X_{ijt} is a vector of attributes associated with each alternative and $\varepsilon_{ijt|s}$ is the random component of utility for each class and is iid extreme value. Since the vectors of coefficients differ between classes, preference heterogeneity across classes is captured. Within a given class, individual decision in each choice situation are assumed to be independent and choice probabilities are assumed to be calculated using the logit model (Greene & Hensher, 2003). Membership to a specific class is determined by a likelihood function M that classifies respondents to one of the classes with probability P_{is}. The membership likelihood function is $M_{is} = a_s´Zi + \xi_{is}$, where a_s is the parameter vector for consumers in class s, Z_i is a vector of socio-economic and other observed characteristics that affect the class membership of individual i and ξ_{is} is an error term (Train, 2003). To identify the optimal number of classes statistically, measure of fit like Akaike and Bayesian Information Criterion (AIC and BIC) are commonly used. However, validity in terms of behavioural aspect should be taken into account.

It should be noted that, in all choice models based on random utility maximisation only the relative magnitude of the parameters matters. The signs and significance could be interpreted while the individual parameters have no direct interpretation (Alfnes, 2004; Brownstone & Train, 1999).

Data and Method

Experimental /Study design

The product of interest in our study is Chinese cabbage because it is a staple vegetable of Thai cuisine. In addition, Thai consumers are moderately concerned about its food safety (particularly chemical residues) (Lippe *et al.*, 2010); hence, they might look for the guarantee of food safety before making a decision. We described Chinese cabbage as a combination of three attributes, namely, freshness, price, and brand & label while considering all the other characteristics invariant. These attributes were selected based on the results of previous consumer research studies regarding the attributes preferred by consumers and their WTP for these attributes (Gorton *et al.,* 2009; Lippe & Isvilanonda, 2010; Moser *et al.*, 2011; Shepherd, 2006) and based on our previous qualitative research. The definition of these attributes are shown in Table 1.

Prices covered by the four equi-spaced price levels (average retail price, -50%, +50%, +100%) were chosen to reflect the range of retail prices for one kilogram of Chinese cabbage at the time of the study in June 2013 (the average price was 50 baht/kg). Freshness referred to days after harvest (0 day, 1 day and 2 days). The baseline for freshness is today. For brand & label, we considered three types of ways to signal a "safer" food product: (1) "Q mark"; (2) Label claiming "Safe Produce" ("ผักปลอดสารพิษ"); and (3) Private brands, "Royal Project" ("โครงการหลวง") and "Doctor's Vegetables" ("ผักด็อกเตอร์"). Q mark is the main food safety label of interest, while other common signals of food safety available on the Thai market are included in this study to ensure it is realistic in consumer's eyes. Since most of the products from these private brands obtained Q mark, in order to make the simulated shopping situation realistic, in this experiment Q mark always appeared together with the private brands. The baseline for brand & label is no information because most of fresh produce sold at the market are without packaging and labelling.

Product attribute	Attribute levels	Description
Price (PRICE)	25 baht/kg 50 baht/kg (Average price) 75 baht/kg 100 baht/kg	Prices in Baht for 1 kilogram of Chinese cabbage
Freshness (FRESH)	FRESH0 (Today) (baseline) FRESH1 (Yesterday) FRESH2 (2 days before)	Day after harvest
Brand and Label (BRL)	BRL0 (No information) (baseline) BRLCL (Claimed "Safe Produce") BRLQM (Q mark) BRLRP (Royal Project & Q mark) BRLDV (Doctor's Vegetables & Q mark)	Food safety brand and label

Table 1 Attributes and levels of fresh Chinese cabbages used in the choice experiment.

Note: In July 2013, 1 Thai Baht (BHT) = 0.032121 US Dollars. In 2011, Purchasing Power Parities (U.S. Dollar = 1.00) for Food and non-alcoholic beverages of Thailand = 19.962 (World Bank, 2011).

Afterward, we used the selected attributes and their levels to design choice experiment. "Opt-out" or no-buy option is included to imitate the real shopping situation where consumers may decide not to buy any available choices (Adamowicz *et al.*, 1998; Gao & Schroeder, 2009; Loureiro & Umberger, 2007; Lusk & Schroeder, 2004). The main effect was employed to select choice situations (Lusk & Norwood, 2005). An efficient or D-optimal design (Jaeger & Rose, 2008) was applied by using the software Ngene 1.1.1 (Choice Metrics, 2012). The final design contains 12 choice situations with two unlabelled cabbage alternatives (Option A and B) and "no-buy" option (Option C). It was chosen as the one, which had the lowest D-error (0.2090) among evaluated designs (iterations).

Information regarding each considered attributes was given to respondents right before the choice experiment part. Respondents were informed that the cabbage products presented to them differ only in terms of the three attributes described, and that all other attributes are identical. Pictures and clear labelling were used in presenting choice situations to aid respondents' understanding (Fig. 1). To prevent systematic order effects, the choice questions were presented in randomized order across respondents (Loureiro & Umberger, 2007). To limit the potential presence of hypothetical bias, "Cheap Talk" script was presented to the respondent right before the choice question, reminding consumers about their budget constraint and ask them to choose the alternative as realistically as possible (Silva *et al.*, 2011).

Option A	Option B	Option C
Freshness = today Claimed "Safe Fresh Produce" ("ผักปลอดสารพิษ") 25 baht/kg	Freshness = yesterday 75 baht/kg	Neither A or B
I choose ...		

Fig. 1. Example of a choice set included in the choice experiment.

Survey procedure and sample characteristics

The data was collected through a survey administered during July 2013 in Bangkok and Nonthaburi. These urban areas were selected because they are targeted area for fresh produce with food safety labelling (e.g., Gorton *et al.*, 2011; Lippe *et al.*, 2010; Roitner-Schobesberger *et al.*, 2008). Quota sampling according to the shopping outlets and convenience sampling methods were adopted to reach the target number of respondents (350). Fifty seven percent of the respondents (200 persons) were recruited at two fresh markets ("Yingchareon Market" and "ATK ") and the rest (150 persons) were recruited at three supermarkets ("The Mall, Ngamwongwan", "TOPs market, Kaset" and "Tesco Lotus, Bangsue") because Thai consumers still buy fresh vegetables mainly from fresh markets (Gorton *et al.*, 2011). The questionnaire was administered face-to-face in Thai language by trained interviewers on the weekdays and weekends and at different times of the day to cover a wide range of consumer types. Interviewers stayed near the fresh fruits and vegetables shelves and asked consumers to participate in the survey on a voluntary basis. Before the interview starts, interviewers asked three screening questions related to being at least 18 years old, being the main household food shoppers, and consuming vegetables and cabbages. The interviews lasted 10-15 minutes.

Questionnaire included choice experiment questions and other questions regarding dietary habits and consumption patterns, knowledge and attitudes of food safety and food safety label, and respondent and household characteristics. The questions take closed-form and multiple choices. In the attitudes section, respondents were asked to give their opinion

toward statements according to a 5-point Likert-like scale, ranging from 1 (Strongly disagree) to 5 (Strongly agree). In the choice experiment part, respondents were presented with a set of 12 simulated choice shopping tasks and they were asked to choose a preferred alternative between two profiles of Chinese cabbages and a "no-buy" option.

Three hundred-fifty respondents completed the choice experiment surveys. Only 345 respondents completed all questions including socio-demographics and consumption habits, therefore, the estimated results of the models are from these 345 consumers. The selected demographic attributes are presented in Table 2.

Sample characteristics

Descriptive statistics analysis was used to describe Thai consumers' features in terms of socio-demographics and consumption habits. Mann-Whitney U tests (Mann & Whitney, 1947) were used to compare features between consumer groups (fresh market and supermarket). The majority of respondents were female, as expected when targeting responsible of food shopping for Thai household. Average respondent is 43 years old. The majority of respondents have University Degree. Average household income was between 40,000 to 54,999 baht/month. However, income levels of respondents are quite diversified. One-fourth of respondents is categorised in the upper income level (70,000 baht/month or more). Nearly a quarter of respondents had children aged less than 8 years old at home. Nearly 70% of respondents purchased fresh produce at least 2-3 times per week; therefore, they regularly consume fresh produce. More than half of respondents had ever bought products with Q mark and private brands of our interest from time to time, so they are aware of these brand & labels.

Comparing between respondents at fresh market and supermarket using the Mann-Whitney U test, respondents at the fresh markets have significantly higher age range, lower education level (high school) and higher frequency of purchasing (4 or more times per week). We found that the respondents' characteristics are consistent with Bangkok census data in 2011 on average age (30-40 years old), average household income (48,951 baht/ month) and average highest level of education (high school). The higher proportion of higher education respondents in the sample might due to the fact that TOP supermarket (Kaset) is located nearby a University and several Governmental Offices. The high proportion of elder respondents might be because the elders had more time and tend to cooperate more in

surveys, whilst the high numbers of respondents with an upper income level may be because ATK is a high-end market.

Characteristics	Percent of total (%)		
	FRESH MARKET (N=200)	SUPERMARKET (N=150)	Pooled sample (N=350)
Gender			
Female	87.00%	85.30%	86.30%
Male	13.00%	14.70%	13.70%
Age (Mean, st.dev.)	54.45 (96.261)	40.39 (15.421)	42.96 (15.067)
19-30 years	21.20%	32.00%	25.90%
31-40 years	16.70%	20.70%	18.40%
41-50 years	22.70%	18.70%	21.00%
51-60 years	24.20%	18.00%	21.60%
More than 60 years	15.20%	10.60%	13.10%
Educational level (Median)	4	4	4
EDU1 = Less than middle school	18.00%	7.30%	13.40%
EDU2 = Middle school	7.50%	3.30%	5.70%
EDU3 = High school or equal	18.50%	18.00%	18.30%
EDU4 = University degree	51.50%	68.00%	58.60%
EDU5 = High Vocational Certificate	4.50%	3.40%	4.00%
Average household income (Median)	3	4	4
INC1 = Less than 10,000 baht/month	7.00%	4.00%	5.70%
INC2 = 10,000 - 24,999 baht/month	20.50%	22.70%	21.40%
INC3 = 25,000 - 39,999 baht/month	25.00%	14.70%	20.60%
INC4 = 40,000 - 54,999 baht/month	15.50%	16.00%	15.70%
INC5 = 55,000-69,999 baht/month	10.00%	12.00%	10.90%
INC6 = 70,000 baht/month or more	22.00%	30.60%	25.70%
Having children < 8 years living with you	24.00%	16.70%	20.90%
Having children 9-15 years living with you	25.50%	20.70%	23.40%
Frequency of buying fresh produce (Median)	4	4	4
1 = Once per month or less	2.50%	4.70%	3.40%
2 = 2-3 times per month	7.50%	10.00%	8.50%
3 = Once per week	18.50%	24.00%	20.90%
4 = 2-3 times per week	35.50%	42.70%	38.60%
5 = 4 or more times per week	36.00%	18.60%	28.60%

Table 2 Socio-demographic characteristics and consumption behaviour of the sample.

Source: Survey sampling

Estimation Procedures

Choice experimental data was analysed using the statistical software NLOGIT 5.0 (Econometric Software, Inc., Plainview, NY).

Model specifications

In this study, all models are estimated on 4,140 choices, based on 345 respondents, each performing 12 choice tasks. An alternative-specific constant representing the "no-buy" option

choice (β_0) and the other considered attributes and attribute levels are included in the specification of the utility function. All attribute variables (except price) and covariate are effect coded relative to the omitted base: today (freshness) and no brand & label (no information) in order to eliminate confounding effects between the constant and the attributes (Bech & Gyrd-Hansen, 2005). The attributes will take a value of 1 when applicable, a value of -1 when the base attribute applies, and zero otherwise (Olynk *et al.*, 2010; Tonsor, Olynk, *et al.*, 2009).

For the RPL-EC model, the utility that individual *i* obtains from alternative *j* at choice situation *t* takes the following form:

$$U_{ijt} = \beta_0 \text{NO-BUY} + \beta_1 \text{PRICE}_{ijt} + \beta_2 \text{FRESH1}_{ijt} + \beta_3 \text{FRESH2}_{ijt} + \beta_4 \text{BRLCL}_{ijt}$$
$$+ \beta_5 \text{BRLQM}_{ijt} + \beta_6 \text{BRLRP}_{ijt} + \beta_7 \text{BRLDV}_{ijt} + \mu_i Z_{ijt} + \varepsilon_{ijt} \qquad (4)$$

where $i = 1, ..., N$ is the number of the respondents, *t* is number of choice occasion, *j* is option A, B, C (no-buy option); V_{ijt} is individual utility for each respondent, alternatives, and choice set; β_0 is an alternative-specific constant representing the "no-buy" option choice; $Price_{ijt}$ is the price for 1 kg of Chinese cabbage of alternative *j*; $FRESH1_{ijt}$ (freshness = yesterday), $FRESH2_{ijt}$ (freshness = 2 days ago), $BRLCL_{ijt}$ (Claimed "Safe Produce"), $BRLQM_{ijt}$ (Q mark), $BRLRP_{ijt}$ (Royal Project & Q mark), and $BRLDV_{ijt}$ (Doctor's Vegetables & Q mark) are attributes of alternative *j*; Z_{ijt} is a normally distributed zero mean error component shared by two purchasing alternatives, and is set to 0 in the utility of the no-buy alternatives (Scarpa *et al.*, 2005); and ε_{ijt} is error term.

The RPL-EC model was estimated using 250 Halton draws for the simulation and taking into account the panel data structure. The price coefficient is assumed invariant across individuals, and the coefficients of freshness and brand & label are treated as random parameters with a normal distribution to account for heterogeneity of consumer preferences. Note that these random parameters could be correlated (Train, 1998), for instance, respondents who concern with the freshness of the cabbage might also value food safety label as well.

In the LC model, the utility function is similar to the RPL-EC model except there is no error component term and all coefficients are treated as fixed parameters. Consumer income (INC), education (EDU) and shopping outlet (LOC) were introduced as covariates in the LC model (other demographic, habits, opinion variables have been introduced as covariates in the LC model as well, however, due to insignificance and poor fit, they were not included in the

final model). Three latent classes were identified as the optimal solution using both the AIC and BIC.

Consumers' willingness-to-pay

Average willingness-to-pay (WTP) for each attribute levels of brand & label attribute was calculated as follows:

$$WTP(Label_k) = - (\beta_k - \beta_{no\ info})/\beta_1 \qquad (5)$$

The parameter on price (β_1) approximates mean marginal utility of income and the parameters on each brand & label ($\beta_4, \beta_5, \beta_6$ and β_7) indicate the marginal (dis)utility change from no information (no brand & label) to Claimed "Safe Produce", Q mark, Royal Project & Q mark, and Doctor's Vegetables & Q mark, respectively. WTP estimates from the LC model were derived specific to each class, accounting for different preference structures.

Ninety-five percent confidence intervals for the WTP estimates were created using delta method. Several methods exist to determine confidence intervals of WTP, namely delta, Fieller, Krinsky-Robb, and bootstrap methods; however, these methods are all reasonably accurate and yielding similar results (Hole, 2007). The delta method estimates the variance of a non-linear function of two or more random variables by taking a first-order Taylor expansion around the mean value of the variables and calculating the variance on that newly created random variable (Greene, 2003, p. 674).

Results

Heterogeneity in consumer preferences

Estimates of the RPL and LC models are reported in Table 3. Results from the RPL-EC model indicated that all coefficients of the selected attributes except Claimed "Safe Produce" label are significantly different from zero at 1% significance level. Nevertheless, this implies that surveyed consumers consider all attributes chosen in this research (freshness, price, and brand & label) as relevant attributes. The constants for no-buy (opt-out) are negative and significant for consumers meaning that consumers are willing to pay a price to purchase the product. As expected, the coefficient for price is negative, indicating that an increase in price will decrease consumer's utility and lower the probability to buy. Moreover, the hypothesis of correlation across utilities was verified since the standard deviation of the error component for the purchase alternatives was statistically significant.

Variables	RPL-EC		LC		
	Mean	Std.Dev.	Class 1 "Pursue for Freshness"	Class 2 "Worried Consumer"	Class 3 "Cabbage Enthusiasts"
NO BUY	-2.4689***	-	0.1065	-2.1245***	-3.2625***
	(0.1916)		(0.1141)	(0.3519)	(0.2765)
PRICE	-0.0293***	-	-0.0325***	-0.0053	-0.02526***
	(0.0011)		(0.0029)	(0.0034)	(0.0019)
Error Component	-	1.6766***	-	-	-
		(0.3044)			
FRESH0[a]	1.0089	-	0.9373	0.3671	0.9248
FRESH1	0.1629***	0.1045	0.3346***	0.0650	0.0407
	(0.0568)	(0.0816)	(0.0837)	(0.1733)	(.0670)
FRESH2	-1.1718***	0.8091***	-1.2719***	-0.4321***	-0.9655***
	(0.0828)	(0.1074)	(0.1219)	(0.1671)	(0.0634)
BRL0[a]	-1.8446	-	-1.3099	-3.5866	-0,7151
BRLCL	-0.1578	0.7509***	0.0028	-0.3363	0.0149
	(0.1226)	(0.1166)	(0.1306)	(0.2117)	(0.1096)
BRLQM	0.6418***	0.7312***	0.4654***	1.3467***	0.2267**
	(0.1069)	(0.2313)	(0.1316)	(0.2685)	(0.1057)
BRLRP	0.7544***	1.1920***	0.5972***	1.8744***	-0.1667
	(0.1212)	(0.1899)	(0.1436)	(0.3054)	(0.1137)
BRLDV	0.6062***	0.9966***	0.2445	0.7018**	0.6402***
	(0.1476)	(0.3693)	(0.1554)	(0.3044)	(0.1490)
Segment membership function: respondent's habit and characteristics					
Constant			-0.5283***	-0.7344***	-
			(0.1780)	(0.1813)	
LOC_Freshmarket[a]			0.3094	-0.1841	-
LOC_ATK			0.0584	-0.0724	-
			(0.2401)	(0.2551)	
LOC_Supermarket			-0.3678*	0.2565	-
			(0.2192)	(0.2166)	
NODEGREE[a]			-0.1467	0.3903	-
UDEGREE			0.1467	-0.3903**	-
			(0.1732)	(0.1893)	
INC_LO40K[a]			-0.3543	0.4711	-
INC_40K			0.3543**	-0.4711***	-
			(0.1615)	(0.1653)	
Latent Class probability	NA		0.285	0.239	0.475
Number of respondents	345		345		
Number of observations	4140		4140		
Log likelihood	-2660.669		-2684.915		
χ^2	3775.172		3726.680		
McFadden's pseudo R^2	0.4150		0.4097		

Table 3 Parameter estimates for Error-Component Random Parameter Logit (RPL-EC), and Latent Class (LC).

Note: Standard errors are presented in parentheses.

*, ** and *** denote significant difference at the 0.10, 0.05, and 0.01 level, respectively.

[a] refer to the reference levels of the attributes, the coefficients was calculated by:

$$\text{coefficient (ref.lev.)} = - \Sigma \text{ coefficients (attribute levels)}$$

Presented models were estimated using NLOGIT 5.0

RPL-EC model was estimated with Halton draws, and 250 replications for simulated probability.

Shopping outlet (LOC): LOC_Freshmarket = shopping at fresh market; LOC_ATK = shopping at ATK
    (high-end fresh market); LOC_Supermarket = shopping at supermarket

Income (baht/month): INC_LO40K = less than 40,000; INC_40K = 40,000 or more

Education: NODEGREE = no University degree; UDEGREE =University degree

Regarding freshness attribute, cabbage that are harvested 2 days ago was less preferred by consumers, while consumers are tolerated to produce harvested yesterday. With respect to brand & label attribute, the coefficients of "Q mark", "Royal Project & Q mark", and "Doctor's Vegetables & Q mark" attributes were significantly positive, whereas the coefficient of Claimed "Safe Produce" label is negative but not statistically significant. This suggests that the utility for Chinese cabbage with these brands & labels (except the claimed label) will be higher than for the one without a label. Nevertheless, all coefficients of parameters in brand & label attribute (except claimed label) are not significantly different among them, perhaps implying that consumers do prefer to have a brand or label over nothing and over claimed label, but they do not care about which label is presented. However, it should be noted that surveyed consumers were informed about the meaning of claimed in advance that claimed label does not possess any real guarantee in terms of certification, but it was only based on trust in the claimer; hence, this information may affect consumers' decision as well.

The derived standard deviation parameters for all brand & label attributes are significantly different from zero, suggesting that there is heterogeneity in the population in terms of respondents' preferences for brand & label, particularly for Royal Project & Q mark and Doctor's Vegetables & Q mark. In addition, Royal Project & Q mark attribute has the highest standard deviation, which is higher than the estimated parameter; this means that there is high heterogeneity among surveyed consumers for this brand & label. Put in other words, for some consumers the brand Royal Project in addition to Q mark might add value to the product whilst for others the brand might have negative effect. However, with this design we cannot distinguish the effect of the brands from the label.

The preference heterogeneity found in the RPL translates into significant differences amongst members of different classes in the LC model. While results from the LC model were similar to those of the RPL-EC model but brand & label attribute have effect on consumers' decision differently according to their classes. Table 3 shows the probability that a randomly chosen respondent belongs to a given class is 28%, 24% and 48%, respectively. The results for the first latent class show a relatively high absolute freshness coefficient relative to the coefficients on the other attributes, indicating a group of consumers that prefer highly fresh cabbage. Freshness 2 days ago has highly negative effect on their purchasing decision. They also count price (-), Q mark (+) and Royal Project & Q mark (+) in their purchasing decision. This class (28% of total sample) may represent a group of Thai

consumers who are relatively more concerned about freshness; we refer them as "Pursue for Freshness". Interestingly, coefficient of no-buy is not significant for consumer in this class, meaning that, for them, buying cabbage add little utility to them, this maybe because they tend to buy fresh produce at fresh market where there are many other choices to buy than at supermarket; hence, they might switch to other products easily.

Shoppers that have significantly positive brand & label coefficients (except claimed label) characterize the second class (24% of total sample) and a high preferences for all brands & labels, we call members of this class "Worried Consumers". For consumers in this class, coefficient of price is close to zero and has no significant effect on their purchasing decision means that they are price-insensitive consumers (at least in the price range we considered), while freshness have effect on their decision but less than brand & label.

Consumers who value Chinese cabbage as a commodity (highest negative value for no-buy option) characterize the third class (48%). Since this group of consumer values cabbage the most out of three groups, we refer them as "Cabbage Enthusiasts". Regarding brand & label attributes, only Q mark and Doctor's Vegetables & Q mark have positive effect on their purchasing decision. They prefer fresh cabbage as well.

The LC results confirm the RPL-EC results that there is high heterogeneity in the population in terms of respondents' preferences for brand & label, particularly for Royal Project & Q mark and Doctor's Vegetables & Q mark. As mentioned earlier, we included shopping outlet, income and education as covariates of the LC model to explore the socio-demographic characteristics and consumption habits of members in each class, and found that they significantly improved the performance of the model. The coefficient on shopping outlet revealed that consumers shopping at supermarket are less likely to belong to the "Pursue for Freshness" (class 1) group relative to those in class 3. The coefficients on education and income indicated that consumers who hold university degree and high income (40,000 baht/month or more) were less likely to belong to the "Worried Consumer" (class 2) group relative to those in class 3. Consumers who have high income were likely to belong to the "Pursue for Freshness" (class 1) group relative to those in class 3. This might contribute to the fact that consumers shopping at ATK, which is a high-end fresh market, is likely to be in this class.

Measures of fit

Table 4 reports the information criteria that can be used to discuss the relative fit of the two models presented here. The lower the information criteria value, the better is the fit. All criteria (log likelihood, AIC, AIC/N, BIC, BIC/N) suggest that the RPL-EC model does slightly better fit the data than the LC model.

Measure	RPL-EC	LC
Log Likelihood	-2660.67	-2684.92
Choices (N)	4140	4140
AIC	5383.3	5437.8
BIC	5433.464	5492.818
AIC/N	1.300	1.313
BIC/N	1.312	1.327
Chi-squared	3775.172	3726.680
Parameters	31	34

Table 4 Comparison of information criteria for RPL-EC and LC.

Willingness-to-pay for food safety labelling on Chinese cabbage

The estimated mean of consumer WTP and 95% confidence intervals for the attributes in each model are presented in Table 4. The WTP is the maximum price that consumers are willing to pay for labelled cabbage (in comparison to an equally fresh (today) cabbage without information at 50 baht/kg).

Results from the RPL-EC model indicated that WTP values are rather high compared to the actual price of Chinese cabbage in the market (without information). This means products with Q mark; Royal Project & Q mark; and Doctor's Vegetables & Q mark are strongly preferred and would certainly gain a premium in the market relative to cabbage without information. The WTP estimations for the three-food safety labelling options look quite similar. Claimed "Safe Produce" also gained premium price, but it is smaller than the others. Results from the LC model indicated that consumers differ in their preferences for different types of brand & label according to their latent classes; nevertheless, they prefer to have any brand & label rather than no information. Interestingly, since "Worried Consumer" (class 2) are not price sensitive at all, results implied that they do not pay attention to price but focus only on quality and safety attribute; therefore, we decided not to calculate WTP in this case as it will be unreliable. The mean values of WTP from the RPL-EC are higher than in the LC model. The ranges of WTP from the RPL-EC model are bigger than results from the LC because of its high standard deviations.

Attribute	RPL-EC		LC					
			Class 1		Class 2*	Class 3		
Claimed "Safe Produce"	57.60	[44.22, 70.97]	40.40	[23.67, 57.14]	n.a.	28.90	[13.41, 44.38]
Q mark	84.90	[69.64, 100.16]	54.64	[35.58, 73.71]	n.a.	37.28	[21.30, 53.27]
Royal Project & Q mark	88.74	[72.60, 104.88]	58.70	[37.81, 79.59]	n.a.	21.71	[5.42, 38.00]
Doctor's Vegetables & Q mark	83.68	[72.51, 94.85]	47.84	[32.02, 63.67]	n.a.	53.65	[44.23, 63.07]

Table 4 Consumer Willingness-to-Pay [95% confidence intervals] for food safety brand & labels on Chinese cabbage in Thai baht (BHT)/kg

Note: No information (no brand & label) is a reference point. These WTPs are premium price in addition to the price of product with no information.

* We did not calculate WTP for consumers in Latent Class 2 because it is unreliable. For this consumer group, coefficient of price is very low, closed to zero means that they are price-insensitive (for the price range we provided); therefore, for them, any price is fine as long as they will obtain cabbage with quality and safety.

In July 2013, 1 BHT = 0.032121 US Dollars.

In 2011, Purchasing Power Parities (U.S. Dollar = 1.00) for Food and non-alcoholic beverages of Thailand = 19.962 (World Bank, 2011)

It should be noted that the values calculated from the models are the average maximum values that consumers are willing to pay to obtain the cabbage for their use, which is the threshold beyond which they would more likely decide to keep their money in their pocket; in this case, this is the difference with a "no brand" cabbage. It is not the recommended price to be set for the products with brand & label. These prices are the level of premium that would make the consumer surplus equal to zero. If prices will be set at these levels, the probability that consumers will buy the product instead of regular cabbage drops to 50%.

Discussion and Conclusions

This study aimed to investigate Thai consumer preferences and WTP for food safety label, brand, and claimed on Chinese cabbage. In line with the findings from Gorton *et al.* (2011), our results indicated that Thai consumers consider freshness and price in their decision to purchase Chinese cabbage. Food safety brands & labels, which are our research interest, have influences on surveyed consumers' decision as well. Surveyed consumers are willing to pay a price premium for Q mark, Royal Project & Q mark, and Doctor's Vegetables& Q mark labelled products over unlabelled ones indicating that they are concerned about food safety and are willing to pay more to assure that they food are safe(r). Hence, when providing such information (food safety) with certain guarantees (by certification and/or brands), consumers are better off.

Results from both the RPL-EC and the LC models indicated that although surveyed consumers are in general concerned about food safety, they are heterogeneous in their WTP

for a price premium to cover the cost of providing safety attributes. The differences in consumer preferences are particularly shown in products labelled Royal Project & Q mark and Doctor's Vegetables& Q mark while Q mark, which is a governmental label, received a positive WTP from all consumer groups. Albeit it might appear that Thai consumer's confidence on the government's food safety control is eroding (Wongprawmas *et al.,* 2015), our research found that the consumers were more confident on government food safety control measures than they were for non-government ones. This indicates that there is a strong need for the Thai government to provide adequate food safety control.

Since in our study the RPL-EC model slightly outperforms the LC model, and fits the data significantly better than the MNL and the RPL models, hence, it may be conclude that probably there are heterogeneity preferences across surveyed consumers and correlation across utility of purchasing alternatives. Nevertheless, from our results, both RPL-EC and LC models' performance are rather similar. Therefore, the model selection should depend on the context and the aims of the researcher. For instance, LC can be/are preferred in case segmentation is one of the objectives of the analysis. Furthermore, the theoretical implication of the different models and its consequences on behavioural assumption should be taken into account in addition to its statistical performance (Greene & Hensher, 2003; Sagebiel, 2011).

For segmentation and marketing purposes, here we discussed results from the LC model. From the LC model, there are three latent classes of surveyed consumers, so called, "Pursue for Freshness", "Worried Consumer", and "Cabbage Enthusiasts". "Pursue for Freshness" consumers are unlikely to buy fresh produce at supermarket; one explanation could be that consumers at supermarket have already known that they might not find produce that is as fresh as at fresh market. This group of consumers is also likely to switch to buy other products (probably as long as those are fresh). While "Cabbage Enthusiasts" favour governmental label (Q mark) and a private brand (Doctor's Vegetable & Q mark), they are also concerned of freshness as well, but not as much as if they do not buy Chinese cabbage.

"Worried Consumer" group is looking for any sign to assure that product is safe. Since this consumer group is very concerned about food safety and wants to have it guaranteed by certification or brand, they could be a target for food safety labelling products. This group of consumer is more likely not to having university degree and likely to have middle-level income (less than 40,000 baht/month) in comparison with consumers in "Cabbage Enthusiasts" group. It is common that people in the middle class income would be a target for premium food products because they could pay more for food while people with higher

income might prefer products that indicate their social status instead, so, they will buy branded products, in which they assumed these products comprise quality and safety attribute at the same time. Nevertheless, governmental authorities should take care and give proper information to protect this group from deception since they seem pay few attentions to the type of label and any guarantee looks fine to them. Since this group of consumer is not price sensitive at all (at least in the price range we considered), it seems that they do not pay attention to price but focus only on quality and safety attributes; therefore, WTP calculated from this group is unreliable. The possible explanation for this situation could be that price is "attribute non-attendance (A-NA)[1]" for them, or they have "lexicographic preferences[2]" so that their choice is based solely on the level of their most important attribute (see Campbell *et al.*, 2007; James & Burton, 2003; Moser *et al.*, 2011). Other possibilities might be that prepared "price range" in the experiment is not large enough to make this group of respondents trade-off (see Bliemer & Rose, 2006), or respondents did not reply realistically, which is one of the main problem of hypothetical choice experiment (Alfnes *et al.*, 2006; Lusk & Hudson, 2004; Neill *et al.*, 1994). Another explanation could be price does not affect utility linearly. For some consumers, price is interpreted as a signal of quality; therefore, they may reject low price products and prefer those with a mid-high price. It is possible to check this issue using a part-worth model instead of the linear model for price. Future research should explore these issues further by accounting for A-NA, or by using different price ranges, or by using a part-worth model for price, or by adopting experimental auctions, or other non-hypothetical techniques.

Our results also suggest to producers and marketers that there is a perceived need for a higher level of food safety in the fresh produce supply chain. There is a potential market share for fresh produce products bearing food safety labels. Private sector could use food safety labels to signal to consumers that products are safe and trusted brands and labels could become a tool to differentiate products and to enhance the competitiveness in the high-value market (Henson & Reardon, 2005). Producers applying for foods safety certifications and labels should have a better chance to approach (especially large) retailers in the middle and high-end markets. Despite there is argument that food safety should be a basic requirement for food products, not a marketing tool, however, Thailand might be a case because everything is done by government and the consumer trust is not so strong (although it is higher than other private brands). If the government cannot ensure basic food safety level during meanwhile market driven should be used (Canavari *et al.,* 2010).

The WTP values for price premia are rather high compared to the actual price of one kilogram of cabbage (more than 100% of the average price of common cabbage). This inferred the high social desirability for food safety label. On the other hand, it might indicate that despite the use of a cheap talk script, it is possible that the hypothetical context can possibly cause participants to overestimate the value of products. Real choice experiment or experimental auction involving real money and products can be used to validate the WTP estimates found in this study.

An important limitation of this study is that, although we chose to put brand & label attributes together with the Q mark to be more realistic, the drawback is that with this design we cannot separate the effect of private brands (Royal Project and Doctor's Vegetables) from the effect of certification label (Q mark). We only know that the cumulated effect is not different from the effect of Q mark alone. In further research, brand attribute and label attribute could be separated in the experimental design in order to define the effect of each attributes on consumers' preferences. Consumers' perception toward food safety & label and its effect on consumers' preferences should be tested as well. Furthermore, the impact of information of brand & label on consumers' preferences should be tested, for instance, there might be two treatments, one shall receive short information regarding brand & label but did not explain further about claimed or guarantee system and another shall receive full information to be compared among treatments.

Since the respondents in this study are mainly from the city of Bangkok and vicinity, the study findings cannot be generalized to Thailand as a whole. However, the results can serve as an input for a wider study to be extended in other areas of Thailand. Although care must be taken when making conclusions based on a hypothetical choice experiment, our results generally indicate high price premia for food safety labels. Despite our study provided insight on consumer preferences, which reflect social desirability for food safety labels, this information alone, might not be adequate to aid policy makers in drafting and implementing more effective food safety policies. Welfare effect from enacting this voluntary food safety scheme in comparison with the possible mandatory one should be analysed in the next research steps. In a possible future research at a nation-wide scale, aimed at evaluating accurate welfare measures, it would be advisable to pair a consumer survey based on a representative sample with more reliable findings on the willingness-to-pay of consumers derived from non-hypothetical techniques that use incentive-compatible mechanisms (i.e., real choice experiment or experimental auctions). This would allow comparison of the results,

estimation of the size of the possible hypothetical bias effect, and calibration of the survey results.

In conclusions, apparently, Thai consumers are highly concerned about food safety and most of them stated that they are willing to pay a price premium to obtain food safety labelling product. Consumers are better off when food safety label & brand are available. Hence, Food safety labels can be used as an incentive to promote safe production/consumption in Thailand. However, Thai consumer preferences toward food safety labels are heterogeneity and they give weight of significant of each product attributes (freshness, price, brand & label) differently. Among them, Q mark, which is a governmental label, received a positive WTP from all consumer groups. Hence, governmental intervention regarding food safety control and labelling is highly relevant. If the government is not able to improve food safety level and credibility of food control scheme and label for the whole market, there is room for industry to play this role by offering (perceived) safer food (guarantee by brand or certification).

Notes

[1] A-NA is an attribute that respondents discard in their decision, in orther word, it is a situation where survey respondents employ heuristics (by ignoring certain attributes) while evaluating food (for further details please see Caputo *et al.,* 2014; Lagarde, 2013; Scarpa *et al.,* 2012). We did not include ANA in our design and it is beyond our study scope, future research could be followed to explore this issue.

[2] Consumers who have a tendency to rank alternatives solely with reference to a sub-set of attributes, ignoring all other differences between the alternatives (Campbell *et al.*, 2007).

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