

## **CONSUMER RESPONSES TOWARDS NON-GM FOOD: EVIDENCE FROM EXPERIMENTAL AUCTIONS IN VIETNAM**

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### **Abstract**

*This study aimed to investigate the point of view of consumers in developing and emerging market about the genetically modified and non-genetically modified food based on the evidence from soymilk non- genetically modified product. The experimental auction method was employed to explicit the willingness-to-pay of Vietnamese consumers for a non-genetically modified soymilk products. Regression analysis was applied to determine factors influencing consumer's WTP for non-genetically modified product. The results indicated that consumers are willing to pay 84% premium for soy milk with non-genetically modified attribute information in comparison with the conventional one. The level of WTP derived from the auction is not much different from the market price of the product being auctioned. Notably, consumers with high level of risk aversion were likely to purchase non-genetically modified food. This was a predominant factor that determines who would accept or deny the consumption of non-genetically modified food*

**Key words:** *genetically modified food; experimental auctions; consumer responses; food labelling; Vietnam*

**JEL Codes:** *D10, L15, Q18*

### **1. Introduction**

In the context of the global population explosion, much effort will be required to produce more foods to feed the world's growing population. In addition, climate-change-induced issues

may cause significant risks to agricultural production, in which, crop yields and productivity will significantly diminish if production activities face natural disasters such as droughts, floods, etc. It hence requires innovative methods that could generate a steady supply for all major crops. To achieve this, the advent of genetically modified (GM) technology is considered to be a feasible approach to provide enough food for all people (Oliver, 2014). Accordingly, GM crops may not only grow in extreme weather conditions but also are with high resistance ability to diseases and pests.

Concerning food security issue, Qaim and Kouser (2013) insisted that GM crops have increasingly contributed to the achievement of food and agriculture sector (e.g., increased crop yield, reduced pesticides applications, enhanced food quality, nutrient composition, resistance to pests and diseases), as well as improved the livelihoods of farmers. Furthermore, to ensure food availability, it is important to support local food production in developing and underdeveloped countries by promoting GM crops in response to the population growth (Herrera-Estrella & Alvarez-Morales, 2001).

Nevertheless, the application of GM technology is still a controversial issue regarding the pros and cons of GM foods. Thus, studies on GM foods have been continuously received much attention from scholars (Muringai et al., 2020; Pham & Mandel, 2019). The safety of GM crops is an argumentative topic for both the scientific community and food consumers. It is fact that some previously scientific studies showed that GM technology is attended as a potentially harmful solution causing health-related issues (Dona & Arvanitoyannis, 2009). Therefore, consumers who are risk-aversed might carefully consider the latent impacts of GM foods to their health. In such circumstances, those consumers may refuse to purchase a GM labeled food.

Many studies have been undertaken to explore consumer preferences for different categories of food labelling, such as eco-labels, nutrition label, organic label, traceability label (Khuu et al., 2019; Liu et al., 2017). As regards labelling for GM and non-GM food, some previous studies have looked at consumer's willingness-to-pay (WTP) and consumer's acceptance for GM food (Boccaletti & Moro, 2000; Huffman et al., 2003; Kim & Boyd, 2006; Tsakiridou et al., 2007) or non-GM food (Bernard, 2006; Lusk et al., 2001). By doing so, they concluded that the logo of GM or non-GM printed on the label may be a good way to help consumers to identify exactly the types of foods that are from GM or non-GM crops.

In terms of labelling treatment, two schemes of food labelling exist, consisting of mandatory and voluntary ones. The first one is compulsory to food producers and this scheme has been applied in several countries such as Japan, South Korea, Australia, New Zealand, European Union (EU), while the second one is optional and this labelling scheme has been exerted in the United State and Canada (Gruère & Rao, 2007). However, due to the scientific nature of food labelling, people tend to ignore the meaning of labels, and the differences between them (McCluskey et al., 2016). Thus, it may confuse the consumers in distinguishing the difference amongst food labels (e.g., non-GM, GM, Organic).

In Vietnam, the potential impacts of GM foods on consumer's health are still argued. In the current context, Vietnamese food producers prefer to label a "non-genetic modification" information on their products because Vietnamese consumers tend to understand the GM foods as the unsafety foods (National Agency for Science and Technology Information, 2010). Moreover, the non-GM organism in food ingredients is a mandatory restriction for the application of organic certificates on food products. Hence, the consumption of organic certified food is meaning that consumers are purchasing a non-GM food, and no GM foods are included in their meals.

It should be considered that, it needs to spend the certain costs to produce organic foods due to the requirements of the safety of the products. Therefore, the price of organic products is estimated to be higher than that of conventional food products. Even though several studies have been conducted to investigate the WTP of Vietnamese consumers for organic food (Luu,

2019; Truong et al., 2012), and showed that Vietnamese consumers are willing to pay a higher premium for organic products. However, organic products are still perceived as luxury and expensive foods, which may be out of financial reach of Vietnamese consumers (Ngo et al., 2013). As a result, Vietnamese consumers mostly find it very difficult to choose non-GM products in their daily consumption. This is a dilemma situation that consumers do not know how to choose the right foods for their consumption.

Soy bean milk is well-known as a healthy food, and is included in the daily meals of many countries all over the world, especially the high-living standards countries such as the US, Japan, Canada, Australia, and Korea (Institute of Agricultural Science for Southern Vietnam, 2018). Vietnam is one of the largest markets of the soybean milk products in the world, accounting 613 million liter per annum in 2014 or approximate 6.8 liter per capita per year (Phien & Doan, 2015). In line with the point of view about GM and non-GM foods of Vietnamese consumers, the scientific studies on public perception and understanding of those foods in Vietnam has currently been absent.

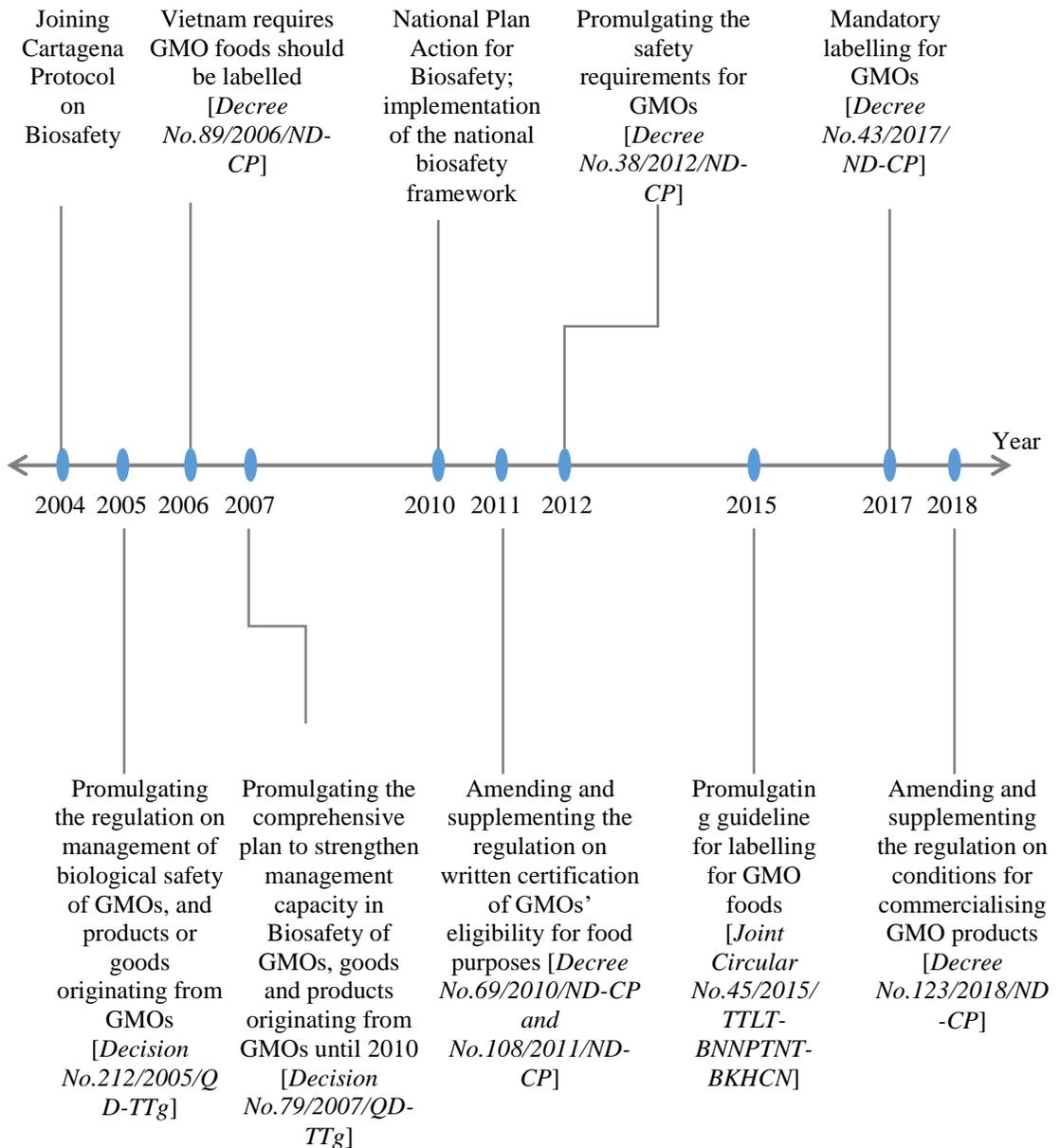
This study investigates the willingness to pay of Vietnamese consumers, based on the evidences from soybean milk products with non-GM attributes. To achieve this purpose, experimental auctions methods was explored to identify and compare the different premiums that consumers would place on non-GM foods over conventional ones. Besides, we will explore factors that affect consumer's willingness-to-pay for non-GM soybean milk attributes using the Generalized Linear Model (GLM). This study is expected to provide insight on consumers' attitudes toward GM food, and their belief in food labelling.

## **2. Institutional Setting Regarding Bio-Safety Issues in Vietnam**

In this section, we will present regulations related to bio-security problems and GM food in Vietnam. In response to the apprehension about GM technology and its potential risks on human health, biodiversity, and the environment, after several years of negotiations, the Cartagena Protocol was adopted in September 2003. A year later, Vietnam officially joined this protocol and it marked the beginning in the effort of the Vietnamese Government to deal with problems about bio-safety.

After joining the Cartagena Protocol, Vietnam recognized the importance of setting up its regulations on the use of GM technology. By consulting policies from other developed countries, Vietnam is building its regulations based on the conceptual structure from many developed countries such as Australia, European Union, Japan, the United States and then adjust to fit with their conditions. In 2005, Vietnam officially promulgated its first protocol about genetically modified organism (GMO) through the Decision No. 212/2005/QĐ-TTg; and required that GM foods should be labelled in 2006 through the Decree No. 89/2006/NĐ-CP.

In the period of 2006-2011, the Government actively concentrated setting and proposing many laws and national actions to raise the knowledge and awareness of producers and consumers (see Figure 1). In 2012, after many discussions, arguments about the benefits and drawbacks, Vietnam finalized their decision and stated their new concept about safety requirements for GMOs through the Decree No. 38/2012/NĐ-CP (The Government of Vietnam, 2012). This Decree lasted until 2015 when the Joint Circular No. 45/2015 was issued by the Ministry of Agriculture and Rural Development (MARD) and the Ministry of Science and Technology (MOST) on November 23, 2015 which states that commercial products containing GMO with a ratio of more than 5% of each ingredient, must show GMO-related information on label of the goods (The Government of Vietnam, 2012). In comparison with the threshold levels of other countries, such as EU countries, Australia, New Zealand (more than 1%), and South Korea (more than 3%); Vietnam's regulation on this ratio seems less stringent (Chung and Peter, 2018; Food Standard Australia New Zealand, 2005).



Source: synthesized by authors

Figure 1. Timeline of GMO-related regulations in Vietnam

By 2017, Decree No. 43/2017/ND-CP was issued that requires mandatory labelling for GM foods in Vietnam. Accordingly, quantity information, date of manufacture, expiry date, ingredients or ingredient quantities, warning information, and the phrase “Genetically Modified Food” (*Thực phẩm biến đổi gen*) or “Genetic Modification” (*Biến đổi gen*) must be given in addition with to the name of GM ingredients attached with contents (The Government of Vietnam, 2017). Nearly 15 years from joining the Cartagena Protocol, the Vietnamese

Government has made its continuous efforts in promoting for bio-safety and GMO-related regulations.

### **3. Methods and Materials**

#### **3.1. Data Collection**

The data used in this study was obtained through experimental auction method, which was widely applied to elicit consumers' willingness to pay (WTP) for goods, services (e.g. Chen et al., 2018; Gallardo et al., 2018). Differences from other valuation methods (such as contingent valuation method, choice modelling), which are conducted based on carefully constructed scenarios and hypothetical market, the experimental auction approach is practiced with real money and real goods, services. This method thus, creates a non-hypothetical market in which participants have a motivation to reveal their sincere value of goods or services (Lusk, 2003). For those reasons, experimental auction method has been widely applied in estimating consumers' WTP for novel goods and services in the last few years (Jin et al., 2017; Khuu et al., 2019; Nguyen et al., 2018).

In this paper, we applied a random *n*<sup>th</sup>-price sealed-bid auction mechanism as proposed in Becker et al. (1964); Shogren et al. (2001); Vickrey (1961) to conduct the auctions from 10 October to 05 November 2018. A total of 100 participants registered for the auction experiments in the city of Can Tho, Vietnam. The experiments were divided into 10 sessions, with 10 individuals for each. According the mechanism of the random *n*<sup>th</sup>-price sealed-bid auction, which is a combination of two strong points of other mechanisms, namely Becker-de Groot-Marschak (BDM) and Vickrey auctions, the process of the auction is described as follows:

- Step 1: Participants were provided an oral presentation on the procedures, rules of the auction, and information about non-GM products.
- Step 2: Each participant was received VND 20,000 in cash, equivalent to USD 0.86 (The exchange rate: 1 USD = 23,305 VND, at the time of auction), bidding cards and their identifier code. This value was decided through a short online survey with open-ended question: "What is the maximum amount of money that you are willing to pay for a soy milk box with non-GM?". The survey received answers from 100 respondents, and the WTP fluctuated between VND 5,000 to VND 20,000 per soy milk box. Eventually, we decided to use the highest value from this survey (VND 20,000) for giving cash to all auction participants.
- Step 3: Participants submitted their bids by bidding cards for non-GM products. Then, bids were arranged in descending order (from 1 to k).
- Step 4: We then randomly drew a ballot from a set of ten ballots, which were marked from 1 to k (in our experiment, we have 10 participants in each section, so k is equal to 10). The number on ballots will be referenced to the rank of bids. Winners are decided if they submitted higher bid over the price at the rank of the number that was drawn. For example, if we drew "n", the submitted bid with the value of greater than "n"-th price would become the winner.

The auctions were conducted in four rounds for each session. For the sake of avoiding the influence of objective factors, the soy milk boxes were wrapped to hide the brand name. To compare the differences between a non-GMO soy milk and a conventional one, we prepared other soy milk boxes without the non-GM label with the reference price is VND 5,000 (approx. USD 0.22). After auction experiments have been finished, each participant was asked to complete the questionnaire. The objectives of the questionnaire are to collect their demographic information, attitudes, and perception towards non-GM products.

### **3.2. Data Analysis**

In this study, we further applied the Generalized Linear Model (GLM) to identify factors effecting willingness to pay of the consumers for soy milk products with non-GM label. Five models were run using bids which were drawn from four rounds and the average bids of all rounds. The models were designed to include both demographic, perception and attitude variables, and were formulated as follows:

$$WTP = \beta_0 + \sum_{i=1}^k (\beta_i X_i) + \varepsilon_i$$

Where: WTP represents consumers' bids for a box of non-GM soy milk;  $X_i$  is defined as independent variables, including demographic information of respondents, their aversion and attitudes towards risk, frequency of milk consumption, and the interaction variables between frequency of milk consumption, family have children, and gender of respondents and risks perception. Also,  $\beta_0$  plays as intercept coefficient, and  $\beta_i$  depicts the parameters respective to the  $X_i$  variable. The relationship between consumer's WTP and explanatory variables was examined by using the Akaike Information Criterion (AIC).

Risk attitudes and risk perceptions were examined by using three statements for each term (i.e, Q1, Q2 and Q3 for risk attitudes; Q4, Q5 and Q6 for risk perceptions), and participants were required to rank these statements based on 6-point Likert scale, ranging from strongly disagree to strongly agree. The use of 6-point scale instead of 5- or 7-point is to evade ambiguity and reduce scale sensitivity (Cummins & Gullone, 2000). Based on the points of respondents for each term of risk attitudes and risk perceptions, we coded the group of risk perceived respondents and group of risk aversion respondents based on the distributions of the obtained data. The statements used for testing risk attitudes and risk perceptions are listed as follows: (Q1) Although I often hear bad news about foods with excessive pesticide residues, illegal uses of preservatives and industrial chemicals, it has no influence on my food-purchasing behaviour; (Q2) When I buy foods, I never worry about pesticides, preservatives or chemical substances; (Q3) I cannot tolerate the health risk when consuming foods containing chemical substances; (Q4) Currently, genetically modified foods are uncontrollably sold in the market and no information is given in their labels; (Q5) The expansion of genetically modified plants and animals could harm the environment; (Q6) Genetically modified foods could be harmful to consumers' health.

Description of dependent variables are presented in Table 1. A total of 100 participants joined with the survey. Of these, around 60% of the sample was female. Age of the respondents range between 17 and 64 with the average age of the sample is approximate 30. The respondents with the ages of 17-25 and 26-35 account for 37% and 39%, respectively. The age levels of the respondents from the surveys indicate that they were able to perceivably make their decisions on food consumptions. Regarding education achievement, about 70% of the participants have graduated from high school. In addition, the participants have an average income of 6.64 million VND per month. With regards to the consumption of soy milk, each family has bought such products about 7.38 times on average per month. Additionally, approximately 43% of the respondents reported that they have children aged under 15.

**Table 1. Description of Explanatory Variables in Models**

Variable	Description	Freq.	Mean	S.D.
Age	Age of participant (years old)	-	30.77	10.71
Education	Educational attainment of participant			
	1: graduated from high school; 0: otherwise	70 30	-	-
Income	Total monthly income of participant (million VND per month)	-	6.64	3.16
	Less than VND 3,000,000 From VND 3,000,000 and above	22 78	-	-
Gender	Gender of participant			
	1: male 0: female	60 40	-	-
Child	Participant who have any child (< 15 years old) in her/his family			
	1: yes 0: no	43 57	-	-
Frequency	Frequency of milk consumption (time per month)	-	7.38	8.40
Risk perception (RP)	Consumer perception towards risk, 1: perceived about risk, 0: did not perceive about risk	-	0.52	0.50
Risk attitudes (RA)	Consumer attitudes toward risk, 1: risk aversion, 0: risk tolerance	-	0.17	0.38
Child*RP	Interaction variable between Child and RP	-	-	-
Gender*RP	Interaction variable between Gender and RP	-	-	-

Source: Data analysis from experiments by authors

#### 4. Results

##### 4.1. Consumer’s Willingness to Pay Premium for non-GM Soy Milk

The average WTP of respondents for a non-GM soy milk box in each round is given in Table 2. Among the respondents, WTP fluctuated from VND 8,070 in the first round to VND 10,192 in the fourth round, and the mean premium was valued at VND 9,204 for a box of non-GM soy milk. Intriguingly, when comparing the consumer's WTP with the actual value of the soy milk box that we used in the auctions, the average WTP (VND 9,204) is almost equivalent to the market price (VND 8,900). The difference is only VND 304, this number is very small and insignificant. In addition, comparing the mean bids within four rounds, we found that there is an increase in the bids that respondents have placed.

**Table 2. The results of Experimental Auctions**

	Round				Average bids
	R1	R2	R3	R4	
Minimum	2,000	4,500	4,900	5,000	4,375
Maximum	20,000	20,000	18,000	19,000	19,000
Mean	8,070	9,059	9,496	10,192	9,204
S.D.	3,328	3,184	3,007	3,630	2,692
Mean / S.D.	2.42	2.85	3.12	2.81	3.42

Source: Data analysis from experiments by authors

In comparison with conventional soy milk, consumers are willing to pay 84% premium for soy milk with non-GM attribute information. This result shows a similar trend with a study that was conducted in Thailand (Krualee & Napisintuwong, 2012). In the study, they found that consumers would place a positive premium for non-GMO information rather than ordinal soy milk products. Furthermore, in terms of stabilization index (i.e., Mean per standard deviation, see Table 2) for all of the trials, they were 2.42, 2.85, 3.12, and 2.81 respectively, which indicates that the bids were placed stably by participants.

#### 4.2. Factors influencing consumer’s willingness-to-pay premium for non-GM soy milk

As can be seen in Table 3, the results of GLM models might not found the statistical affecting of demographic characteristics, including education, age and income to the consumer’s WTP for non-GM soy milk in the 1<sup>st</sup> and 2<sup>nd</sup> round of the auction experiment ( $P < 0.05$ ). However, it is found that the bids submitted by male participants are significantly higher than those of female in the 3<sup>rd</sup> and 4<sup>th</sup> rounds of the auctions ( $P < 0.05$ ). The number of children in the family significantly affected the WTP for non-GM soy milk amongst consumers. This result was consistent with the previous study in Taiwan obtained by Yang and Chang (2013). Accordingly, those who have at least a child in his/her family submitted the lower bids in compared to the others ( $P < 0.05$ ).

In whole, the frequency of consumption has a negative relationship with the bids of the respondents ( $P < 0.05$ ), suggesting that consumers might be more likely to buy cheaper products to reduce their expenditures for foodstuff. Probably, non-GM soy milk might be seen as a superior good in Vietnamese consumer’s perspectives, and they were not able to buy it on a regular basis but conventional ones (National Agency for Science and Technology Information, 2010).

**Table 3. The Results of GLM models**

Variable	Round 1	Round 2	Round 3	Round 4	Mean of bids
Age	-0.006	-0.006	-0.001	-0.001	-0.003
Gender	-0.065	0.119	0.178**	0.283***	0.136*
Education	-0.110	-0.125	-0.051	-0.009	-0.066
Child	-0.314***	-0.246**	-0.166*	-0.126	-0.202**
Income	0.191*	0.129	0.022	-0.051	0.066
Frequency	-0.011**	-0.010**	-0.006	-0.007	-0.008**
Risk perception	-0.157	0.035	0.112	0.221**	0.060
Risk aversion	0.292**	0.237***	0.188**	0.194**	0.221***
Child x Risk perception	0.268*	0.228*	0.115	0.065	0.162
Gender x Risk perception	-0.044	-0.295**	-0.289**	-0.309**	-0.239**
Intercept	9.310***	9.326***	9.180***	9.160***	9.237***
AIC	18.994	18.911	18.898	19.244	18.577
Log-likelihood	-938.707	-934.558	-932.614	-951.181	-917.841
N	100	100	100	100	100

**Source:** Estimated from the survey data

**Note:** \*, \*\*, \*\*\* denote the statistical significance at 10%, 5%, 1% level respectively. N is abbreviation of number of observations, which are included in the models.

In respect of risk perception, people who perceive the risk relating to food consumption tend to be more likely to place a lower bid for soy milk product with non-GM label in the 1<sup>st</sup> round. However, the result was changed in 4<sup>th</sup> round with higher bids ( $P < 0.05$ ). Notably, the non-GM products, including soy milk, were eagerly considered as the superior goods in Vietnamese's perspectives. In addition, the potential harmful effects of GM foods, and the useful effects of non-GM foods on the consumer's health were still questioned in Vietnam. Moreover, Vietnamese consumers might probably have several substitute choices for their dairy milk, instead of soy milk. Therefore, the participants might pay a strict consideration on the price of non-GM soy milk at the beginning of the auction, even though he/she was the risk-perception consumers. However, during the auction experiment, the participants were estimated to clarify all benefits of non-GM soy milk. Therefore, the group of consumers, who were perceived risk of unsafe food, changed their perspectives and were willing to submit a higher bid for the non-GM soy milk.

Attitudes to risk was a positive significant factor affecting to the WTP of consumers for non-GM food ( $P < 0.01$ ). Accordingly, risk-averse consumers would be willing to pay a higher premium for non-GM products. Our results consisted with the previous statement of Lusk and Coble (2005) that risk-averse individuals would not accept or willing to purchase GM food than risk-tolerant ones.

Furthermore, different influences of interaction variables are found, including risk perception and the number of children in the family and risk perception and gender of the respondents. It should be noticed that, the male respondents submitted a higher bid for non-GM soy milk as found results of the GLM models. However, the negative significant of the interaction variable between risk perception and gender of the respondents indicated that the male respondents who were aware of the risks of un-safety foods were not willing to pay a higher bid for non-GM products ( $P < 0.05$ ), suggesting the consumer's willingness to pay for a non-GM foods was strongly effected by their gender and level of risk awareness.

## **5. Discussion and Conclusion**

GM foods have a potential to solve the problems of the world's hungers and malnutrition, and to help protect the environment by increasing yields and reducing the use of synthetic pesticides and herbicides. Challenges ahead lie in many areas are safety testing, regulations, policies and food labelling.

This study found that the level of risk aversion is an important factor that determines the person who would accept or reject the spread of genetically modified crops. This finding may provide policy makers in Vietnam with an orientation to design a credible regulatory process to assure that bio-products reaching the market are safe and all necessary information are provided. Such process may involve documentation procedures, animal testing, environmental testing, or labeling regulations prior to a bio-product's approval. A stringent regulatory process and a government authorized agency's certificate may provide a chance for GM foods to be more acceptable to risk-averse consumers.

An important implication of this research is that markets for GM foods may be characterized by distinct market segments. Market segments may be formed on the basis of many variables, including socio-economic and cognitive variables. The results of this study indicate that cognitive variables are especially useful in understanding consumer preferences for GM foods. An explanation for the better conveyance of cognitive variables, in compared to socio-economic variables, is that they are more closely related to factors affecting consumer's motivation and underlying reasons why the consumers purchase the products.

Accordingly, marketing strategies for bio-products may not focus on educating public awareness regarding GM foods or bio-technology but on differentiating GM foods based on

beneficial characteristics desired by consumers. Furthermore, if labeling is required, the genetically modified nature of food products will be readily apparent to consumers, and this is more important for producers to ensure that consumers understand the benefits of GM products in compared to non-GM products.

From policy perspective, the government may need to provide more information to consumers regarding ecological concerns through educational training programs or via public media means to help them to make appropriate decisions in choosing healthy foods.

The results from this study may imply some work for future research. For example, the current study was conducted with auction experiments focusing on non-GM soy milk. Other types of bio-products may be tested for more generalized results. Important differences may exist based on the level of processing, which was not examined from this study. Particularly, consumers may be willing to pay higher premiums when considering fresh food products rather than snack foods. Future research may also be expanded to more geographical areas and attempts to include more minority members in the sample pool, especially in light of current findings that some differences may exist.

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