Theoretical and Practical Issues of Research on the Consumption Needs for Safe Foods in Vietnam Using the Willingness to Pay Model

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Abstract

Research on consumer needs for safe foods under the willingness to pay (WTP) approach based on consumer behavior has been performed widely and has contributed greatly to the development of safe foods, assisted enterprises’ decision-making processes in improving agricultural and food products, and provided orientation to policymakers in improving public health as well as in fostering sustainable economic growth. Some of the methods used for measuring WTP for safe foods, such as contingent value (CV), choice experiment (CE), and auction experiment (AE), have made significant contributions to the evaluation of consumers’ WTP for food safety. Moreover, the application of these models has helped to estimate the effects of many factors such as demography, consumer habits, continuation of food safety, individual characteristics, promotion, and product attributes, etc., on the WTP for food safety. The trend of safe food consumption in Vietnam has distinct characteristics, some of which come from national cultural identities; therefore, Vietnamese researchers may approach the empirical studies on this issue all over the world in order to find proper methods for studying consumer needs for safe foods in Vietnam.

Keywords

Willingness to pay, safe food, consumer need

Introduction

The process of choosing food for consumption is significantly influenced by consumer consciousness in safety and nutrients (da Fonseca & Salay, 2008). Food safety plays an important role in food consumption decisions, and shoppers have a tendency to switch to healthier diets (Radam et al., 2007). Consumers have started to people’s health, which can change the consumption behaviors of the buyers (Rimal et al., 2001). In China, some studies have shown
that consumers are willing to pay for the attributes of products which can improve their trust in the safety of foods such as food safety certificates from the government or certificates from private organizations, labels with detailed information, and traceability systems of the products (Ortega et al., 2011). In Thailand, the need for safe foods has also increased dramatically, and quality and safety requirements are emphasized in the consumption of fruits, vegetables, and meat products (Wongprawmas et al., 2014). Research on consumer demands for safe foods is one of the most urgent research topics which needs to be carried out in order to develop sustainable agriculture and build appropriate marketing strategies for businesses.

Worldwide, many authors have used the willingness to pay (WTP) approach to study consumer needs for safe foods. Many previous studies have approached the assessment of the need to reduce risks in food consumption by estimating WTP (the amount of food and budget for consumption) for taxation or labeling the biosafety certificates for the food products (Travisi & Nijkamp, 2004). Safe food consumption is impacted by a variety of attributes, so the WTP price for safe foods is achieved by the WTP for these attributes (Kehagia et al., 2007). Research on WTP essentially evaluates the level of consumer satisfaction of using safe foods, and from that, the producers and retailers can obtain insights into safe food consumption and can access available advantages to raise consumers’ trust (Misra et al., 1991). The equilibrium of the market will be achieved if the price that consumers are willing to pay for increasing the safety of food is equal to the price set by manufacturers and/or retailers, at which point manufacturers can decide to produce more (Wilcock et al., 2004).

In Vietnam, although controlling food safety is a major challenge due to the complex distribution of safe foods, consumers have a tendency to choose safer and more nutritional products (Mergenthaler et al., 2007). In fact, the consumer’s need for safe foods has increased significantly; for example, in research on consumer willingness to pay for safe vegetables in Long Bien district, Ha Noi, Viet Nam, 65.9% of respondents had bought safe vegetables, and approximately 15-35% of them chose to consume safe vegetables daily (Do Thi My Hanh et al., 2017). In another study about safe vegetable consumption in Northern Vietnam, a majority (46.25%) of 40 households chose the survey answer that they need to consume safe foods (Nguyen Van Cuong et al., 2019). These results indicate a positive sign for consumer needs in research on food safety in Vietnam. However, empirical studies in Vietnam have mainly focused on safe vegetables and seafood, and little attention has been paid to other agricultural products. Hence, scientific research on consumer needs for safe foods in Vietnam is important. With the adoption of the WTP approach to assessing consumer needs for safe foods, research can be of paramount importance for businesses, retailers, and policymakers to propose policies for agricultural development in Vietnam in the future. For the reasons mentioned above, this study endeavored to review the theoretical and practical issues of research on consumer needs for safe foods in Vietnam with the willingness to pay approach concerning buyers. We aimed to provide an overview of the WTP approach in research on assessing consumer needs for safe foods and discuss methods used for measuring consumer needs for safe foods using the WTP approach.

Methodology

The article reviews various empirical journal articles about the consumption needs for safe foods and the willingness of consumers to pay for safe foods. We have also referenced some professionals’ opinions related to the willingness to pay approach including methods for measuring WTP and estimation models, and some factors which affect the WTP of consumers or buyers in order to discuss the application of these methods in studies on consumption need.

Overview of the WTP Approach in Research on Assessing Consumer Needs for Safe Foods

Willingness to Pay (WTP)
Given that most of the good studies are not available in the market, the measurement of consumer needs in the market presents some difficulties. Assessing WTP is essential in studying consumer need for new products, and it is crucial to optimize the imperative price policies (Martínez-Carrasco et al., 2015). Previous studies have assessed consumer WTP for products so as to set up impeccable strategies to develop and complete products based on consumer needs. Research on WTP is associated with the theory about consumers’ buying decisions from problem identification, acceptance of personal responsibility, readiness for action, information searches, evaluation of alternatives, and selection of products to purchase (Figure 1) (Schifferstein & Ophuis, 1998). In case consumers decide to choose a product, they accept and place value on the product, which means they decide to consume that product not at market price but intuitive price (Horowitz & Mcconnell, 2003). WTP can be measured by the amount of payment or percentage of payment increment for a unit of goods or an additional attribute of that good, which can differ depending on the objectives of each research study.

Safe foods

According to the 2010 Food Safety Law of Vietnam, “food safety is the assurance that food is not harmful to life and human health” (Pham Hai Vu & Dao the Anh, 2016). Therefore, safe foods must be foods that meet respective safety standards (contain no plant protection residues, contain no pathogens, and are traceable) and have a valid certificate issued by competent authorities. In Vietnam, the issue of food safety received early attention by the Vietnamese government. In 1995, the Government of Vietnam carried out a "safe vegetable" program in response to improving food safety in Vietnam. The Ministry of Agriculture and Rural Development established the standards on the manufacturing of safe vegetables to meet the standards of the CODEX (Codex Alimentarius Commission). In that program, the Government endeavored to coordinate with local authorities to promote "safe vegetable" brands to retailers and consumers (Mergenthaler et al., 2009a). Since then, the program has been raising concerns about food safety to the government and society.

In 2008, the Vietnam Technical Board of Standards (TCVN/TC/F5): Food Radiation and Sanitation Group compiled the Vietnam National Standard TCVN 5603:2008. The standard was announced by the Ministry of Science and Technology in order to replace the old Vietnam National Standard TCVN 5603:1998 which was issued in 1998. This is the current national standard of Vietnam, completely equivalent to the CODEX standard of CAC/RCP 1-1969, Rev. 4-2003. The standard sets out the general rules of practice for food hygiene, which have been recognized by the world as necessary to ensure food hygiene quality. The Vietnam National Standard TCVN 5603:2008 guides the entire food chain from the initial stages to the final consumption, and indicates how to inspect each

![Figure 1. Model of consumer behavior theory (Schifferstein & Ophuis, 1998)](image-url)
stage of the processing cycle, making recommendations on basic solutions based on HACCP (Hazard Analysis and Critical Control Points) to enhance food safety. This general principle standard is a firm foundation for ensuring food hygiene in Vietnam. On this basis, Vietnam built a separate regulatory system of sanitary practice in an appropriate manner. To control food hygiene and safety, until now, Vietnam has issued a range of national standards, which have been applied to different food groups. Safe food standards raise the final food quality, affect the internal organization of manufacturers, and orient the supply chain management. Moreover, the standards indirectly influence the competition and policies for public intervention to ensure that the food sold fulfills the designed requirements (Hammoudi et al., 2009).

The management system of food safety in Vietnam is carried out from the central government to the local governments (Figure 2); in which, three ministries, the Ministry of Health, the Ministry of Agriculture and Rural Development, and the Ministry of Industry and Trade, are in charge of the nationwide management of food safety. In addition to the Food Safety Law issued in 2010, the Vietnam Government has issued a series of decisions and resolutions relating to food safety requirements for each group of goods like vegetables, fruits, meats, etc. The People's Committees are responsible for the local management of food safety; they are responsible for controlling the qualifications of food safety criteria in food manufactories, food retailers and food service agencies, street food sellers, local markets, and others, and for the inspection and handling of violations of food safety legislation in the managerial areas (Vietnam Congress, 2010). The food manufactories, food retailers, and foodservice agencies are responsible for the implementation of food safety qualification.

**Consumption trends and consumer willingness-to-pay for safe foods**

There has been an increasing tendency in the number of expenses related to safety factors in food consumption needs in Vietnam (Figué et al., 2004). Vietnam consumers have been spending 1.9% of their budget on safe foods because they trust the sellers, and 0.3% of their budget for their trust in formal certification (Mergenthaler et al., 2009b). The WTP for safety

| Ministry of Health | Ministry of Industry and Trade | Ministry of Agriculture and Rural Development |
|--------------------|--------------------------------|-----------------------------------------------|
| - Food additives   | - Wine and beer                | - Cereals and salt                             |
| - Processing support agents | - Drinks                      | - Fisheries and aquaculture products          |
| - Bottled water    | - Dairy products               | - Vegetables and fruits                        |
| - Natural mineral water | - Vegetable oil               | - Eggs and raw milk                            |
| - Functional foods | - Products processed from flour and starch | - Honey                                        |
|                    |                                | - Genetically modified products                |

Figure 2. Management, inspection, and handling of food safety at the national level
factors in food is about 30% to 74% higher than the market prices of conventional vegetables (Mergenthaler et al., 2009a; Do Thi Ha Phuong et al., 2017). Given a higher comprehension of food safety certification and higher prices, consumers would be willing to pay for 1 kg of safe products compared to conventional products (My et al., 2017).

In Vietnam, many barriers have appeared to limit consumers’ access to safe food consumption, which can make it difficult to increase safe food production over the country. Firstly, consumer’s access to safe food signage, such as brand name or government certification, is still restricted. Meanwhile, a majority of consumers still trust in food safety signs. A previous study focusing on safe food consumption in Vietnam showed that 55.5% of consumers trust in the quality of food sold at supermarkets, 49.5% of them trust the food with a reliable checkmark, and 42% of them believe in food from prestigious brands, and they are convinced by the assurance of the government and official organizations about the quality and safety of food (Vo Thi Ngoc Thuy, 2016). However, barriers to safe food consumption occur when consumers state that "they do not do shopping in supermarkets", "cannot find the quality checkmark", and "are afraid of buying counterfeit goods" (Figuié et al., 2004). Secondly, because the price of safe foods is generally higher than their ability to pay, 68% of consumers choose to buy traditional vegetable products rather than safe vegetable products. Consequently, many retailers do not sell safe vegetables to replace conventional food (Van Hoi et al., 2009).

There are a number of factors affecting safe food consumption in Vietnam, such as “food safety certificates”, “clear traceability”, and “supplier commitment”, that may significantly impact the level of trust among Vietnamese consumers in safe food (Van Hoi et al., 2009). In Vietnam markets, there are several product quality certifications such as VIETGAP (clean agricultural practices in Vietnam), GLOBALG.A.P. (global clean agricultural practices), organic (organic agricultural production), and HACCP (Hazard Analysis and Critical Control Points). However, food safety certifications (such as VIETGAP, organic, GLOBALG.A.P., and HACCP) are unfamiliar to many Vietnamese consumers. For example, in the study on Vietnamese consumers’ familiarity with food quality certifications, more than 60% of 500 study respondents were not familiar with either GLOBALG.A.P. or HACCP standards, and 30% of them claimed that they had "heard" about these certificates, but they did not understand what they were (My et al., 2017).

The significant differences in food consumption between rural and urban consumers is also a current trend in food consumption research in Vietnam (Hoang, 2009). The shifting into a health concerned, environmentally-friendly manner of living is the driving force for sustainable consumption of the middle-income class in urban areas (De Koning et al., 2015). Urban consumers are also more likely to understand safe food and food safety certifications (Figuié et al., 2004). Safety consumption trends are also being formed among urban consumers. For sustainable consumption purposes, consumers are willing to eat more organic food, less meat, and more local foods, and they prepare food with less waste and minimized food storage in the fridge (De Koning et al., 2015).

The above issues are important considerations for the selection of proper research methods as well as appropriate models for assessing safe food consumption needs in Vietnam. Different contexts and circumstances require different methods and approaches; therefore, researchers should select a suitable method and model in accordance with their particular purposes.

Methods used for Measuring Consumer Needs for Safe Foods Using the WTP Approach

Methods for measuring WTP
There are five standard methods for measuring WTP, which are the contingent value
method (CV), choice experiment method (CE), auction experiment method (AE), menu-based choice experience method (MBC), and conjoint analysis method (CA). All of the above five methods have been considered for the research of food consumption in Vietnam.

**CV method**

The CV method generally uses non-market valuation to access WTP such as questionnaires for consumers. This method has been widely used in empirical research on consumer behavior or consumption need to estimate WTP, but since there is no market for safe foods, the direct observations for monetary amounts that people pay for safe foods cannot be obtained (Bozoglu et al., 2019). Instead of a survey for consumption habits, this method allows researchers to directly ask consumers through survey questions about their buying options: whether they would buy a product or not, and at what price and quantity (Carson & et al., 2001). The CV method is commonly used in food studies, especially in measuring WTP for safe foods (Radam et al., 2007). The results of survey questions can be used to implicate a direct economic interpretation if the good to be valued is clearly explained, its delivery to consumers is conceivable, and a realistic expectation of payment was identified (Carson et al., 2001). In CV, the WTP for a single well-defined product is identified by asking respondents to place an acceptable value on that product (Mørkbak et al., 2011). The study by Haghjou et al. (2013) made an effort to evaluate the factors affecting the need for safe products by the CV method. Their research conducted a trial survey on 50 people before an official survey on 423 consumers. Haghjou et al. assessed consumers’ willingness to pay on a 6-point scale (6-point Likert Scale): not willing to pay, willing to pay less than 5% higher than traditional product’s price, willing to pay 5-14% higher than traditional product’s price, willing to pay 15-24% higher than traditional product’s price, willing to pay 25-34% higher than traditional product’s price, and willing to pay 35% higher than traditional product’s price. Their study examined the explanatory variables for the willingness to pay decisions, including demographics, behavior, shopping habits, knowledge about safe products, and level of risk tolerance, etc. WTP can also be evaluated using the CV method by the dichotomy method, in which the questions for the interviewees require the respondents to answer whether they are willing to an additional amount of B1 for a safe food. The respondents can answer yes/no, and if yes, the respondents continue to answer questions of whether they are willing to pay a higher price for the safe food (B2) with the answer to this question being yes or no (with the conditional restriction B2> B1, and B1, B2,..., Bn being the value range of money respondents are willing to pay for safe products) (Travisi & Nijkamp, 2004).

**CE method**

In addition to the CV method, the CE method was developed to estimate WTP for safe foods as a broader approach of CV for food consumption. CE respondents are asked to choose between a number of a set of product characteristics. Then the WTP of individual characteristics can be evaluated (Mørkbak et al., 2011). Because safe food gives credibility to some characteristics which differ from conventional ones, the CE method is based on the assumption that consumers choose to buy safe foods by comparing not only observable characteristics but also unobservable characteristics. Consumer WTP is an aggregation of WTP for product attributes. Therefore, in the survey, consumers are asked to choose among a number of products which are associated with specific characteristics (each particular characteristics is one product attribute) such as safety, traceability, and certificates, etc. (Gracia & De Magistris, 2008; Wongp rawmas et al., 2014). Consumption decisions are made based on the degree of utility gained from a series of consumption options, and each option displays some product characteristics in an attempt to keep a balance of the product characteristics in order to optimize utility. To minimize the bias in measuring WTP, the role of cheap talk was mentioned. Cheap talk can remind participants of some realistic issues which can limit their options. The cheap talk can warn consumers not to exceed their actual WTP threshold in terms of income constraints, consumer budgets, and product knowledge, etc.
Theoretical and practical issues of research on the consumption needs for safe foods in Vietnam using the WTP model

(Van Loo et al., 2011). Attributes to safe food consumption can include the following components: price, freshness, brand name, traceability, government food safety certificates, and certificates of other organizations (Ortega et al., 2011; Van Loo et al., 2011; Wongprawmas et al., 2014). The main criticism of CE is that there are numerous choice sets. A WTP questionnaire with a yes/no option for all possible combinations for five different characteristics will create a questionnaire with \((2^5)^2\) options or 1024 choice sets, which is not feasible when conducting a survey. Thus, fractional factorial design (Table 1) is often used to deal with this problem (Ortega et al., 2011). The fractional factorial model is designed to offer some options with particular combinations of product characteristics and then asks participants their favorite choice options.

**AE method**

The AE method is rarely used, usually due to limitations on the cost and time of research, scope of the study area, and sampling. Therefore, although this method is costly, the results are not representative of the whole population (Martínez-Carrasco et al., 2015). AE uses empirical supermarkets and allows consumers to choose products at the same price as they do in actual shopping. The change in the information listed about the safety of the products corresponding of the risk of product consumption is conducted in parallel with the change in price, and then the willingness-to-pay is the average price of the results from the trial. Hayes et al. (1995) applied this method to evaluate WTP for safe foods (sandwich products with safe and quality ingredients). The research revealed that customers were willing to pay $0.70 more for safer products. Fox et al. (1995) designed experiences to apply the AE method to estimate WTP in which participants were given the options of consuming ordinary food without payment or bidding to consume food with additional safety ingredients. The screening process to select individuals participating in the experiments affected the estimated WTP value. According to Fox et al. (1995), if there is a failure in creating a strict set of criteria for selecting participants, the estimated WTP value may be higher than the real WTP value for safe products (Martínez-Carrasco et al., 2015).

**Menu-based choice experience method**

This method was applied in some research about the WTP for the attribution of food products. By setting menus for the shopping experience, the study collected the alternative choices of participants. Based on a MBC experience auction, the corresponding reactions of consumers when product attributions change are captured (Hou et al., 2020a). Generally, MBC is a complicated procedure and expensive to use (Hou et al., 2020b).

**Conjoint analysis method**

CA provides numerous sets of products with particular characteristics. Each combination is known as a product profile, and then consumers give a score to evaluate the level of preference related to each combination of product characteristics (Hou et al., 2020b). The issue that occurs in this method is to reduce the number of attributes of the products in order to manage the number of combinations (Green & Srinivasan, 1978). Due to the profiles including sets of

| Table 1. WTP questionnaire for safe food attributes |
|-----------------------------------------------|
| Option 1 | Option 2 | Option 3 |
| Price ($) | 12 | 8 | Not buy, not accept product |
| Traceability systems | Yes | No |
| Government certificate | Yes | Yes |
| Certificate of private organization | Yes | No |
| Label | No | No |
| I will buy (stick in O) | O | O |

Source: Ortega (2011)
attributes of each product, we can derive discrete measures of WTP for each attribute. The most suitable number of attributes should not exceeded 6 because at that point, the sample size is still small, and the questionnaire can be designed so that respondents pay attention to the answers (Hou et al., 2020b). To get the effective WTP measurements, CA and CE or AE have been used by corporations to better understand consumer preferences for food characteristics (Darby et al., 2008; Imami et al., 2016).

WTP estimation models

Recent empirical research on WTP used different models for the estimation of WTP such as the discriminant analysis, logistics regression, combined model and filter design, and Heckman two-step models.

Discriminant analysis model

Some effective models of discriminant analysis methods can be listed as radar diagrams, descriptive statistics, and non-parametric tests. Discriminant analysis is related to classifying respondents into different groups. For example, respondents of a sample could be divided into three groups depending on consumption behaviors with regard to alternatively grown foods and reform foods. Respondents who can buy both alternatively grown food and reform foods would be referred to the first group, respondents who cannot buy organic foods but do buy reform foods would be referred to the second group, and respondents who cannot buy either of the two food types would be referred to the third group (Schifferstein & Ophuis, 1998). Radar diagrams can depict the purchase behaviors between some classified characteristics of respondents: concern for their own health, concern for environment protection, knowledge of organic food, etc. Then, the decisive factors influencing consumer purchase decisions can be determined (Yin et al., 2010). Descriptive statistics and non-parametric tests can be used to determine the statistical significance of the explanatory variables to attitudes and behaviors toward safe food. The non-parametric test enables users to analyze all of the cases for the purpose of comparing of two independent samples (e.g. female/male and buyer/non-buyer) in terms of attitudes towards the safe foods (Sangkumchaliang & Huang, 2012). Although it is suitable for a simple analysis of WTP, it is hard to estimate appropriate WTP results through this method because this method is primarily focused on evaluating the differences of WTP between some groups of consumers. Otherwise, discriminant analysis cannot achieve the optimal results unless participants were provided the definition of each safe food without attempting to educate or influence their purchase decision. This means there is a requirement that questionnaires need to be carefully designed to avoid influencing consumer responses in respect of minimizing the bias of information reflected in the consumer’s behaviors (Rimal et al., 2001).

Logistics regression model

Some studies have assessed customer behaviors in purchasing safe foods and the factors affecting those decisions based on discrete choice theory. When studying WTP, the variable Y denotes the choice of WTP, which shows the consumers’ WTP choices being either 0 (no WTP) or 1 (yes WTP). Data collected in a survey are converted to binary variables for the assumed results of 0 and 1, and the probability of distribution for each variable of 0 and 1 is the Bernoulli distribution, in which P (Y = 1) = π, probability P (Y = 0) = 1 − π, and π in the range (0,1) is the probability of choosing to consume the product. The purpose of WTP estimation is to assess the impact of each variable on WTP. The simplest case following a linear regression model is $E( Y | x) = \pi = \beta + \beta_1 x$. The introduction of binary and dummy variables in the study of consumer behavior has given rise to limitations in the application of linear regression in quantitative analysis. First, estimating by linear regression can give results of estimating the probability of consumer choice which exceed the range (0,1). Second, the correlation between the independent variables and the probability of choosing the product is not a linear correlation. These two issues are appropriately addressed by logistic regression (Fitzmaurice & Laird, 2015). The simple logistic regression model is as
follows: \( g(\pi) = \beta_0 + \beta_1 x_1 \), and the multivariate logistic regression model has the form: \( g(\pi) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \ldots + \beta_n x_n \), in which, \( \pi \) is the probability that consumers choose between \((0,1)\), while \( x_1 \ldots x_n \) are the independent variables affecting the probability of choosing to consume the product. The different models of logistic regression are as follows:

**Logistic (logit) function**: \( g(\pi) = \log\left[\frac{\pi}{1-\pi}\right] \)

**Probit function** \( g(\pi) = \Phi^{-1}(\pi) \) in which \( \Phi \) is the Gaussian normal distribution function

**Log-log function**: \( g(\pi) = \log(-\log(1-\pi)) \)

The logistic regression method mentioned above is the simplest form. Furthermore, some recent researchers studying consumer willingness to pay have used random parameters logit (RPL) and multinomial logit (MNL). The traditional conditional logit model (often referred to as the MNL model) was proposed by McFadden (1973) and is widely used to estimate WTP, then it was upgraded to the mixed multinomial logit model (MMNL), which can be called the random coefficients logit (RCL) model. This upgrade improved the model’s ability to deal with more complex error component structures. In the model, WTP cannot be estimated as a fixed value but is represented by a random distribution of WTP (Balogh et al., 2016). WTP can also be estimated with RPL, which limits three disadvantages of MNL by allowing random taste variation and alternative percept patterns, and correcting unobserved factors (Alfnes et al., 2006). Furthermore, since the WTP for the food attributes contributes to the consumer’s WTP for a food, a model that can estimate WTP for each attribute’s contribution is necessary (Hou et al., 2020a). In empirical research, MVP was used to access the WTP for multiple choices of substitute attributes. The MVP model is characterized by a set of dependent variables and each equation was considered to use the fixed set of independent variables (Ngenoh et al., 2019). Generally, the logistic regression model produces the higher significant estimation for WTP in case of binary and dummy variables used in models compared to the linear regression model. However, this method cannot incorporate factors analysis to deal with a series of interrelated relationships among the numerous of factors.

**Combined models and filter design model**

Some research approached WTP by combining the models based on filter design to minimize deviations in analyzing survey data. Obviously, the analysis of survey data based on filter design can be performed by a probit estimation model for binary variables. The filter design was studied in estimating WTP with the assumption that consumers make two decisions: (1) whether they are willing to pay or not; and (2) how much they are willing to pay (Huang et al., 1999). According to behavior and decision-making processing theory, consumers will decide to buy safe food, and if they choose to buy, then consumers will decide to buy at what price, or decide how much to pay for safe products. So, the filter structure consists of two dependent variables \( d \) (\( d = 1 \) if they are willing to pay and \( d = 0 \) if they are not willing to pay), and the variable \( y_j \) (\( y_j = 1 \) if \( y_{j-1} < y \times \beta Z \times \theta \); \( y_j = 0 \)), in which \( (y_{j-1}, y_j) \) is the price range. The equation has the following form:

\[ d = \alpha X + \varepsilon_d \text{ and } y_j = \beta Z + \varepsilon_y; \text{ of which, } \varepsilon_d, \varepsilon_y \text{ are constants, and } X, Z \text{ are the sets of explanatory variables} \]

The probability function is as follows:

- **Probability of events** \( d = 0 \): \( P(d=0)=\int_{\alpha X}^{\infty} \int_{\beta Z}^{\infty} f(e_d, e_y, \theta) = F(-\alpha X, \infty, \theta) \)

- **Probability of events** \( d = 1 \): \( P(d=1) = \int_{-\infty}^{\infty} \int_{m_j-1}^{\infty} \frac{m_j-\beta Z}{f(e_d, e_y, \theta) \cdot F(\alpha X, \beta Z, \theta)} \cdot f(\alpha X, \beta Z, \theta), \) of which \( m_0, m_1, \ldots m_n \) are the list of options of the WTP variables and \( j \) accepts the value from 0 to \( n \).

The model makes estimates by the method of maximum likelihood. Thus, the likelihood function for the proposed models is as follows:

\[ L = \prod_{i=1}^{N} \prod_{j=1}^{N} P(d_i = 0)^{1-d_i} \cdot P(d_i = 1, y_{ij})^{d_i}, \text{ of which } i \text{ is the index of individual observations, } N \text{ is the size of the sample, and } \alpha, \beta, \theta \text{ are the parameter estimations}. \]
The study of Huang (1996) was one of the pioneering studies when analyzing safe food consumption needs through two aspects of consumer behavior: liking products and accepting purchases. His research has built two models to evaluate the factors that influence consumers' preference for safe products and the factors that influence consumer acceptance of the safe product. The results showed that consumers are interested in safe products, are interested in limiting pesticides, and understand the importance of quality control, nutritional ingredients, and product price that affect their preference for safe food. However, the acceptance of consumption depends on the level of education, family size, income, product prices, product appearance, age, and income. However, this research still has a limitation in answering “how much consumers can consume for the product they choose.” Heckman (1976) introduced a two-stage regression estimation model, which was first designed for cases where consumption can be zero (Bozoglu et al., 2019), so the process of consumer needs research will be divided into two steps: (i) Step 1: identify whether consumers are willing to buy the product; and (ii) Step 2: if they are willing to buy, how much are they buying? Asatryan (2004) applied this model to study pork consumer needs by assessing the influences of factors on safe food purchase decisions (crop, diet as suggested by doctors, gender, age, educational level, area of residence, number of family members, and families without members under 18) and factors influencing the amount of food purchased (crop, doctor's diet recommendations, gender, age, region of residence, and number of family members).

When studying food products, it can be seen that the distinct characteristics of a product create the differences among similar products and safe foods have their own specific characteristics which differ from traditional products. For this reason, customers are willing to pay for these differences, which include both observable differences and unobservable differences (Gracia & De Magistris, 2008). In such a case, it can be assumed that consumers buy a product's characteristics instead of the product itself, and then the Lancaster consumer needs model can be highly evaluated to analyze the WTP for safe foods (Gracia & De Magistris, 2008). In the Lancaster model, consumers select products as a process of combining complementary characteristics, which can be known as the attributes of products, to maximize usability. In particular, the utility is measured by the following function: \( U_{ic} = U_0(z_1, z_2, \ldots, z_n) \) where \( z_i = a\beta_i \) is the consumption attributed to characteristic \( i \), in which one is the consumption volume and \( p_i \) is the price of the product consumed. The utility function is related to two groups of impact factors, the observable group such as the characteristics of the product, and the unobservable group such as customer preferences. The unobservable part is often difficult to measure, so it is possible to write the utility function of a safe food as follows: \( U_{0} = \beta_{io} z_i + \varepsilon_{io} \), where \( \varepsilon \) represents the effect of the unobservable part. The utility function of a conventional food can be written as \( U_{ic} = \beta_{ic} z_i + \varepsilon_{ic} \); in which, \( \beta_{io} \) and \( \beta_{ic} \) are the estimated parameters. Then, the probability of the WTP for safe foods will be \( P(Y_i) = P(U_{io} > U_{ic}) = P(\varepsilon_{io} > \varepsilon_{ic}) \). In addition, to explain why consumers choose safe foods, the bivariate choice model is used as follows: \( y^*_{io} = \beta_{io} z_i + \varepsilon_{io} \), of which: \( y^* \) is the unobservable variable which represents the probability of a safe food consumption option, \( z_i \) is the explanatory variable of the purchase decision, and \( y \) is the observable variable, which is in relationship with \( y^* \) and can accept the values 0 and 1, if \( y=1 \): \( y^*_{io} \geq 0 \) or \( \varepsilon_{io} \geq -\beta_{io} z_i \); \( U_{io} > U_{ic} \). Then, the probability of the consumption frequency can be written as follows: \( x^*_{io} = \alpha d + \lambda_i \), of which: \( x^* \) is the unobservable variable, which represents the probability of the safe food consumption frequency, \( d_i \) is the explanatory variable of the option of the safe food consumption frequency, \( x_i \) is the observable variable in the relationship with \( x^* \), \( y_i = 1 \), where \( x = 0 \) if the consumer is not a regular safe food consumer, and \( x = 1 \) if the consumer is a regular safe food consumer, and \( e_i \) and \( \lambda_i \) are also accepted in \( N(0,1) \).

Generally, the combined models and filter design increase the significance of WTP of...
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consumption need for safe food since the model adds the selectivity of the sample into its databases. Filter design can correct for zero consumption cases and limits model bias generating from sample selection by dropping observations (Lanfranchi et al., 2019). However, one disadvantage of this method is that numerous variables selected into the model can make a multidimensional problem, which is caused by some variables being interconnected with others.

Previous studies have shown that the factors that explain WTP for safe foods can be grouped into: factors related to food safety awareness, health awareness, and human factors, anthropology, individual characteristics, media and promotion factors, and product contribution factors (Capps & Park, 2002; Michaelidou & Hassan, 2010; Liu et al., 2013) (Figure 3). WTP research is derived from identifying whether customers prefer safe foods; if they prefer them, whether they will accept the consumption of the safe foods; and if they accept consumption, how much money are they willing to pay or the amount they are willing to pay for the safe foods. The studies can set the price range for the WTP and the amount of the product that consumers are willing to buy in order to design appropriate questions. Accordingly, many variables are included in the models to assess the factors explaining WTP for safe foods (Table 2). Variables can be selected such as age, gender, education level, knowledge of safe foods, health concerns, environmental concerns, product prices, product quality, taste, and color, etc. Depending on the characteristics of each type of safe food and geographic region, cultural factors, and general consumer trends, etc., the proper models are selected and applied appropriately. Two methods which can be used to screen variables are EFA (exploration factors analysis) and SEM (structural equation modeling). EFA is a multivariate statistical method designed to find potential variables from observed variables, based on the assumption that the observed and measurable variables can be captured and laid into latent variables. The number of samples considered for this method is about 300 observations (Yong & Pearce, 2013; Janssen, 2018). SEM is a model used to verify the suitability of a linear model of the explanatory variables of WTP, and this model is used when analyzing the interrelationships of the

Figure 3. Model of assessing a factor's influence on WTP
explanatory variables of WTP. The model can be seen as an extension of the multiple regression method. The technique allows the estimation of a range of regression models, in which the function is discrete but interdependent, with the ability to contain a series of interdependent relationships (layers). This technique may incorporate factor analysis to explain the model structure or hidden, unobservable factors, and then examine the model structure. This technique is performed before the statistical analyses are conducted, so it is often used to test the model's suitability (Michaelidou & Hassan, 2010).

Conclusions

The paper attempts to review the theoretical and practical issues about the consumption and needs for safe foods in Vietnam through the willingness to pay of concerned consumers.

Table 2. Review of the explanatory variables of WTP for safe foods in empirical research

| Groups                      | Explanatory                        | References                                                                 |
|------------------------------|------------------------------------|-----------------------------------------------------------------------------|
| Individual characteristics   | Age                                | Thompson & Kidwell, 1998; Huang et al., 1999; Radam et al., 2007; Gracia & De Magistris, 2008; Yin et al., 2010; Mørkbak et al., 2011; Ngo Minh Hai & Vu Quynh Hoa, 2016; Do Thi My Hanh et al., 2017; My et al., 2017 |
|                              | Sex                                | Huang et al., 1999; Asatryan, 2004; Mørkbak et al., 2011; Haghjou et al., 2013; My et al., 2017 |
| Education situation          |                                    | Thompson & Kidwell, 1998; Huang et al., 1999; Asatryan, 2004; Gracia & De Magistris, 2008; Haghjou et al., 2013; Ngo Minh Hai & Vu Quynh Hoa, 2016; My et al., 2017; Wang et al., 2018 |
| Promotion and media          | Promotion                          | Rimal et al., 2001; Van Loo et al., 2011; Haghjou et al., 2013 |
|                              | Price                              | Rimal et al., 2001; Radam et al., 2007; Ortega et al., 2011; Janssen, 2018 |
|                              | Certificates                        | Ortega et al., 2011; Ngo Minh Hai & Vu Quynh Hoa, 2016 |
| Health situation             | Quality                            | Gracia & De Magistris, 2008; Yin et al., 2010 |
| Product contributions        | Environmentally friendly           | Gracia & De Magistris, 2008; Ortega et al., 2011 |
|                              | Taste                              | Yin et al., 2010; Ortega et al., 2011 |
|                              | Color                              | Yin et al., 2010; Janssen, 2018 |
|                              | Convenience                        | Yin et al., 2010; Janssen, 2018 |
|                              | Marriage situation                 | Haghjou et al., 2013 |
|                              | Size of family                     | Huang, 1996; Radam et al., 2007 |
| Demography factors           | Income                             | Huang, 1996; Huang et al., 1999; Radam et al., 2007; Gracia & De Magistris, 2008; Yin et al., 2010; Nguyen Minh Duc & Dang Thanh Liem, 2015; Do Thi My Hanh et al., 2017; My et al., 2017; Wang et al., 2018 |
|                              | Children family members            | Thompson & Kidwell, 1998; Huang et al., 1999; Radam et al., 2007; Yin et al., 2010 |
|                              | Diseases                           | Huang et al., 1999 |
|                              | Trust and comprehension of safe foods | Yin et al., 2010; Ngo Minh Hai & Vu Quynh Hoa, 2016; Prakash et al., 2018 |
|                              | Concern about environmental protection | Haghjou et al., 2013; Le Thi Phuong Dung & Nguyen Huu Dat, 2016; My et al., 2017; Janssen, 2018; Prakash et al., 2018 |
|                              | Awareness of health                | Huang, 1996; Rimal et al., 2001; Janssen, 2018; Prakash et al., 2018 |
|                              | Awareness of safety                | Le Thi Phuong Dung et al., 2016; My et al., 2017; Nguyen Thi Thu Quynh et al., 2018 |
|                              | Concern about testing              | Huang, 1996; Xu & Wu, 2010 |
|                              | Concern about nutritional values   | Huang, 1996 |
Research on safe food consumption needs using the WTP approach is consistent with current consumption trends and in line with the national agricultural development strategy orientation. The results of the empirical studies mentioned above have contributed greatly to decision making of enterprises, agricultural development policies, and public health. The WTP estimation methods implemented such as CV, CE, and AE have made significant contributions to the assessment process of the WTP for safe foods. In addition, the application of analytical models, such as the discriminant analysis, logistics regression model, and combined models, have helped to evaluate the influences of explanatory factors of WTP for safe foods such as consumer behaviors, health awareness, demography factors, individual characteristics, media and promotion factors, and product contribution factors.

Many previous studies have explained the effects of a variety of explanatory variables of consumers’ WTP for safe foods such as age, gender, income, and health concerns, etc. through the different WTP models. They are important references for Vietnam’s safe food consumption assessment. Nevertheless, there are various factors affecting consumption trends for safe foods in Vietnam which are country-specific. Depending on the particular context to achieve the most meaningful findings, it is proposed to follow three steps when calculating the WTP for safe foods which are: (1) choose the appropriate WTP measurement; (2) perform evaluation methods to estimate WTP; and (3) establish the model of explanatory variables of WTP for safe foods.

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