Consumer perception and behavior toward food safety risk in Vietnam

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Ha, Thi Thanh Mai

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ABSTRACT

Perception of food safety risk is heightened in Vietnam. The main objective of this thesis is to gain an understanding of consumer perception of food safety risk and the relationship between risk perception and behaviour toward food safety risk in Vietnam. The thesis used the primary data that comes from our survey of 498 consumers and group discussions. Data were collected during 2017 in Hanoi, Vietnam.

Results from Structural Equation Modelling (SEM) analysis confirmed that extensive media coverage of food safety scandals decreased trust in institutions and heightened risk perception of common food and risk perception of hazards directly. Negative food safety information indirectly amplified perception of food safety risk in general. Using the mixed method, we found that risk perception was shaped by the fear of hazards, risk perceived from common foods, and food risk information. This finding was supported by those generated from SEM. Region was the most important determinant of risk perception, where urban consumers perceived a higher food safety risk than their rural counterparts.

Applying Principle Component Analysis and ordered logit regression, we found differences and similarities in the determinants of vegetable risk perception between the rural and urban regions. The Kruskal-Wallis test shows that higher risk perception was associated with a larger decline in vegetable consumption. To reduce the perceived risk, consumers avoided eating vegetables that were believed to be unsafe and switched to safer ones. We used the contingent valuation method to predict the willingness to pay (WTP) for organic vegetables. Results show that the WTP of urban consumers was higher than that of rural respondents. Perceived values of organic food, trust in organic labels, and income increased the WTP across the regions. Growing own vegetables reduced the WTP in the rural region only. Our findings suggest that regional differences need to be considered when designing risk communication and food safety policy. Urban farming should be encouraged as a mean to reduce food safety concerns in cities.

SUMMARY OF PUBLICATIONS

Published articles

1. Ha, T. M., Shakur, S. & Pham Do, K. H. 2019. Consumer concern about food safety in Hanoi, Vietnam. *Food Control*, 98, 238-244. (Scopus: Q1, IF 4.248)

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Works in progress

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Discussion papers

1. Ha, T. M., Shakur, S. & Pham Do, K.H. 2018. Regional differences in willingness to pay for organic vegetables in Vietnam. Economic discussion paper 18.08. School of Business, Massey University. December 2018.

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LIST OF ABBREVIATIONS

AIC	Akaike Information Criterion
BIC	Bayesian Information Criterion
ADF	Asymptotic Distribution Free Method
AVE	Average Variance Extracted
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CR	Composite Reliability
CVM	Contingent Valuation Method
E. coli	*Escherichia coli*
GDP	Gross Domestic Product
GFI	Goodness of Fit Index
GMO	Genetic Modified Organism
MRLs	Maximum Residue Limits
MSV	Maximum Shared Variance
PCA	Principle Component Analysis
RMSEA	Root Mean Square Error of Approximation
SD	Standard Deviation
SE	Standard Error
SEM	Structural Equation Modelling
SRMSR	Standardized Root Mean Square Residual
VND	Vietnamese Dong
WTP	Willingness to Pay

1.1 Introduction

Food supply chains in Asian developing countries are rapidly transforming its structure due mainly to 1) the rise in income; 2) rapid urbanization; 3) diet change; and 4) retail revolution. The rising income and urbanization process lead to lifestyle changes, resulting in a shift to the consumption of more non-grain, processed, and pre-prepared food (Reardon and Timmer, 2014). With better income and growing awareness about food safety, consumers are increasingly demanding for specific quality attributes of food (McCluskey and Swinnen, 2011). In response, modern retailers, such as supermarkets have cropped up rapidly as they offer many advantages compared to traditional markets. These include greater variety, lower cost of processed food, shopping convenience, and the implementation of private standards for quality and safety of food products (Reardon et al., 2003). In this context, food safety and quality are well recognised as a crucial competitive strategy of the players in the high-value food market.

Vietnam has anticipated shifts in food consumption patterns and spending (World Bank, 2016). Vietnam is considered the most dynamic economy in the East Asia region with the annual GDP growth rate in the range from 5.2 to 6.8% during the past 10 years. Given such economic development, there is an emerging middle class. This class has accounted for 13% of the population in current years and is expected to reach 26% by 2026[1]. Furthermore, the urban population is booming, from 28% of the total population in 2007 to 35% in 2017. To serve this population that has a better income, a changing lifestyle, and food preferences, supermarkets are proliferating in urban regions. All of these factors lead to an increase in the consumption of high-value products in both rural and urban areas (World Bank, 2016).

Food safety is a major problem in Vietnam, as food contamination remains prevalent. The main culprit is microbiological pathogens, responsible for 33.2% of food poisoning

[1] https://www.worldbank.org/en/country/vietnam/overview

outbreaks. The corresponding figures for toxin and chemical contamination are 25.2% and 10.4%, respectively (Sarter et al., 2012). Previously, a high level of food additives, pesticide, antibiotics, and hormones that are exceeding the Maximum Residue Limit (MRLs) was found in the domestic and international market (World Bank, 2006). While the data about the burden of foodborne illness are unavailable, there is a common belief that unsafe food has been the leading cause of growing cancer cases in Vietnam in recent years (Nguyen-Viet et al., 2017).

Inadequate risk communication via the media continues to worsen consumer's trust in food. Food safety incidents have attracted media attention in Vietnam. Social amplification of risk proposed by Kasperson et al. (1988) is a useful framework to explain how the media play roles in developing a small risk, as assessed by experts to public concerns and profound impacts. When an incident occurs, information about risk is collected and processed by individuals. Risk is then amplified through the interaction between individuals and social amplification stations (e.g., scientists, the media, and social networks). Poor communication of food risk can become amplified in the same way. Media, with its intensified campaign on a wide range of negative news about food safety, has played a role as a risk amplifier. In Vietnam, no sooner had the national television discovered a food incident than other information platforms such as online newspapers exploited the event to weave their own fallacious stories. As a result, consumers are often misled in the process (Nguyen-Viet et al., 2017).

Rapid urbanization also aggravates food safety issues in Vietnam. Urbanization is linked with longer food chains, resulting in a higher chance of food contamination, especially from perishable foods. Food safety in urban regions, therefore, become more vulnerable (Reardon and Timmer, 2014). In metropolitan cities like that of Hanoi, an extended food chain results in little direct contact between farmers and their final consumers. This generates consumer's uncertainties about food quality and safety (Shields, 2013). In this case, trust in the government and stakeholders in the food chain can serve to reduce such uncertainty. Unfortunately, that trust has eroded. Consumer concern about food safety is accelerating as a result.

Food safety concerns might cause substantial economic losses to Vietnam. At the domestic level, Vietnam has about 86 million consumers. Consumers are more interested

in imported foods as their trust in the safety of fresh domestic products declines (Nguyen-Viet et al., 2017). Subsequently, domestic food producers have to give away their market to foreign producers. The livelihood of a large proportion of domestic farmers, particularly those on a small scale, will be negatively influenced. Vietnam is a big exporter of some agricultural products such as rice, coffee, and seafood. Recent domestic food scares prompted trade barriers imposed by importing countries. This is happening at a time when Vietnam is aiming to integrate more deeply into the global and regional markets (World Bank, 2017). Hence, it is reasonable to project that Vietnam might suffer significant economic losses in the domestic as well as the export market owing to domestic food scares. To solve the problem, there is a need to gain a comprehensive understanding of risk perception of food and its role in driving food choice.

Food safety risk perception refers to consumer evaluation of the health risk associated with food consumption (Schroeder et al., 2007). It can be measured by either the mean score of the risk perceived (Schroeder et al., 2007) or the concern about food safety (Liu et al., 2014). Since risk perception is subjective, it is often expected to be biased. Consumers tend to underestimate real risk, such as lung cancer from smoking but overestimate less important risk, such as foodborne illness from canned food (Frewer et al., 2007). Consumers who hold a bias risk perception have to bear avoidable costs because of their risk ignorance or the use of additional precautionary measures. Also, these behaviours lead to the failure of consumer education programs (Frewer et al., 2007).

Perception of food safety risk seems to be biased in Vietnam. Consumers are likely to overestimate the health risk from chemical contaminations in food while the evidence worldwide shows that bacterial hazards are the main drivers of foodborne illness (Nguyen-Viet et al., 2017). Reducing food safety concerns and the bias in risk perception requires effective risk communication that cannot be implemented without an insight into the determinants of risk perception. Risk perception is often shaped by trust in institutions and food risk information (Rutsaert et al., 2013a). The linkages among risk perception, trust, and risk information need to be taken into account in developing food risk communication programs.

Heightened risk perception is an underlying driver of consumer behaviour in food choice (Yeung and Morris, 2006). When consumers perceive a risk that is higher than the

acceptable level, logically, they will take action to reduce the perceived risk. Avoiding certain foods is one of risk reduction behaviours (Grunert, 2005). Empirical evidence worldwide shows that due to the concern about the BSE crisis, beef consumption across countries drops dramatically (Schroeder et al., 2007, Liu et al., 2014). Such effect might be seen for food consumption, particularly vegetable consumption in Vietnam as vegetables are regarded by consumers a the riskiest fresh food (Figuié et al., 2004). The reduction in vegetable consumption might be another consequence of risk perception. This consequence should be studied to inform food safety policy in Vietnam.

Believing that the risk associated with conventionally-produced food is high, switching to safer and higher quality food might be another risk reduction behaviour of consumers. The anxiety about food safety is a key reason for the growing demand for organic food which is considered to have superior attributes as compared to conventionally produced ones (Yiridoe et al., 2005). In response to this growing demand, organic farming has developed rapidly over the world (Willer and Lernoud, 2019). The concern about vegetable safety has also driven the development of organic farming in Vietnam. The organic vegetable market, in particular, is up-and-coming as consumers were willing to pay a very high premium for organic products (Hai et al., 2013). Taking into account the influence of risk perception and other factors on willingness to pay for organic vegetables, this research will predict a potential market for organic vegetables in Vietnam. The research will inform food producers and regulators about the benefits gained from food safety improvement. This thereby will assist their decision making in organic farming.

1.2 Research gaps

A rich body of literature has established the underlying drivers of food safety risk perception (Lobb et al., 2007, Liu et al., 2014, Rutsaert et al., 2013b). Studies found that trust is one of the key predictors of risk perception, particularly when knowledge is absent. Employing trust in public authorities and the food industry helps consumers who lack knowledge of hazards reduce the complexity of food choice (Siegrist, 2000). Risk information has been found as another important determinant of risk perception (Verbeke, 2005). This is because risk perception is shaped by a complex process of seeking information from various sources, interpreting, then filtering it via direct experience and socio-cultural circumstances (Roberts et al., 2016). Some studies, such as Lobb et al.

(2007) have examined the associations among trust, information, and risk perception. Other studies have investigated one of three concepts: risk perception of particular hazards (Kher et al., 2013), risk perception of specific food categories (Lobb et al., 2007), and risk perception of food as a whole (Liu et al., 2014, Liu and Ma, 2016). Risk perception of hazards means consumer evaluation of their health risk from exposing particular hazards through food consumption. Risk perception of food categories presents their assessment of the health risk from consuming specific food products. Risk perception of food as a whole is consumer judgment of the safety risk of food in general. While the linkages among different levels of risk perception, trust, and risk information might exit, no studies focus on these linkages.

Risk perception is shaped by social and cultural factors (Dosman et al., 2001, Schroeder et al., 2007). The cultural theory developed by Douglas and Wildavsky (1983) argues that risk perception is a social-cultural construct. Different people with different social norms and cultural values will perceive risk differently. Sociologists highlighted disparities between rural and urban people in terms of social interaction, culture, and economic activities (Durkheim, 1933). Rural and urban consumers also divide in health information searching (Hale et al., 2010), trust in institutions that are responsible for food safety management (Shi, 2001). Since rural and urban people are inhomogeneous in not only risk judgment but also many other aspects, factors influencing risk perception and risk-reducing behaviour might differ between these two consumer groups. However, very little is known about these issues from previous literature.

Studies have paid attention to how consumers respond to a perceived risk associated with food. Most of the consumers are risk-averse. If the risk is perceived to be at a higher than acceptable level, consumers are likely to develop strategies to reduce it (Mitchell, 1999, Yeung and Morris, 2006). Consumers might employ many risk reduction strategies such as self-provisioning of food (Green et al., 2003), reducing consumption of affected food (Schroeder et al., 2007), and switching to high-quality food such as organic products. While the relationship between food safety risk perception and risk reduction strategies has been investigated in some developed countries (Schroeder et al., 2007, Green et al., 2003), this relationship has remained unexplored in developing countries including Vietnam.

1.3 Research objectives

This doctoral dissertation aims to gain an understanding of consumer perception of food safety risk and the relationship between risk perception and risk-reducing behaviour in Vietnam then draw relevant policy implications. Four specific objectives below are distinguished:

1) To analyse linkages among food safety risk perception, trust, and food risk information;

2) To examine consumer perception of food safety risk in general;

3) To investigate consumer perception of vegetable risk and its impact on vegetable consumption;

4) To identify the effect of perception of vegetable risk and other factors on willingness to pay for organic vegetables.

The first objective focuses on the complex relationships among constructs including trust in institutions, information acquisition on food safety incidents, and three levels of food safety risk perception. Risk perception at hazard level refers to consumers' evaluation of their health risk from exposure to particular hazards from food consumption. Risk perception at product level presents their assessment of the health risk from common foods that are consumed daily. Risk perception at the general level is defined as consumer judgment of the safety risk of food as a whole. Structural equation modeling (SEM), which is a powerful method to test complex causal relations among the constructs above would be applied. We would measure risk perception at the general level by the extent consumers are concerned about food safety. From now on, the four terms: "food safety concern", "food safety worries", "perception of food safety risk in general", and "risk perception of food in general" are used interchangeably.

The second objective concentrates on the risk perception of food in general and its determinants. Regional disparities will be taken into account by comparing how rural and urban consumers are different in food safety risk evaluation. Since risk perception is a complex concept, we will apply the mixed-method approach, which combines data from our consumer survey and group discussions to provide a better understanding of this concept. The determinants of risk perception of food, in general, would be

quantified through the analysis of data from a whole survey sample, not separating between rural and urban subsample.

The third objective centers around risk perception of vegetables and its impact on vegetable consumption while also considering regional differences. For this, we compare the determinants of risk perception between the rural and urban regions and analyse how risk perception affects vegetable consumption. Our interest in vegetables comes from four reasons. Firstly, vegetables are important in Asian's diet. In Vietnam, vegetables appear in almost every meal. Secondly, the concern about vegetable safety is remarkably high in developing countries, especially in Vietnam, due to the fear of pesticide residue (Figuié et al., 2004, Hoi et al., 2016). Thirdly, it is expected that a high level of concern about vegetable safety would prompt consumers to reduce vegetable consumption. Fourthly, unlike livestock production, growing vegetables does not require a large space. Hence, not only rural but also urban households can grow vegetables for family consumption. The presence of home-grown vegetables might influence risk perception in each region.

The fourth objective is to compare the willingness to pay (WTP) for organic vegetables between the rural and the urban regions. We are interested in 1) estimating the average WTP for organic vegetables and 2) investigating how risk perception of vegetables and other factors can influence WTP for organic vegetables in each region. Survey data would be used separately for each subsample to estimate and predict WTP for a particular region.

Based on findings generated, policy implications that address current problems relating to risk perception and risk-reducing behaviour would be drawn.

1.4 Scope of this thesis

Consumers might be vulnerable from many aspects of food risk such as price risk (fluctuated price, high price), unavailability of food, limited access to food, food in poor quality (e.g., low nutrition food), and unsafe food. Among many aspects of food risk, we only focus on the safety of food, as food safety is the main concern in developing countries in South East Asia. Particularly in Vietnam, food access and availability have become less important. However, food safety presents a social and economic problem. In this thesis, when using the term "risk" or "food risk", we mean "food safety risk".

Purchasing and consuming unsafe food, consumers might suffer from several possible losses. Marketing researchers therefore, often consider consumer perceived risk as multi-facets of loss in a purchasing situation. For example, Yeung and Morris (2001) defined six components of perceived risk associated with the purchase of unsafe food, including physical, financial, time, social, performance, and psychological loss. Though we are aware of possible components of perceived food safety risk in previous marketing literature, in this thesis, we are only interested in the physical and psychological component of consumer perceived food safety risk. Physical component refers to consumers' judgment of health impact while psychological component implies their negative emotion from food consumption, such as worry and pessimism.

Consumer behaviour toward food safety risk is a broad research topic. Being aware of a risk associated with food, different consumers will respond differently. Some of them are risk-takers, being willing to accept the risk as it is while the majority of them are risk-averse, trying to lower the probability and the impact of the risk. Within the risk-averse consumer group, a wide range of risk reduction behaviour are well documented in previous literature. One of them is the avoidance or the reduction in consumption of affected foods (Schroeder et al., 2007, Grunert, 2005). Other behaviours during purchase might be evaluating food appearance, choosing well-known brands, buying food that has quality assurance, and are traceable (Yeung and Yee, 2003). In consumption, to eliminate the risk, consumers might take other precaution measures from storage, preparation, and cook of food (Redmond and Griffith, 2003b). Moreover, a proportion of consumers are interested in the self-provision of food and consider it a favorite risk reliever (Green et al., 2003). Among various behaviours mentioned above, in this thesis, we would focus on only three risk-reducing behaviours including traceable food purchase (chapter 2), vegetable consumption reduction (chapter 5), self-provision of food and vegetables (chapter 2, 4, 5), and willingness to pay for organic vegetables (chapter 6).

1.5 Contributions of this thesis

Through this research, we provide a better understanding of food safety risk perception. Earlier studies consider food risk information and trust as isolated factors affecting food safety risk perception. In chapter 3, we would investigate how institutional trust,

information about food incident, risk perceived of hazards, and risk perceived of common foods are linked together to shape the concern about food safety. Our study is the first attempt that explores such relationships.

This thesis provides the first extensive examination of regional disparities in risk perception and risk-reducing behaviour. It would highlight rural-urban differences in risk perception of food in general (chapter 4). Furthermore, the thesis investigates the diversity as well as similarity in the determinants of risk perception of vegetables (chapter 5) and willingness to pay for organic vegetables (chapter 6) between the rural and urban regions. The insight about rural-urban disparities in risk perception and risk relieving behaviour is vital to develop effective risk communication and marketing strategies that are suitable for each region.

The current study is the first attempt to examine the influence of various risk characteristics of hazards on risk perception of a particular food. We would underline how three risk characteristics (perceived knowledge, perceived control, perceived consequence) of four hazards (pesticides, heavy metal, GMO, bacterial) determine risk perception of vegetables (chapter 5). We uncover the significant influence of perceived consequence and perceived control. This has an implication for risk communication on food hazards in Vietnam.

This thesis provides several important policy implications for Vietnam. Based on the empirical evidence on the relationship among trust, risk information, and risk perception, the thesis suggests solutions for better risk communication and the improvement of trust to reduce food scares (chapter 3, 4). Furthermore, since rural and urban differences in consumer risk perception and preference for food safety exit, this thesis recommends the relevance of regional approach in food safety policy in Vietnam (chapter 4 to 6). This study also suggests the development of urban farming, as it helps reduce food safety anxiety in urban regions (chapters 4 to 6). From the findings on barriers to organic purchase, this thesis provides policy recommendations on the development of the organic market (chapter 6).

1.6 Thesis outline

This thesis consists of seven chapters. The next chapter (chapter 2) describes data collected through a consumer survey and three group discussions. Chapter 2 also presents a preliminary analysis of the data. Each of the next four chapters (3, 4, 5, and 6) is formed to serve a specific corresponding objective that is stated below.

Chapter 3 identifies the relationships among risk perception, trust, and information. Chapter 4 explores the differences in consumer assessment of food safety risk in general between the rural and urban regions. Also comparing across regions, chapter 5 focuses on risk perception of vegetables and its influence on vegetable consumption. Chapter 6 looks at the effect of risk perception and other factors on willingness to pay for organic vegetables, also taking into account rural-urban differences and similarities. These four chapters are a compilation of papers that have been published or submitted to international peer-reviewed journals. Hence, each chapter is presented as a complete paper that often has a separate introduction, method, results, discussions, and conclusions as standards of refereed journals.

The final chapter (chapter 7) provides general conclusions and policy implications. This chapter also outlines some limitations of this research, coupled with suggestions for future work.

CHAPTER 2: DESCRIPTION OF CONSUMER SURVEY

This chapter is based on:

Ha, T. M., Shakur, S. & Pham Do, K.H., 2020. Food safety in consumers' eyes and their consumption responses: evidence from Hanoi survey. Journal of Asian Business and Economic Studies. Under revision. Resubmitted.

2.1 Introduction

This study applies the explanatory sequential mixed method approach that involves 2 phases in data collection. The quantitative phase is conducted first then a qualitative phase is facilitated later to explain quantitative results (Creswell, 2013). In this research, quantitative data were obtained through a consumer survey while qualitative data were gathered from focus group discussions. We conducted the survey from February to April 2017 then carried out the preliminary analysis of data. The initial survey results were used to plan for three group discussions that were organised one month later. Both the survey and group discussions took place in Hanoi, Vietnam. Since risk perception is multidimensional and complex (Roosen et al., 2004, Vance et al., 2014, Slovic, 2016), the use of mixed method in this chapter and chapter 4 will enable us to explore this concept in more depth.

The study site of this research is Greater Hanoi. It was expanded in 2008 by merging the Old Hanoi with former Ha Tay province, Me Linh district of Vinh Phuc province, and 4 communes of Hoa Binh province. By 2017, Greater Hanoi has 12 urban, 17 rural districts, and 1 town with a total population of 7.654 million, of which 50.8% is rural people[2]. Having both rural and urban residents, Hanoi offers a complex mix of heterogeneous consumers, who are ideally suited for this research. A high level of economic development alongside with increasing food safety concerns would make Hanoi an interesting case to study about consumer perception of food safety risk and their risk-reducing behaviours.

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[2]: Data from Hanoi People Committee
http://thanglong.chinhphu.vn

The purposes of this chapter are to describe the data collection process and to present a preliminary analysis of data. The chapter is organised as follows: Section 2.2 describes the implementation of our consumer survey and three group discussions; section 2.3 illustrates research design and data source, section 2.4 demonstrates some primary analysis of the data. Through this analysis, we proposed an overview of consumer evaluation of food safety, their judgment of the risk associated with vegetables, and their response to the risk perceived from vegetables. The last section draws conclusions and policy implications.

2.2 Consumer survey and group discussion

2.2.1 Consumer survey

2.2.1.1 Survey sample

We selected 7 districts including 4 urban and 3 rural ones to conduct the survey. Rural and urban districts are defined by the Hanoi People Committee. Urban districts must have at least 90% of the population being non-farm labours and population density being 12 thousand people/km^2. Moreover, they must satisfy other criteria regarding economic and social development, infrastructure, and landscape for urban districts, as regulated by the Vietnamese government. Districts that do not meet the criteria above are classified as rural districts. Selected districts in this research are marked by red dots in Figure 1. These districts are diverse in history, social, economic development and geographical characteristics (Table 2.1).

Hai Ba Trung is one of the central, old and most wealthy urban districts. Thanh Xuan and Long Bien were formed later than Hai Ba Trung and a little bit further from Hanoi centre. Ha Dong is even further distanced and used to be a rural district, before being upgraded to an urban district in 2009. It is now one of the newest urban districts of Hanoi.

Chuong My, Dong Anh, and Gia Lam are representative for rural areas of Hanoi where the majority of the labor force is engaged in farming activities. Chuong My has joined Hanoi since 2008. Before, it belonged to the former Ha Tay province. Unlike Chuong My, Dong Anh is an old rural district that was formed in 1901. Differently, Gia Lam is

experiencing a more rapid urbanization process. This district has not only rural villages, where the majority of the population is engaging in farming and but also small towns with supermarkets, shopping centres, and residential blocks. For these characteristics, Gia Lam can be considered as a semi-urban district though; in fact, it is administratively classified as a rural district.

Table 2.1: Description of the study area and the number of observations by district

	Chuong My	Dong Anh	Gia Lam	Ha Dong	Long Bien	Thanh Xuan	Hai Ba Trung
Location	South East	North	West	South East	West	South East	Centre
Region	Rural	Rural	Rural	Urban	Urban	Urban	Urban
Foundation year	2008	1901	1954	2009	2003	1996	1961

Due to budget constraints, we applied quota sampling (Kothari, 2004). We predetermined a quota of 70 to 80 respondents to be taken from each selected district in order to obtain an expected total sample ranging from 490 to 560. There are two reasons for this choice. Firstly, this sample size is sufficient for Structural Equation Modeling (SEM) (chapter 3). The proposed SEM model has about 40 to 45 parameters to be estimated. Following the rule 10 observations/parameter (Kline, 2011), the sample size should be at least 450. Secondly, this sample size is also efficient for multiple regressions that will be employed in other chapters. Based on the proposed methodology and previous literature, it was expected that there would be 10 to 14 key independent variables per model for each rural and urban subsample. This brings to 20 - 28 predictor variables in total for the two regions. Schmidt (1971) recommended that the minimum number of subjects per predictor lies in the range of 15 to 20. Therefore, a sample ranging from 300 to 560 is required for this research.

With support from community leaders, oral invitations to take part in the survey were sent to local people who were the main food shoppers of the family, and at least 18 years old. Community leaders were heads of hamlets, civil groups, or residential blocks. In each district, agreed shoppers of varied income and age categories were selected under the consultancy of community leaders. We yielded 515 questionnaires in total (245 rural and 270 urban). However, 17 questionnaires (15 from the rural, 2 from the urban region) were excluded from the analysis because of missing data and inconsistent responses. Finally,

we achieved 498 validated survey questionnaires that comprise 230 ones from the rural and 268 from the urban area.

It should be noted that quota sampling is a non-random sampling. Sampling bias, therefore, might be an issue though we have tried to eliminate this bias by selecting respondents varying in income, age, and from representative districts. With a non-random sampling, survey results are unable to generalise to the whole population of Vietnam. Research findings can generalise to only provinces that have a high level of economic development but considerable concerns about food safety.

Figure 2.1: Hanoi map and study area

We conducted a face-to-face survey using paper-based questionnaires, in which interviewers asked questions and recorded answers. A face-to-face survey has some advantages. Firstly, it can facilitate a high degree of interaction between interviewers and

respondents. This, thereby, would increase the quality of survey data and allow researchers to have more control over the measurement process. Secondly, interviewers can assist by clarifying, probing, and encouraging respondents to provide complete and accurate responses (Groves et al., 2011). Thirdly, this type of interview also increases the richness of information collected as it allows interviewers involved in this research to record supplementary explanations from the respondents.

However, face-to-face interviews might be prone to social desirability bias. This bias refers to the tendency that respondents choose answers that are believed to be more socially desirable or acceptable rather than the ones that reflect their true thoughts or feelings (Grimm, 2010). To eliminate this bias, we recruited interviewers who are experienced in survey methods. Moreover, essential training on the survey questionnaire was provided to all interviewers involved in the research. These interviewers include the author of this doctoral dissertation and other experienced researchers from the Faculty of Economics and Rural Development, Vietnam National University of Agriculture.

We conducted interviews at the respondent's home with appointments in advance to create a comfortable environment. On average, the interview time for each respondent is in the range of 25 -30 minutes.

2.2.1.2 Survey questionnaire

Since most of the questions are not sensitive, closed-ended questions with all reasonable possibilities to explicit response options were utilised, as suggested by Groves et al. (2011). We tried to make question items specific and easy to understand by respondents. The detailed questionnaire is presented in the Appendix.

We conducted a pilot study on 28 respondents to pretest the initial questionnaire. The pilot study revealed some issues relating to wordings, information flow, selection of response options for multiple-choice questions, and measurement scales. Respondents in the pilot study felt uncomfortable with either 5 point or 7 point-Likert scales. We, therefore, used the 10-point scale to measure items relating to perception. This scale made respondents feel comfortable to answer, as it reminded them of the academic grading system of 10 point-scale in Vietnam that they were familiar with.

The final questionnaire has 4 blocks (see the Appendix). The first block conveys information on risk perception of food in general, risk perception of several selected common food products, trust in responsible institutions, food safety information acquisition, and personal experience with food poisoning. The second block captures perceived knowledge, perceived control, and perceived consequence of selected hazards associated with vegetables, and the influence of risk perception on vegetable consumption. The third block comprises items on willingness to pay for organic vegetables, perceived values of organic vegetables, and trust in organic labels. Lastly, the fourth block conveys socio-economic information of the respondents and their households.

2.2.1.3 Demographic profile of the surveyed respondents and their households

The target respondents of the survey must be at least 18 years old and be principal meal planners of households. There are some reasons for this choice. Firstly, principal meal planners play a role as the family's gatekeepers to select and determine the content, preparation, and consumption of food in households (Lin, 1995). Thus, they are able and have incentives to provide informative responses relating to perception, WTP and food consumption of the household. Besides, since their perception can affect the health of the elderly and children in the family who are more vulnerable to risk, primary meal planners might require a higher level of food safety to protect themselves and their families. Hence, it is important to identify these groups who have a greater appreciation for food safety.

Table 2.2 illustrates the demographic characteristics of the surveyed respondents. The majority of the respondents are female, as shopping and cooking are mainly women's responsibilities in Vietnam. Household food shoppers were relatively young. Their mean age was 42, and nearly 60% of them were between 30 to 49. Since Hanoi is one of the education centres of the country, respondents' education level was quite high. About half of them had a university degree. Rapid economic development means a better income for Hanoi residents. Respondents' average monthly income was 7.5 million VND (USD 333), higher than the national level (205 USD). The mean household size was 4.4, suggesting that most of the surveyed households were nuclear families of two generations of parents and children. Noticeably, nearly 60% of the families are growing vegetables to serve family needs due to food safety anxiety.

Table 2.2: Background information on respondents and their households

Features	Frequency	%
1. Household information		
Number of elderly		
0	314	63.1
≥ 1	184	36.9
Number of children (under 12 years old)		
0	122	24.5
1-2	351	70.5
≥ 3	25	5.0
Household size (number of family members)		
1-2	30	6.0
3-4	276	55.4
≥ 5	192	38.6
Monthly expenditure (Million VND)		
<5	106	21.3
From 5 to less than 10	163	32.7
From 10 to less than 15	148	29.7
From 15 to less than 20	42	8.4
≥ 20	39	7.8
Growing vegetables	298	59.8
2. Respondents' characteristics		
Female	435	87.3
Education		
No schooling	8	1.6
Primary school to vocational school	227	45.5
University and postgraduate	263	52.9
Monthly income (million VND)		
<5	119	23.9
From 5 to less than 10	253	50.8
From 10 to less than 15	85	17.1
≥ 15	41	8.2
Age		
≤ 29	66	13.3
From 30 to less than 39	207	41.6
From 40 to less than 49	86	17.3
From 50 to less than 59	84	16.9
≥ 60	55	11.0

Note: 23 thousand VND = 1 USD

2.2.2 Focus group discussions

The purpose of focus group discussions was to obtain a further explanation of the survey results by listening to consumers' own words. Some studies on food safety risk perception have employed this type of data collection (Green et al., 2003, Yeung and Yee, 2003) because of its advantages. Focus group discussions enable researchers to explore new topics and obtain insights into complex issues (Redmond and Griffith, 2003a). Since risk perception is a complex construct that is influenced by social, cultural, and psychological factors, the use of focus group discussions to complement the surveyed data in this thesis is useful.

Three focus group discussions were facilitated in Dong Anh, Gia Lam (rural districts), and Thanh Xuan (urban district) during May 2017. Since our hypothesis is the disparity in risk perception and risk-reducing behaviour between rural and urban consumers, group discussions were conducted in both the rural and urban regions to gain further insight into this issue. Group discussion participants were those who previously engaged in the survey. To select them, the survey questionnaire for these three districts had a question asking whether the respondent wants to participate in the focus group discussions afterward. During the survey, interviewers made a list of agreed respondents for each district above. From these lists, we selected 8 participants for each district

According to Ritchie et al. (2013), either a very heterogeneity group or a very homogeneity group can be problematic for group discussions. Therefore, in each group discussion, we balanced the diversity, as well as homogeneity of group participants. We selected participants living in the same district but varying in income and employment. The information relating to income and the residential location was distracted from the survey data while employment information was gathered from community leaders. All of the discussions were tape-recorded, transcribed, and then analysed.

Group discussions focused on some themes including consumer feeling about food safety, vegetable safety, and the reasons for their risk rating of some selected common foods. Since the survey result showed a considerable level of food safety worry and a very low level of trust, group discussion later explored in consumers' eyes, which type of food was

safe/unsafe and whom consumers trusted/distrusted. Group discussions also identified consumers' responses to perceived risk and the reasons behind their responses.

2.3 Research design and data source

Table 2.3 illustrates the research design and data source for the next four chapters. Chapter 3 introduces and develops some core constructs that would be used later in the remaining chapters. Chapter 4 combines both qualitative and quantitative data while the remaining chapters use quantitative data only. Rural-urban comparisons are proposed in chapters 4, 5, and 6.

Table 2.3: Research design and data source

Chapter	Research topic	Design		
		Qualitative	Quantitative	Compare between regions
3	Linkages among risk perception, trust, and food risk information	No	Consumer survey (n=498)	No
4	Perception of food safety risk in general	3 focus group discussions	Consumer survey (n=498)	Yes
5	Perception of vegetable risk and its impact on vegetable consumption	No	Consumer survey (n=498	Yes
6	Willingness to pay for organic vegetables	No	Consumer survey (n=498	Yes

2.4 Data analysis from the consumer survey and group discussions

2.4.1 Overview about consumer evaluation of food safety

Food safety is a real concern of Hanoi people. For the whole sample, the safety of current food was evaluated poorly, between "a little bit worse" and "much worse", as compared to that in the past (Table 2.4). The level of worry was also substantial with a mean score of 3.98 (worry very much). These two indicators were not statistically significantly different between the rural and urban regions, indicating that the concern about food safety spread to the whole population. In group discussions, most of the respondents

expressed themselves as "overly anxious" about food safety because of the fundamental role of food and the presence of various hazards in the current food.

Table 2.4: Respondents' evaluation of food safety by region

Indicators	Whole sample (n=498)		Rural (n=230)		Urban (n=268)	
	Mean	SD	Mean	SD	Mean	SD
The safety of today food as compared to 10 years ago[1]	4.64	0.70	4.70	0.59	4.59	0.77
The level of worry about food safety today[2]	3.99	0.93	4.01	0.91	3.96	0.95

Note: [1]: answers are coded from 1(much better) to 5(much worse)

[2]: answers are coded from 1(no worry at all) to 5(extremely worry)

"*We are all worried (about food safety), right? But we all have to eat*." (Urban group discussion)

"*Polluted water, polluted air makes food unsafe*." (rural group discussion)

"*Too many processed food, frozen food, and Chinese food."* (rural group discussion)

"*Pesticide, preservatives, nitrates, growth hormone, etc…. too many things are in the food now."* (Rural group discussion)

Respondents had different attitudes toward the risk perceived. Some were extreme risk-averse individuals. As risk attitude determines risk behaviour (Cho and Lee, 2006), their fear of food safety risk resulted in their strong self-protection actions:

"*I am very worried. I don't dare to buy food from wet markets because I am afraid the food there is fake and untraceable. So, I mainly grab the food from my mom in my hometown*" (Urban group discussion).

In contrast, many consumers were risk-takers; they were aware of food risks, but they had to accept the risks, as they had no choice. Their common response is "*I am very worried (about food) but I have to live with risk*" (Urban group discussion).

Consumers' pessimism over food safety revealed through the survey led us to a further investigation on which type of food was believed to be safe by group discussion participants. Very often, the majority of participants cited that homemade food was the best. For example, one respondent said that she just trusted in the food produced and cooked by herself and only her homemade food was completely safe. These results reflect those of Green et al. (2003)**,** who also found that homemade food was the most preferable. However, we found a bias in consumer perception since homemade food is not always safe. We observed that several respondents in Gia Lam district grew vegetables for family consumption without any pesticides and chemical fertilizers but using contaminated water. Their home-grown vegetables, therefore, was not completely safe as their belief.

Since home-grown food just contributed a very marginal share of total food consumption of the family, the majority of households surveyed still relied on marketed food. Local food, food from rural areas, food in supermarkets and safe food stores are marketed foods that were thought to be relatively safe. As all of these types of food are traceable, this finding suggests that food traceability was an important purchasing criterion. Interestingly, we found that in the context of increasing food safety anxiety, there was a common perception that food from the rural area was safer. This finding is comparable to that of Gong and Jackson (2012)**.** The authors found that the rural region in China was highly acknowledged by its residents because of the capacity to produce safer food, despite a traditional notion that the rural region was backward as compared to urban areas. This belief also exists in Vietnam as there are rural-urban gaps in economic and social development. However, the rural region, thanks to the capacity in supplying safer foods, has propositioned.

"*I just buy vegetables from my neighbors in my home village though the price might be triple than that in the market here. I just trust in the food of rural people. Rural food is safer, fresher and more delicious*." (Urban group discussion)

"*I just buy (food) from 5 people at Dang Xa market. They are local people, just selling a little bit after supplying enough for their family*." (rural group discussion)

"*Fresh food in supermarkets and safe food stores are safer than those in the wet market, but not absolutely safe.*" (Urban group discussion)

Table 2.5: Trust in responsible institutions

Trust in	Whole sample (n=498)		Rural (n=230)		Urban (n=268)	
	Mean	SD	Mean	SD	Mean	SD
Central government	4.11	2.95	5.28*	3.15	3.11*	2.34
Local government	3.56	2.54	4.32*	2.75	2.91*	2.14
Farmers	2.77	2.18	3.16*	2.44	2.44*	1.87
Food traders at wet markets	2.42	1.85	2.77*	2.13	2.13*	1.52
Supermarkets	4.46	2.44	4.50	2.66	4.43	2.25

Note: Answers are coded from 1 (don't trust at all) to 10 (completely trust)
**: significant at 5% level, using a two-tailed test*

It is important to examine trust in responsible institutions, as trust might be associated with risk perception. For the whole survey sample, trust was very low, especially trust in farmers (mean score of 2.44) and trust in food traders at wet markets (mean score of 2.77). The finding from group discussions complemented the finding from the consumer survey. Very often, group discussion participants expressed that they did not hold the trust in any organisation or person. Particularly, the distrust in farmers and food traders leads to a perception that food in the wet market was unsafe.

"*Buying untraceable food in the market is very dangerous. Sellers said their food is safe although farmers just have sprayed pesticides and grew regulators. All of them are profit-oriented*." (Urban group discussion)

The group discussions then explored who gained the trust of consumers. It was evident that consumers trusted themselves the most, then their relatives and friends, local farmers, and regular vendors whom they had established a relationship for a long time.

"*I can evaluate food safety through my cooking experience. I just trust in myself. Government, supermarkets, farmers, I don't trust any of them.*"(Rural group discussion)

"*I live in Gia Lam but have to shop weekly for fresh food at Hang Be market (at Hanoi centre). I only buy from my regular vendors whom I have known for long since I was a child. I feel the food there is more delicious and safer.*"(Rural group discussion)

"*I only buy vegetables from local people who sell vegetables in a small quantity. These people grow vegetables for their family eating and just sell oversupply amount. Because they grow vegetables for their family need, their vegetables are safe.*" (Urban group discussion)

Comparing across regions, the trust level of rural consumers was higher than that of urban people. The mean score of most of the trust indicators was statistically different between the two regions, using the two-tailed test. Group discussion found that stronger social ties in the rural area and less information acquisition about food incidents spread in the rural region (Table 2.6) resulted in a higher level of trust of rural respondents.

Table 2.6: Access frequency to food incident information

Food incident heard[1] from	Whole sample (n=498)		Rural (n=230)		Urban (n=268)	
	Mean	SD	Mean	SD	Mean	SD
TV	3.92	0.83	3.81*	0.80	4.01*	0.84
Social media	3.34	1.27	2.83*	1.35	3.78*	1.02
Relatives	3.68	0.93	3.54*	0.91	3.81*	0.94

[1]: answer are coded from 1(never) to 5 (very regular)
**: statistically significantly different at 5%*

Respondents observed or heard about food incidents frequently. Among various information platform providing food safety information, Television is the most common in both regions. Social media such as Facebook was also an important source to access food safety information, as internet access is relatively easy, even in the rural region. However, there is a disparity in information acquisition between the two regions. Information about food incident obtained by rural people was less frequent than that received by their urban counterparts.

2.4.2 Consumer evaluation of food safety risk of vegetables

Rural subjects perceived a lower level of vegetable risk and were less worried about vegetable safety than urban consumers were. The mean values of the two indicators in Table 2.7 are statistically lower in the rural region. We will later discuss the reason for this disparity in chapters 4 and 5.

Table 2.7: Risk perceived of vegetables

	Whole sample (n=498)		Rural (n=230)		Urban (n=268)	
	Mean	SD	Mean	SD	Mean	SD
Risk perceived of vegetables	7.13	2.01	6.77*	2.11	7.45*	1.86
Level of worry about vegetables consumed	5.72	2.62	5.39*	2.79	6.01*	2.45

Note: Answers are coded from 1 (don't worry at all) to 10 (extremely worry)

**: significant at 5% level, using a two-tailed test*

Vegetables can be contaminated by several hazards such as pesticides, heavy metals, harmful bacteria (e.g., *E. coli*). In addition, the impact of GMO technology on health and the environment is a controversial issue, causing concerns worldwide. In order to gain an in-depth insight into consumer evaluation of food safety risk of vegetables, we analysed how surveyed respondents viewed these hazards (Table 2.8).

In general, respondents believed that they posed a very low level of knowledge as well as control over all selected hazards. The mean perceived knowledge and control across hazards for the whole sample were just under the neutral level (from 3 to 5 out of 10). The mean perceived consequence across all the hazards was in the range from 7.3 to 8.2 for the whole sample, suggesting that respondents viewed these hazards as highly dangerous. We found significant correlations among perceived knowledge, perceived control, and perceived consequence of the same hazard. We argue that consumers viewed hazards associated with vegetables dangerous because consumers thought that they did not have sufficient knowledge as well as control over these hazards.

Comparing among different hazards, chemical hazards (pesticides, heavy metals) were thought to be riskier than bacterial hazards. Perhaps, this is due to a perception that

chemical hazards are hard to control, have severe consequences and cause long term effects (Kher et al., 2013).

Table 2.8: Perceived knowledge, control, and consequence of potential hazards in vegetables

	Whole sample (n=498)		Rural (n=230)		Urban (n=268)	
	Mean	SD	Mean	SD	Mean	SD
1. Perceived knowledge[1] of						
Pesticide residue	5.167	2.524	5.091	2.682	5.231	2.383
Bacterium contamination	4.899	2.335	4.756	2.383	5.022	2.290
Heavy metal contamination	4.197	2.390	3.974*	2.403	4.388*	2.367
GMO	3.378	2.415	3.130*	2.410	3.590*	2.404
2. Perceived control[2] over						
Pesticide residue	3.454	2.193	3.748*	2.317	3.202*	2.051
Bacterium contamination	4.936	2.566	4.735	2.482	5.108	2.628
Heavy metal contamination	2.860	2.015	3.061*	2.064	2.700*	1.968
GMO	2.700	2.105	3.087*	2.280	2.366*	1.884
3. Perceived consequence[3] of						
Pesticide residue	8.205	1.980	8.130	2.052	8.269	1.918
Bacterium contamination	7.281	2.198	7.117	2.340	7.421	2.062
Heavy metal contamination	7.910	2.093	7.583*	2.295	8.190*	1.86
GMO	7.411	2.515	7.009*	2.736	7.758*	2.258

**: statistically significantly different at 5% using independent sample t-test*

[1,2,3]: answers are in 10 point- scale from 1 to 10

Comparing cross regions, perceived knowledge of hazards of rural respondents was lower than that of urban residents. Rural people reported a higher level of control over all hazards, except bacterial contamination. As a result, they expressed a lower level of consequence across the hazards, as compared to their urban counterparts. The mean scores of perceived knowledge, control, and consequence for heavy metal and GMO were

statistically significantly different between regions, suggesting that consumers across regions viewed these hazards differently.

2.4.3 Consumers' responses to food safety risk perceived from vegetables

Being aware of potential risks associated with vegetables, consumers reacted to reduce such risk. Table 2.9 shows the self-reported share of vegetable consumption from different sources of surveyed households. Vegetable sources varied, and the proportion of the vegetable consumed from each source was different between the regions. Large standard deviations, as shown in Table 2.9, reflect a large amount of variation in the proportion of vegetable consumption from a particular source in the surveyed sample.

Table 2.9: Percentage of household's vegetable consumption by source among regions

% of vegetable	Rural (n=230)		Urban (n=268)	
	Mean	SD	Mean	SD
Offered by relatives/friends in rural regions	6.54*	12.59	13.56*	21.03
Are home-grown	44.11*	33.6	12.24*	24.17
Purchased from supermarkets and safe food stores	2.54*	8.19	17.79*	25.15
Purchased from wet markets	46.06*	32.19	50.52*	34.41
Purchased from home village	0.73*	5.59	5.81*	15.67

**: statistically significantly different at 5%*

Holding the perception that home-grown vegetables being the safest, when the land was available, growing vegetables for family consumption was the most favourable strategy of consumers to ensure food safety. Land availability was not a big issue in the rural region. Therefore, most of the rural households were able to grow vegetables for their own family need. That is why home-grown vegetables occupied 44% of the total vegetable quantity consumed by an average rural household. In contrast, in the urban region, the land was a scarce resource. Only a smaller percentage of urban households, therefore, could grow vegetables. On average, home-grown vegetables contributed 12% of total family consumption in the urban region.

Since the volume of home-grown vegetables was insufficient for most of the families, urban consumers seek other available solutions to reduce risk from vegetables such as

sourcing from relatives and friends in rural districts, purchasing from rural villages. It is worth noting that many Hanoi people migrated from rural regions. Hence, these people somewhat connect with the rural region where their friends and relatives are living. When food from the rural region was perceived to be safer, getting food from rural people became a common risk-reducing strategy of urban food shoppers. In total, about 20% of vegetables consumed by the family came from the rural region (purchased from home villages and offered by relatives and friends in the rural region). Through the exchange of vegetables, the social linkage between rural and urban people enhances. Furthermore, supplying safe food for the urban region means that rural farmers can capture a better return from a higher price. This finding provides evidence about the social and economic linkages between rural and urban regions.

"*I live near Hoan Kiem Lake (a central district of Hanoi) but rarely buy fresh food from either supermarkets or wet markets here. Every week, my mom, from Hung Yen (province) send me a big package of food by bus. Some are grown or raised by her; some are from her neighbours. All of these foods are safe, of course*." (Urban group discussion)

Another strategy to eliminate the perceived risk is purchasing vegetables from supermarkets or safe food stores. This is due to the perception that fresh food in supermarkets was safer than those in the wet market. However, the high price of fresh food in supermarkets is a constraint to many food shoppers, particularly low-income ones. As shown in Table 2.9, about 18% of the vegetable volume was purchased from supermarkets by urban households. The corresponding figure for rural households was just nearly 3%. This difference reflects the absence of supermarkets and a lower purchasing power in rural regions of Vietnam.

For the middle-income group, buying organic vegetables was one of the risk relievers. Survey data revealed that only 35.3% of respondents used to purchase organic vegetables at least once during the last 2 years. However, most of them (60.2%) were infrequent organic purchasers. Group discussions found that in most of the families, organic vegetables were for children only, in the small quantity.

In the urban household, all vegetable sources are quite equally important (Table 2.9). Perhaps, perceiving a higher level of vegetable risk, urban households were forced to

diversify their vegetable sources. In the rural household, vegetables mainly came from the wet market or were grown by the household. This is due to the absence of supermarkets and the availability of agricultural land in the rural region.

The percentage of vegetables bought from the wet market was the highest for both regions, occupying from 46 to 50% of the total volume of vegetables (Table 2.9). Though consumers perceived that fresh food in the wet market was unsafe, this type of market still attracted the majority of the consumers across regions because of its convenience, lower price, and the freshness of the products. When vegetables at the wet market was a buying choice, to address food safety issues, consumers selected products from local people, regular vendors, and carefully evaluated product appearance.

2.4.4 Projected consumption of vegetables if food safety issues are addressed

To project the growth in demand for vegetables if the food safety is controlled, we asked consumer the scenario "If the vegetable safety is ensured, meaning that all vegetables at the market are safe to eat does your family intend to eat more vegetables? And if yes, how much of vegetables does your family will increase?" About 70% of households will increase the consumption of vegetables if this is a case. Furthermore, vegetable consumption is expected to increases by about 20% per household, and this can be seen at the maximum level of vegetable consumption (Table 2.10). Noticeably, the percentage of households reporting an increase in consumption and the percentage of vegetable consumption increase per household was higher in the urban region. Obviously, such a growth in consumption can be considered as a great benefit of food safety improvement.

Table 2.10: Changes in the household's consumption of vegetable if food safety issues are addressed

Indicators	Whole sample	Rural	Urban
% of households will increase vegetable consumption	68.5	66.1	70.5
% of vegetable consumption will increase per household	21.3	19.37	23.09

We further looked at the association between risk perception and the increase of vegetable consumption when food safety is controlled (Table 2.11). The means of risk perception and the increase in vegetable consumption were positively related. One way ANOVA test

and Post Hoc Test show that the mean risk perception is statistically significantly different between groups, suggesting that consumers who hold a higher level of risk perception would have a higher level of vegetable consumption increase if food safety is well managed. This finding again implies the benefit of enhancing food safety: that is the increase in domestic demand.

Table 2.11: Mean of risk perception and the increase of vegetable consumption

Increase in vegetable consumption	N	Mean risk perceived of vegetable	SD	SE	95% Confidence Interval for Mean		Min	Max
					Lower Bound	Upper Bound		
1.00	237	2.567	1.109	0.072	2.427	2.711	1.00	5.00
2.00	161	3.012	1.037	0.081	2.851	3.173	1.00	5.00
3.00	67	3.179	1.242	0.151	2.876	3.482	1.00	5.00
4.00	32	3.625	1.070	0.189	3.239	4.010	2.00	5.00
Total	497	2.863	1.144	0.051	2.762	2.964	1.00	5.00

Notes: increase in vegetable consumption=1(increase less than 20%);=2 (increase from 20% - 39%; =3 (increase from 40% - 59%);= 4(increase > 60%)

2.5 Conclusions

This chapter illustrates the data collection process that begins with a survey on 498 principal food shoppers of households and proceeds with three group discussions in Hanoi, Vietnam. Hanoi experienced rapid economic development but ensuring food safety is a big challenge, and the rural-urban gap is likely to be widened.

Food scares spread widely in Hanoi. We found that rural, as well as urban consumers, were very pessimistic about the safety of current food. Consumers perceived that most of the food was unsafe, leaving only some food sources that were safe. Consumers ranked homemade food the safest, then locally produced food, followed by food sold in supermarkets. Consumers' safety perception of homemade food is biased since homemade food is not always safe. Consumers' preference for local food, food from rural areas is evidence that the rural region now is widely acknowledged because of its ability

to supply safe food. This suggests a chance for local farmers to expand the production of safe food to serve their wealthy urban counterparts.

With a high level of risk perceived from vegetables in mind, consumers seek risk-reducing solutions. Growing vegetables was a favourable risk reduction behaviour of not only rural but also urban consumers who had very limited or no farming land. However, since home-grown vegetables were insufficient, other risk relievers were adopted such as purchasing from local people, regular vendors, from relatives and friends in the rural region, buying safe vegetables including organic vegetables from supermarkets and safe food stores. These buying behaviours suggest that food traceability seems to be important criteria to evaluate the safety of vegetables.

We raised the question on what the government should do to support consumers. Urban consumers are now increasingly interested in sourcing safe food from rural regions. However, a very high transportation cost is one key barrier that hinders food trade between the rural and urban regions of Vietnam. Hence, transportation costs should be reduced to stimulate agricultural trade across regions.

This chapter confirms the role of the traditional food chain, such as the wet market. The majority of the consumers have a habit of purchasing fresh food in the wet market. Employing trust in regular vendors in this market helps consumers reduce food safety anxiety. Therefore, wet markets need to be maintained besides the development of modern food retailers such as supermarkets. Furthermore, a very high level of pessimism about food safety also means that in order to improve consumer confidence in food, the Vietnamese government needs to demonstrate greater efforts in managing food safety.

This chapter illustrates a preliminary analysis of both quantitative and qualitative data. The next chapter (chapter 3) uses quantitative data to depict the relationship among core constructs: risk perception, trust, and risk information.

CHAPTER 3: LINKAGES AMONG RISK PERCEPTION, TRUST AND INFORMATION

This chapter is based on:

Ha, T. M., Shakur, S. & Pham Do, K.H., 2020. Linkages among risk perception, trust, and information: Evidence from Hanoi consumers. *Food control*. Volume 10.

3.1 Introduction

Food safety has emerged as a social, economic, and political issue in Vietnam. A high proportion of food is regarded as unsafe by Vietnamese consumers (World Bank, 2017). Many food hazards such as pesticide residues in vegetables, preservatives in fruits, and growth hormones in livestock products are common fears of the majority of them. Poor food safety practices in every stage of the food chain led to the high prevalence of contaminated food and foodborne outbreaks. Moreover, such issues are often exploited by the media, aggravating food scares. Having observed a series of food scandals reported by media adds fuel to consumer concerns about food safety.

There is ample evidence worldwide to show that food safety risk perception is a key driver of food buying decisions (Frewer et al., 2007). Safety perception acts as a 'sleeping giant' that can cause sweeping effects during the crisis period (Grunert, 2005), resulting in a dramatic drop in consumption. This effect was also recorded in Vietnam. After the media reported pig diseases, a majority of consumers cut pork consumption and switched to other meat categories (World Bank, 2017). Food safety concerns also prompt consumers to switch to imported products that are more affordable and perceived to be safer than domestically-produced food (Nguyen-Viet et al., 2017). Amplified risk perception leads to unnecessary precautions of consumers, causing welfare loss.

Being aware of the economic and social impact of food safety risk perception, studies on food safety risk perception in Vietnam have recently gained much attention from researchers. Figuié et al. (2004) examined the risk perception of various food products and risk-reducing practices of urban consumers in Hanoi. Van Hoi et al. (2009) discussed consumer distrust on the safety of fresh vegetables. Also focusing on fresh vegetables, Wertheim- Heck et al. (2014) explored whether the concern about food safety drive food

purchasing practices and the utilization of risk reduction strategies. At a broader level, Nguyen-Viet et al. (2017), in their policy discussion, elaborated on the drivers of risk perception and the failure of risk communication in Vietnam. However, these studies limit their focus on one level of risk perception, either product or general level. None of these studies comprehensively investigate the relationships among risk perception, trust, and risk information.

Research conducted outside Vietnam on food safety risk perception has predominantly focused on the influencing factors of risk perception (Lobb et al., 2007, Liu et al., 2014, Rutsaert et al., 2013b). Many studies noticed that trust and risk information were some of the key drivers of risk perception. A few studies, such as Lobb et al. (2007) have examined the associations among all three variables: trust, information, and risk perception. Other studies have investigated risk perception through one of three levels: the hazard level (Rutsaert et al., 2013a, Kher et al., 2013), the product level ((Lobb et al., 2007), or general level (Liu and Ma, 2016, Liu et al., 2014). Risk perception at the hazard level refers to consumer evaluation of their health risk from exposing particular hazards through food consumption. Risk perception at the product level presents their assessment of the health risk from consuming specific food products. Risk perception at a general level is defined as consumer judgment of the safety risk of food as a whole. While there might be linkages among risk perception at three levels above, studies on these links are still lacking. The associations among three levels of risk perception, trust, and risk information remain unexplored.

To fill the gaps above, this chapter empirically investigates the relationships among information acquisition about food incidents, institutional trust, risk perception of hazards, risk perception of common food products, and risk perception of food in general. We applied Structural Equation Modelling (SEM) to reveal the relationship among these variables.

In this chapter, “risk perception of food in general” was measured by consumers’ worry about food safety. This term is thus used interchangeably with other terms that convey consumers’ feeling such as “food safety concerns” and “food safety worries”.

3.2 Conceptual framework

3.2.1 Conceptual framework

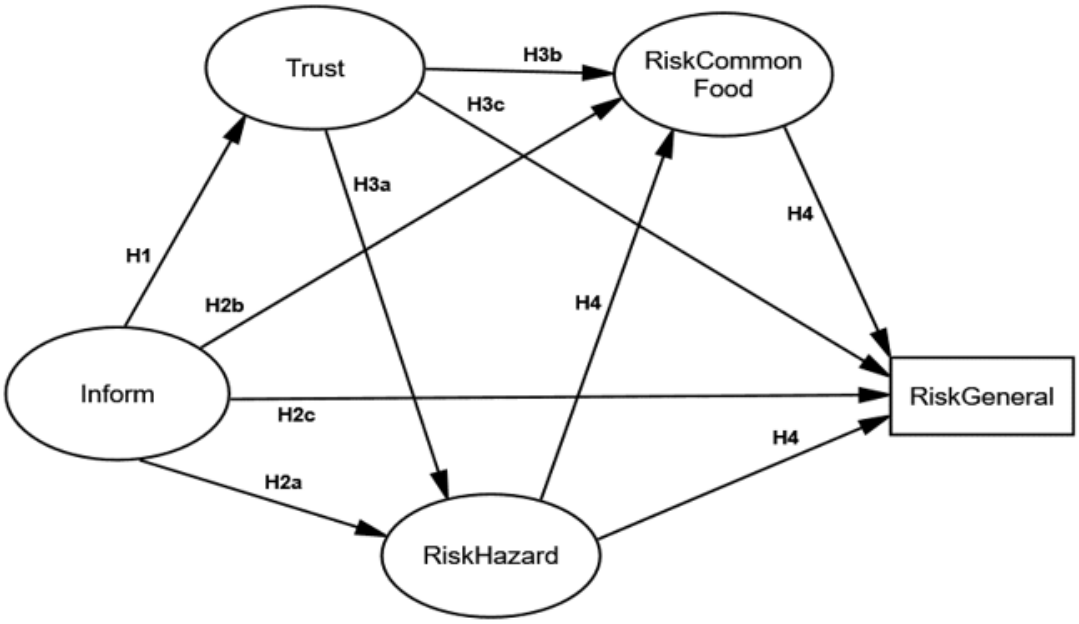

Figure 3.1: Conceptual framework

Note: An oval shape represents a latent variable while a rectangle shape illustrates an endogenous observed variable. Each arrow presents one direct effect. H1 to H4 denote hypotheses 1 to 4 that are direct effects.

The conceptual framework illustrated in Figure 3.1 depicts 5 core concepts of this chapter: 1) information acquisition on food incidents (Inform), 2) institutional trust (Trust), 3) risk perception of food hazards (RiskHazard), 4) risk perception of common foods (RiskCommonFood), and 5) perception of food safety risk in general (RiskGeneral) (Figure 3.1). The last three concepts respectively present the hazard level, product level, and general level of food safety risk perception. Each concept is related to others through either direct or indirect effects. The relationship between each pair of concepts would be illustrated, followed by corresponding hypotheses.

3.2.2 Direct effects

From Information to Institutional Trust

Institutional trust refers to the trust that consumers place on the government and actors in the food chain. According to Chryssochoidis et al. (2009), trust in institutions varies, depending on how a given risk is managed or communicated. Specifically, the content and the amount of information about food risks shape public trust. Yee et al. (2005) postulated that during food scares, amplified bias information that consumers receive would destroy their trust. Upon receiving information about food incidents frequently, consumers' trust in the institutions will be eroded. Thus, we proposed the hypothesis below:

H1: Information acquisition of food incidents will have a negative effect on institutional trust.

From Information to each level of risk perception

Risk perception of hazards is formed through the information that consumers obtained from various sources. Media is the most powerful channel that shapes the way consumers assess food hazards. The bad news about food safety, including food hazards spread by the media, has played a role in developing a small risk into a major food scare (Rutsaert et al., 2013a). Moreover, consumers' evaluation of risks from hazards might be dependent on the information from their family and friends, who they trust (Bruhn, 2017).

Frequent access to food safety incidents heightens risk perception of common foods that are important in the Asian diet and often consumed daily. In Asian developing countries, the perishability of common foods such as vegetables, fruit, meat, and fish embodies a high level of risk since they are often sold at wet markets where food hygiene is lacking. Unsurprisingly, many food safety incidents are reported about them. Owing to the positive association between risk information and risk perception (Wachinger et al., 2013), such negative news will lead to the perception that all food, including common foods is unsafe. All of these lead us to formulate the second hypothesis:

H2: Information acquisition of food incidents will have a positive effect on a) risk perception of hazards, b) risk perception of common foods, and c) risk perception of food in general.

From Trust to each level of risk perception

Consumers are not always capable of assessing the risk of food hazards. They rely instead, on institutions that manage the hazards (Lobb, 2005). Thus, when placing trust in these institutions, consumers will feel that the risks associated with hazards are not serious. This also happens with risk perception at the product level and general level. Lobb et al. (2007) reported that trust in public authorities lessened the risk perceived of chicken meat. De Jonge et al. (2007) found that trust reduced consumers' pessimism about food safety. These findings lead to the hypothesis as follows:

H3: Institutional trust will be negatively associated with a) risk perception of hazards, b) risk perception of common foods, and c) risk perception of food in general.

The linkages among different levels of risk perception

Previous studies have established a relationship between the risk perception at the hazard level and the product level. The belief that pesticide is the top dangerous hazard makes vegetable risky food in the consumers' eyes in China (Cheng et al., 2016). In Vietnam, Figuié et al. (2004) found that risk perception of vegetables, meat, fruit, and fish was influenced by the fear of pesticides, preservatives, and growth promoters.

Risk perception of common foods and risk perception of hazards both affect the way consumers assess the safety of food in general. Brewer and Prestat (2002) revealed that consumer anxiety about food safety was positively related to the risk perception of chemical and microbiological hazards. In developing countries, where food safety management is largely ineffective, consumers might perceive the danger from various hazards and common food categories. They will form a perception that food overall is unsafe to eat. Based on the discussions above, the hypothesis H4 is formulated:

H4: There will be positive relationships among risk perception of hazards, of common foods, and of food in general

3.2.3 Indirect effect

Effect of trust on risk perception of food, in general

Trust in institutions helps lower the risk perceived from some particular common foods such as chicken (Lobb et al., 2006), and beef (Schroeder et al., 2007). Believing that common foods become safer, consumers will feel a reduced risk associated with food overall. This leads to the following hypothesis:

H5: Institutional trust will indirectly affect perception of food safety risk in general through risk perceived of common foods.

Effect of information on risk perception of food in general

The more frequently consumers heard about food safety incidents, the lower level of trust they would hold. Moreover, such incidents also level up risk perception of common foods due to the widespread effect of risk perception, as mentioned by Grunert (2005). Similarly, media attention to food incidents increases the risk perception of hazards. Observing all of these issues, consumers would perceive that the food overall is at a high level of safety risk. We hypothesize that:

H6: Information acquisition about food incidents is likely to cause indirect effects on risk perception of food in general.

Demographic variables were excluded in our framework as they are less coherent from a theoretical perspective. When treated as independent variables, they are often insignificant or inconsistent across similar studies conducted in developing countries (Liu et al., 2014, Wang et al., 2019).

3.3 Method

This chapter uses the data from the consumer survey that is fully described in chapter 2. 498 consumers (230 from the rural and 268 from the urban region) participated in the survey with complete and valid questionnaires. This sample size is sufficient to employ SEM as it allows the ratio of observations to parameters to be estimated is at least 10 (Kline, 2015).

3.3.1 Measurement development

Table 3.1 shows 15 observed variables used in the analysis. Risk perception is linked with emotional components, such as the feeling of fear or worry (Setbon et al., 2005). RiskGeneral, the observed endogenous variable, was measured by one question item that conveys this feeling: "To what extent do you worry about food safety today?". The responses ranged from 1 "no worry at all" to 5 "extremely worry". The rest 14 variables establish 4 constructs: Inform, RiskHazard, RiskCommonFood, and Trust.

Inform was operationalised by three items asking how frequently respondents heard about food safety incidents from mass media (television), social media (Facebook), and word-of-mouth (relatives and friends). These are the consumers' favourite information channels to access food safety news (Rutsaert et al., 2013a).

Risk perception can be measured by the level of health risk (Schroeder et al., 2007). We, therefore, use items that reflect the evaluation of health risk to measure RiskHazard and RiskCommonFood. To measure RiskHazard, we used the item: "To what extent do you think that eating food which contains the hazards below might cause the danger to your health?" Risk perception is found to be different across hazards (Kher et al., 2013). Several hazards were thus selected to obtain a more comprehensive understanding of this issue (see Table 3.1). Vietnamese consumers are familiar with pesticide residues and bacterial pathogens. However, they are less aware of heavy metal and GMO.

RiskCommonFood contains four common fresh foods (vegetables, fruit, meat, and fish). These foods are potentially contaminated by chemical as well as microbiological hazards (Van Boxstael et al., 2013). We asked respondents to evaluate their health risk of consuming these products. The responses were coded from 1 to 10, with a higher score reflecting a higher risk perceived.

We included three institutions (government, food retailers, and farmers) in Trust construct, as they are key actors involving in food safety control. Respondents were asked, "To what extent do you trust institutions below?" Answers were recorded on a 10 point scale ranging from 1 (do not trust at all) to 10 (completely trust).

Table 3.1: Measurement of observed endogenous variable and latent constructs

Endogenous observed variable and constructs	Observed variables	Scale [Min-Max]
RiskGeneral	Worry about food safety today	[1-5]
Inform	Mass media (MassMedia)	[1-5]
	Social media (SocialMedia)	[1-5]
	Relatives and friends (Friends)	[1-5]
RiskHazard	Risk perceived of heavy metal (HeavyMetal)	[1-10]
	Risk perceived of bacteria (Bacteria)	[1-10]
	Risk perceived of GMO (GMO)	[1-10]
	Risk perceived of pesticide (Pesticide)	[1-10]
RiskCommonFood	Risk perceived of meat (Meat)	[1-10]
	Risk perceived of vegetables (Vegetable)	[1-10]
	Risk perceived of fish (Fish)	[1-10]
	Risk perceived of fruits (Fruit)	[1-10]
Trust	Central government (Government)	[1-10]
	Farmers (Farmer)	[1-10]
	Food retailers (Retailer)	[1-10]

Note: RiskGeneral = Perception of food safety risk in general, Inform = Information acquisition about food incidents, RiskHazard = Risk perceived of hazards, RiskCommonFood = Risk perceived of common foods, Trust= Institutional trust; RiskGeneral is an observed endogenous variable; *Inform, RiskHazard, RiskCommonFood, and Trust are constructs.*

3.3.2 Analysis of survey data

We used Structural Equation Modelling (SEM) to test a complex array of simultaneous causal relations among trust, information, and risk perception at three levels. The SEM models hypothesize how sets of observed variables define these constructs and how these constructs are related to each other (Lomax and Schumacker, 2004). SEM has been theoretically and empirically confirmed to be powerful in unraveling such complex relations among variables in social studies (Gao et al., 2008). Specifically, we applied a partial SEM (Kline, 2015) that has a mix of latent variables (Trust, Inform, RiskHazard, and RiskCommonFood) and one observed variable (RiskGeneral) as core variables. We use AMOS 25.0 to perform SEM on 15 variables (see Table 3.2) on 498 observations

with no missing data. The analysis of the data follows 3 steps: 1) Testing assumptions of SEM, 2) analysing the measurement model, and 3) testing the structural model.

Step 1: Testing assumptions of SEM

Three assumptions (univariate normality, multivariate normality, and multicollinearity) were assessed. The first two helps select an estimation method for the parameters of the models. The last is to confirm whether the dataset is relevant to use SEM. The first assumption was violated. 3 out of 15 observed variables deviated slightly from normality. They had an absolute value of skewness and kurtosis in the range from 1 to 1.5, higher than the cut-off 1.0 proposed by Muthén and Kaplan (1985). The second assumption was not supported since the normalized estimate of multivariate kurtosis of our sample at 25.70, lager than the cut-off of 3.0, as recommended by Ullman (2006). Multicollinearity was not an issue, as correlation coefficients are in the range from 0.00 to 0.70 (Table 3.2).

Since our data was not multivariate normalized, it is not suitable to use the maximum likelihood estimation method. Instead, we applied the asymptotic-distribution-free method (ADF) developed by Browne (1984) to estimate parameters. ADF does not assume multivariate normality and is feasible for a model with less than 20 variables like in our study. According to Byrne (2016), the results from ADF could be trusted if the sample size/parameter ratio is greater than 10. In our study, this ratio is 12.45.

Table 3.2 also reveals some interesting features of surveyed respondents. First, the mean risk rating of chemical hazards was higher than biological and technological hazards. This result implies that consumers were concerned more about chemical hazards. Second, some correlation coefficients of selected hazards are in the range of 0.6 to 0.7, suggesting that respondents were unable to distinguish different food hazards. In other words, their knowledge about food hazards is poor.

Step 2: Analysing measurement model

The measurement model identifies the relations between 14 observed variables (except for RiskGeneral) and their underlying constructs. This model was estimated by using confirmatory factor analysis (CFA) to assess construct reliability and validity (Byrne, 2016).

Table 3.2: Descriptive statistic and correlation matrix of observed variables

Variable	Mean (SE)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.RiskGeneral	2.68 (0.55)	1.00	0.20**	0.21**	0.15**	0.13**	0.17**	0.11*	0.14**	0.08	0.12**	0.03	0.00	-0.04	-0.01	-0.02
2.Fruit	6.74 (2.25)	0.20**	1.00	0.62**	0.48**	0.44**	0.21**	0.17**	0.17**	0.17**	0.11*	0.21**	0.17**	-0.18**	-0.07	-0.09
3.Vegetables	7.14 (2.01)	0.21**	0.62**	1.00	0.45**	0.41**	0.23**	0.17**	0.25**	0.14**	0.17**	0.23**	0.17**	-0.23**	-0.10*	-0.13
4. Meat	6.69 (2.23)	0.16**	0.48**	0.45**	1.00	0.60**	0.22**	0.18**	0.24**	0.24**	0.08	0.11*	0.19**	-0.18**	-0.09	-0.12
5.Fish	5.19 (2.22)	0.13**	0.44**	0.41**	0.60**	1.00	0.21**	0.19**	0.27**	0.20**	0.10*	0.15**	0.20**	-0.17**	-0.15**	-0.19
6.Pesticides	8.21 (1.99)	0.17**	0.21**	0.23**	0.22**	0.21**	1.00	0.63**	0.64**	0.34**	0.23**	0.28**	0.14**	0.04	0.00	0.03
7.Bacteria	7.28 (2.20)	0.11*	0.16**	0.17**	0.18**	0.18**	0.63**	1.00	0.70**	0.53**	0.20**	0.23**	0.20**	-0.04	0.01	0.06
8.Heavy metal	7.91 (2.10)	0.14**	0.17**	0.25**	0.24**	0.26**	0.64**	0.70**	1.00	0.66**	0.19**	0.24**	0.20**	-0.11*	-0.16**	-0.07
9.GMO	7.41 (2.52)	0.08	0.17*	0.14**	0.24**	0.20**	0.34**	0.53**	0.66**	1.00	0.11*	0.16**	0.14**	-0.09	-0.03	0.01
10.MassMedia	3.91 (0.08)	0.12**	0.11*	0.17**	0.08	0.10*	0.23**	0.20**	0.18**	0.11*	1.00	0.42**	0.36**	0.00	-0.03	-0.01
11.SocialMedia	3.35 (1.27)	0.03	0.21**	0.23**	0.11*	0.15**	0.28**	0.23**	0.24**	0.16**	0.42**	1.00	0.46**	-0.15**	-0.03	-0.06
12.Friend	3.68 (0.93)	0.00	0.16**	0.17**	0.19**	0.20**	0.14**	0.20**	0.20**	0.14**	0.36**	0.46**	1.00	-0.06	-0.07	-0.07
13.Government	4.11 (2.95)	-0.04	-0.18**	-0.23**	-0.18**	-0.17**	0.04	-0.04	-0.11*	-0.10	0.00	-0.15**	-0.06	1.00	0.41**	0.39
14.Farmer	2.78 (2.18)	-0.01	-0.07	-0.10*	-0.09	-0.15**	0.00	0.01	-0.16**	-0.03	-0.03	-0.03	-0.07	0.41**	1.00	0.69
15.Retailer	2.43 (1.86)	-0.02	-.09*	-0.13**	-0.12**	-0.19**	0.03	0.06	-0.07	0.01	-0.01	-0.06	-0.07	0.39	0.69**	1.00

Note: Variables 10, 11, 12 were measured by 5 point likert scale while the remaining variables were measured by 10 point likert scale.

Step 3: Testing the structural model

The structural model helps reveal the relations among four constructs and the observed endogenous variable. The direct effect of one causal variable to its outcome variables (with an arrow coming in) was estimated as coefficient regressions of each path in the conceptual framework (Figure 3.1).

Indirect effects were estimated as the product of the coefficient regression of 2 paths: from a causal variable to its mediator and from the mediator to its outcome variable (Hayes, 2009). If there is more than one mediator (e.g., H6), the total indirect effect is quantified as a sum of all specific indirect ones. We used the bootstrapping method to test the total as well as specific indirect effects, as this method does not require an assumption of normal distribution and is more powerful than competing methods such as product-of-coefficients and causal-step approach (Preacher and Hayes, 2008).

3.4 Results

3.4.1 Measurement model

The Goodness of fit of measurement model was assessed through 4 common indices including the ratio of Chi-square to the degree of freedom (χ^2/df), Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), and Standardized Root Mean Square Residual (SRMSR). The models are considered to have a good fit if they have χ^2/df smaller than 3 (Schreiber et al., 2006), CFI higher than 0.9 (Bentler and Bonett, 1980), RMSEA and SRMSR smaller than 0.08 (Hu and Bentler, 1999).

Composite Reliability (CR) of all constructs was above the threshold of 0.7, suggesting good construct reliability. The model achieved convergent validity since the Average Variance Extracted (AVE) was larger than 0.5 and all of the items had factor loading exceeded 0.7 on their construct (Fornell and Larcker, 1981) (Table 3.3). Discriminant validity was established as the evidence of 1) non-cross-factor loadings and 2) significant correlation among the constructs.

Table 3.3: Factor loading, construct reliability and validity

	Components			
	RiskCommon Food	RiskHazard	Trust	Inform
Survey items				
Fruit	0.07	**0.80**	-0.04	0.12
Vegetable	0.09	**0.75**	-0.08	0.20
Meat	0.16	**0.79**	-0.08	0.02
Fish	0.16	**0.73**	-0.16	0.04
Pesticides	**0.75**	0.16	0.08	0.17
Bacteria	**0.85**	0.08	0.06	0.15
HeavyMetal	**0.89**	0.13	-0.13	0.12
GMO	**0.75**	0.12	-0.04	0.03
MassMedia	0.13	0.04	-0.05	**0.78**
SocialMedia	0.15	0.12	-0.04	**0.78**
Friend	0.08	0.15	-0.05	**0.76**
Government	-0.01	-0.21	**0.66**	-0.07
Farmer	-0.04	-0.01	**0.89**	-0.04
Retailer	0.04	-0.07	**0.87**	0-.03
Construct reliability and validity				
CR	0.80	0.78	0.81	0.93
AVE	0.58	0.54	0.52	0.76

Note: the bolded number presents the factor loading of an observed variable on its underlying component.

The original measurement model did not fit the data well ($\chi^2 = 224.307$, df = 71, $p < 0.001$, CFI = 0.852, RMSEA = 0.066). The model was modified to gain an expected model fit. However, model modification without theoretical considerations can become an exploratory approach, and therefore, increases type I error (Schreiber et al., 2006). To avoid this criticism, we considered theoretical aspects when conducting model modification.

We covariate the measurement errors of "Pesticides" and "GMO" to modify the measurement model. It is appropriate to allow this covariation. Williams and Hammitt (2001) found that risk perception of a hazard correlated with the perceived risk of other hazards, as consumers might be unable to differentiate different hazards. In Vietnam, perhaps consumers judged the risk of GMO, which they were not familiar using their risk perception of pesticide, widely-known hazard as a reference point.

After modifications, the final measurement model gained an adequate goodness of fit (χ^2/df = 2.334, CFI = 0.910, RMSEA = 0.052, SRMR = 0.07). As expected, 14 observed

variables were loaded in 4 components: RiskCommonFood, RiskHazard, Trust, and Inform (Table 3.3).

We conducted Explanatory Factor Analysis (EFA) to evaluate the construct reliability, convergent validity, and discriminant validity of the final measurement models.

3.4.2 Structural model

Model fit

Except for the marginal value of CFI of 0.906, all of the other indices obtained values higher than the recommended levels ($\chi 2/df = 2.383$, GFI= 0.944, RMSEA =0.053, and SRMS= 0.076). A Chi-square ($\chi 2$) value of 188.627 with 79 df and $p < 0.001$ demonstrates that the structural model yielded a good fit with the sample data.

Direct effects (H1 to H4)

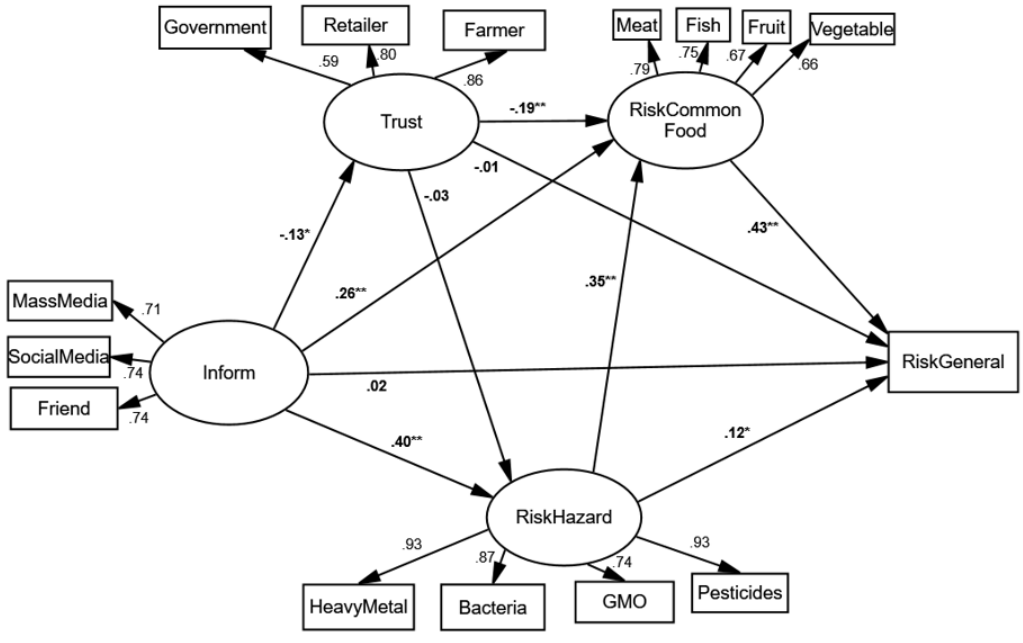

Figure 3.2: Structural model with results

Note*: standardized estimates are shown. *, **: p <0.05 and p < 0.001, respectively*
All factor loadings are significant (p< 0.01); Square multiple correlations (R^2) of Trust, RiskCommonFood, RiskHazard, and RiskGeneral are 0.02, 0.31, 0.16, and 0.26, respectively

Figure 3.2 presents the estimated results for direct effects. Three paths including Trust→RiskGeneral, Trust→RiskHazard, and Inform→RiskGeneral were not statistically significant. The rest were statistically significant either at $p < 0.05$ or $p < 0.001$ level. Predictors could explain 31%, 16%, and 25% of the variance in RiskCommonFood, RiskHazard, and RiskGeneral, respectively. Standardized estimates and the conclusions about hypothesis testing relating to direct effects are shown in Table 3.4.

Table 3.4: Standardized estimate of direct effects and conclusion about hypothesis support

Hypothesis	Path	Standardized path coefficient (B)	P	Conclusion
H1	Inform→Trust	-0.13	0.01	Supported
H2a	Inform→ RiskHazard	0.40	< 0.001	Supported
H2b	Inform→RiskCommonFood	0.25	< 0.001	Supported
H2c	Inform→ RiskGeneral	0.02	0.71	Unsupported
H3a	Trust→RiskHazard	-0.03	0.52	Unsupported
H3b	Trust→RiskCommonFood	-0.19	< 0.001	Supported
H3c	Trust→RiskGeneral	-0.01	0.83	Unsupported
H4	RiskHazard→RiskCommonFood	0.35	< 0.001	Supported
	RiskHazard→RiskGeneral	0.120	0.02	
	RiskCommonFood→RiskGeneral	0.427	< 0.001	

Information and institutional trust

Hypothesis H1 is supported ($B = -0.13$, $p < 0.05$), indicating that respondents who obtained information about food incidents more frequently would have a lower trust. However, risk information was not a strong predictor of trust since it could explain only 2% of the variance in trust ($R^2 = 0.02$).

Information and risk perception at the three levels

Information strongly affected risk perception at the hazard level and the product level ($B = 0.40$ and 0.25, respectively, $p < 0.001$), providing support for hypothesis H2a and H2b.

The size of this effect was relatively big, as compared with other direct effects. However, information did not directly influence perception of food safety risk in general (B = 0.02, p = 0.71). H2c is thus unsupported.

Trust and risk perception at the three levels

As expected, all paths associated with institutional trust have negative regression coefficients, suggesting the inverse relationship between trust and risk perception at all three levels. However, trust causes a significant effect on only risk perception of common food (B = -0.20, p < 0.001). Accordingly, only H3b is supported while H3a and H3c are not.

The linkages among risk perception at the three levels

All three paths RiskHazard → RiskCommonFood, RiskCommonFood → RiskGeneral, RiskHazard → RiskGeneral have positive and significant coefficients. Therefore, H4 is supported. The linkages among three levels of risk perception are thus empirically confirmed. Respondents who perceived a higher level of risk from food hazards also perceived a higher level of risk from common food categories, which in turn led to a higher level of worry about food safety.

Indirect effects (H5 and H6)

We used AMOS user-defined estimand developed by Gaskin (2016) and bias-corrected bootstrap on 2000 bootstrap samples to calculated and test indirect effects. It should be noted that there is a large variation about the acceptable number of the bootstrap sample in published works, ranging from 500 (Fink et al., 2008) to 10 thousand (Streukens and Leroi-Werelds, 2016). A current review by Ali et al. (2018) concluded that the average number of bootstrap used per study is 1360. We chose 2000 boostrap samples as it is higher than the average number shown in Ali et al. (2018).

Trust transmitted an indirect effect on the perception of food safety risk in general via risk perceived of common foods (β = 0.04, p = 0.018) (Table 3.5). Thus, H5 is supported, confirming that trust reduced risk perceived of common foods, thereby lowering the concern about food safety.

Table 3.5: Indirect effect estimation results

Indirect effect	Hypothesis	Point estimate (β)	SE	Percentile 95% CI		P
				Lower	Upper	
1. Trust→RiskGeneral through RiskCommon	H5	-0.04	0.02	-0.10	-0.007	0.02
2. Inform→RiskGeneral through:						
a) Trust		0.00	0.02	-0.05	0.06	0.83
b) RiskCommonFood		0.28	0.07	0.11	0.35	0.00
c) RiskHazard		0.08	0.06	0.01	0.28	0.03
TOTAL Inform→RiskGeneral	H6	0.38	0.10	0.17	0.58	0.01

Note: Unstandardized estimate using bias-corrected bootstrap on 2000 bootstrap samples, CI denotes bias-corrected bootstrap confidence interval. The total indirect effect from Inform to RiskGeneral did not equal the sum of 3 specific indirect effects (a,b,c), as not all of the specific indirect effects are included in the Table.

Information indirectly influenced the perception of food safety risk in general through 2 mediators: risk perception of common foods and risk perception of hazards (β = 0.28, p = 0.00; β = 0.08, p = 0.03). The first mediator exhibited a relatively larger effect. The total indirect effect of Inform on RiskGeneral was statistically significant (β = 0.38, p = 0.01), providing support for H6.

3.5 Discussions

Information acquisition about food incidents was found to dampen consumers' trust in the government and actors in the food chain. We found that consumers placed a very low level of trust in supermarkets (mean score of 4.46 out of 10, Table 3.2), as they were influenced by some previous scandals relating to supermarkets' fraudulent claims. In 2015, some big supermarkets in Hanoi were reported to trade untraced vegetables but labeled them as "safe vegetables" to gain higher profit. The incident publicised by various media outlets impacted negatively on supermarkets' image. Three years after the incident, trust in supermarkets was still low, suggesting that the impact of the incident still exists.

Trust in farmers was even lower (mean trust level = 2.76, Table 3.2), as a result of extensive media coverage about the overuse of pesticides on vegetables and growth promoter in livestock. Many of surveyed consumers questioned on farmers' "lack of ethics" or labeled them "liar." Trust in the government is also low (mean = 4.11, Table 3.2). Information disclosure about food scandals leads to consumer feeling that the government has failed to manage the food safety of the country.

The study suggests that the acquisition of negative food safety information augmented risk perception of hazards and risk perception of common foods. Risk perception involves a complex process of seeking, interpreting, and filtering information (Roberts et al., 2016). Negative news is believed by consumers to be more reliable than positive ones (Siegrist and Cvetkovich, 2000). Although both bad news, as well as good news about food safety, spread via media, bad news tends to attract more attention in Vietnam. A disproportionate amount of information on the overuse of chemical inputs amplified consumers' risk perception of hazards and common foods. This explains why of all selected food hazards were regarded to be dangerous (risk ratings in the range from 7.4 to 8.2, Table 3.2). Risk perceived of three out of four of selected common foods was also high, with the mean risk perceived being between 6.6 and 7.0 (Table 3.2).

Interestingly, a low level of institutional trust sharply increased risk perception of common foods but not of hazards. Siegrist and Cvetkovich (2000), and Bronfman et al. (2009) reported a strong negative association between social trust and risk perception of hazards. However, such an association was not confirmed in our findings. Perhaps, this is because of the exclusion of other hazards that cause a high level of consumer concern, such as preservatives in food processing and growth regulators in livestock production in our questionnaire. Regarding risk perception of common foods, we found contradicting pictures between Europe and Vietnam contexts. European consumers rely on and trust in the food industry and public food control system. They, therefore, feel the confidence in eating various common foods such as eggs, beef, fish, and vegetables (Berg et al., 2005). Inversely, in Vietnam, lack of trust in the government and actors in the food chain has resulted in consumers' belief that common foods are unsafe. This made the perception of food safety risk in general rise.

Our finding supports the links among risk perception of hazards, risk perception of common foods, and perception of food safety risk in general. The chapter found that the way consumers rate the risk of a hazard depends on their evaluation of their control over the hazard and the danger of the hazard, as suggested by the psychometric paradigm developed by Slovic (1987). Hence, pesticide residues which were thought to have a long-term effect, severe consequences, and beyond the personal capacity to control were rated by consumers as the riskiest (Table 3.2). Subsequently, vegetables and fruits that have a higher potential to be contaminated by pesticide residues were ranked the most dangerous (Table 3.2). This explains the positive association between risk perception at the hazard level and product level. Since risk perception has a sweeping effect when consumers' view that the most important and common food categories unsafe, they will develop a negative attitude that risk associated with all types of food is high.

Finally, frequent information acquisition about food incidents was found to indirectly accentuate consumers' worry about food safety. Irresponsible risk communication remains a persistent problem in Vietnam. According to Van Hoi et al. (2009), information about food risk was embargoed by government authorities. On the other hand, there is extensive media coverage of a few food safety incidents (Nguyen-Viet et al., 2017, World Bank, 2017). We conducted a Google search on 24 May 2019, using the keywords in Vietnamese "thực phẩm bẩn" (contaminated food). 138,000 results appeared instantly. It is argued that when consumers obtain a vast amount of food safety information from a multitude of sources, this has not led to an improvement of consumers' knowledge but escalated their risk perception.

3.6. Conclusions

Food safety risk perception is heightened in Vietnam. If not addressed, such perception may force consumers to move away from domestic food or reduce food consumption. In order to improve the sustainability of food production in Vietnam, it is important to investigate risk perception in relation to other influencing factors.

Previous literature treated food risk information and trust as isolated predictors of risk perception. This chapter investigates how institutional trust, information about food incident, risk perceived of hazards, and risk perceived of common foods correlate together

to influence perception of food safety risk in general. Our study is the first attempt that examines such relationships with some definitive results.

Trust is found to directly reduce risk perceived of common foods and indirectly dampen risk perception of food in general. In addition, trust in food suppliers and regulators in Vietnam is critically low. Thus, improving trust in government and food actors in the food chain is essential. This can be done by better enforcement of food safety regulations and the provision of transparent information on food products. Capacity building for actors in the food chain and incentives offered to those who engage in food safety practices will improve sustainable food safety management. Since information about food incidents impacted adversely on trust, better risk communication is required to improve trust.

Food incident information directly determined risk perceived of common foods, risk perceived of hazards and indirectly shaped perception of food safety risk in general. Poor food risk communication has contributed to unnecessary panic among consumers in Vietnam. A better risk communications strategy, therefore, is urgently needed. There should be collaboration among government bodies to communicate food risk. Furthermore, food risk information must be consistently, accurately, and on time (Nguyen-Viet et al., 2017). Since consumer knowledge about food hazards is limited, communication about food hazards must be a focus. Evidence worldwide shows that many attempts to educate consumers are rarely successful, as information provided is not of their interest (Verbeke et al., 2007). Consumer education programs should focus on chemical hazards that are their biggest concerns. Consumers should be provided unbiased scientific evidence about the health impact of food hazards, particularly of chemical varieties.

Finally, our study confirms the linkages among risk perception of hazards, common foods, and perception of food safety risk in general. To reduce food safety concerns, it is crucial for Vietnam to manage food hazards more effectively. While there are many food items in the households' food basket in Vietnam, food categories that are consumed daily but believed to be the most unsafe such as fruit, vegetables, meat, and fish should be priorities of food safety policy.

This chapter develops constructs of trust, risk information, and risk perceptions then investigates the linkage among these constructs. Chapter 4, the following chapter, uses

the constructs that have been validated in this chapter. Chapter 4 introduces some other variables (demographic and food poisoning experience) to explain risk perception of food as a whole while taking in to account the rural-urban divide.

CHAPTER 4: CONSUMER PERCEPTION OF FOOD SAFETY RISK IN GENERAL

This chapter is based on:
Ha, T. M., Shakur, S. & Pham Do, K. H. 2019. Consumer concern about food safety in Hanoi, Vietnam". Food Control, 98, 238-244

4.1 Introduction

Like in many developing countries, Vietnam has witnessed shifts in food consumption patterns and spending, driven by structural and institutional changes in the food chain and the growth of income in recent years. The share of high-value products in the household's food basket is increasing in both rural and urban areas (World Bank, 2016). The demand for safe and high-quality food demonstrates a growing trend (Mergenthaler et al., 2009) due to not only the rise in living standards but also the concern about food safety.

Managing food safety is a challenging task in Vietnam because of fragmented food chains and a lack of enforcement of government regulations (Nga et al., 2014). Consequently, the country is confronted with the prevalence of food-borne illnesses. The main culprit is microbial pathogens (causing one-third of food poisoning outbreaks), followed by toxin and chemical contaminations (Sarter et al., 2012). There are high levels of toxic residues with food additives, pesticide, and antibiotic residues exceeding the Maximum Residue Limits (MRLs) (World Bank, 2006). Such food-related risk has even been particularly stressed by mass media. Extensive media coverage of food safety incidents has caused consumers' fear of some certain foods. Their confidence in food safety has eroded (Wertheim-Heck et al., 2014).

In this chapter, consumer perception of food safety risk in general refers to their feeling about the unsafety of food, in a broad sense, not of a specific hazard or a particular food product. To restore consumer trust in food, food producers, and retailers in Vietnam need to understand how consumers feel about food safety. A better insight into the determinants of consumer concern about food safety will assist policymakers in reducing recent food fears. Moreover, an examination of spatial differences in consumer judgment of food safety risk is important, as it will support the development of effective food safety and risk communication strategies that are relevant to the local conditions.

Previous studies have explored consumer risk perception of particular hazards (Liu et al., 2014, Omari et al., 2018) and of specific food products (Lobb et al., 2007, Tonsor et al., 2009). Moreover, the concern about food safety or perception of food safety risk has been discussed (Chen, 2013, Liu and Ma, 2016). However, studies that investigate links among risk perception of hazards, risk perception of a particular food, and perception of food safety risk are a few. Risk perception was found to differ between rural and urban areas in some research (Liu and Ma, 2016, Verbeke and Viaene, 2000). However, a comprehensive investigation of the disparity in risk perception between the rural and urban regions remains unexplored.

Some attempts have been made to explore consumers' perception of food safety (risk) in Vietnam (Figuié et al., 2004, Van Hoi et al., 2009, Wertheim- Heck et al., 2014, Nguyen-Viet et al., 2017). However, most of these studies focus on risk perception for a specific food, such as vegetables, rather than risk perception of different hazards and food categories. Furthermore, the determinants of consumer perception of food safety risk have not been quantified.

The objectives of this chapter are twofold. First, the chapter provides an overview of consumer perception of food safety risk by region in Hanoi. Primary data from the consumer survey and group discussions were integrated to explain consumers' feelings about food safety, food safety issues that are their concern, and their risk rating of some common foods. Furthermore, the comparison between rural and urban regions was made. Second, the chapter investigates the determinants of consumer perception of food safety risk in general using the survey data. Then, information from group discussions was used to gain a complete insight into significant predictors of the food safety worry.

4.2 Data and method

In this chapter, we used mixed method research, which integrates data from a consumer survey with three group discussions. Food safety risk perception is a complex concept, as it comprises social, cultural, and psychological dimensions. The use of the mix method would provide a more comprehensive understanding of these concepts than either the qualitative or quantitative approach alone.

4.2.1 Consumer survey

The consumer survey was conducted in Hanoi, Vietnam, during 2017. The surveyed data and sampling procedure can be sourced from chapter 2. The total sample size was 498, comprising 230 rural and 268 urban respondents. Their demographic and socioeconomic characteristics are presented in Table 4.1.

Table 4.1: Background information on the respondents and their household by region

Features	Rural (n=230) (Mean & SD)	Urban (n=268) (Mean & SD)
Repondent's monthly income (million VND)	4.958^{a} [2.98]	9.74^{b} [6.60]
Age	46.00^{a} [13.93]	38.32^{b} [10.06]
Education level	2.87^{a} [1.17]	3.90^{b} [1.90]
Gender (1= male)	0.12^{a} [0.33]	0.12^{a} [0.33]
Number of children in the household	1.13^{a} [0.97]	1.38^{b} [0.85]
Number of family members	4.63^{a} [1.60]	4.22^{b} [1.12]
Household monthly expense (million VND)	6.09^{a} [3.89]	11.46^{b} [5.79]

Note: 23 thousand VND = 1 USD; a,b Scores in one row with a different superscript are statistically significantly different at 5% using Two-sample T-test; Numbers in brackets are standard deviation; Education levels are coded from 1(no schooling) to 6 (postgraduate qualification)

Data shows income and education gaps between the rural and urban regions. Urban districts of Hanoi experienced a stronger development in industry and service sectors than their rural counterparts. As a result, urban respondent's monthly income and their monthly household expense were nearly twice that of rural participants. On average, most of the rural respondents had a high school qualification while the majority of urban respondents held a university degree. The family structure was also different between the two regions. Urban families were characterised by younger main food shoppers, having more children, and smaller household size, as compared with rural households. This was attributed to the migration flow of youths from rural to urban, where greater earning potential was expected.

4.2.2 Variables used in the analysis

Table 4.2: Variable definition and statistics

Variables	Variable definition and measurement	Scale	Mean (SD)
PF	Perception of food safety risk in general	1-5	3.98 (0.92)
ConcernIssue	Number of food safety concerning issues	0-9	5.47 (2.48)
RiskCommon	Risk perceived from egg	1-10	4.28 (2.24)
	Risk perceived from meat	1-10	6.68 (2.22)
	Risk perceived from fish	1-10	5.20 (2.28)
	Risk perceived from milk	1-10	4.46 (2.46)
	Risk perceived from vegetables	1-10	7.13 (2.01)
	Risk perceived from fruits	1-10	6.74 (2.22)
Trust	Trust in local government	1-10	4.11 (2.95)
	Trust in central government	1-10	3.56 (2.54)
	Trust in supermarkets	1-10	4.46 (2.44)
	Trust in farmers	1-10	2.77 (2.18)
	Trust food traders at wet markets	1-10	2.43 (1.85)
Inform	Food incident heard from TV	1-5	3.92 (0.82)
	Food incident heard from social media	1-5	3.34 (1.27)
	Food incident heard from relatives/friends	1-5	3.68 (0.93)
Region	=1 if urban	0-1	0.53 (NA)
Age	Respondent's age	23-84	41.86 (12.5)
Income	Natural log of monthly income	0 -17.6	15.2 (2.48)
Gender	=1 if male	0-1	0.13 (NA)
Children	=1 if the family has at least 01 child	0-1	0.76 (NA)
Education	=1 if hold university degree	0-1	0.51 (NA)
FoodPoison	=1 if have been poisoned by food	0-1	0.85 (NA)

Note: values in brackets denote standard deviations; Region and the last four variables are binary, their reported means, therefore, should be interpreted as a proportion. NA: standard deviations are not applicable.

The variable used in the analysis covered six issues: 1) perception of food safety risk in general, 2) the concern about specific food safety issues, 3) risk perception of common foods, 4) trust, 5) information about food incidents, and 6) demographic characteristics. Variable definitions and statistics are illustrated in Table 4.2.

Perception of food safety risk in general (PF) is the dependent variable. Feelings such as worry, fear, dread, or anxiety exert a reciprocal influence on cognitive evaluations of risk

(Loewenstein et al., 2001). Therefore, risk perception can be measured by worry (Rosati and Saba, 2004). Following this, we used one question item to measure perception of food safety risk: "To what extent are you worried about food safety today?". The responses were in a range from 1 "not worried at all" to 5 "extremely worried". Like in chapter 3, the three terms: "perception of food safety risk in general", "food safety concerns" and "food safety worries" refer to the same concept in this chapter.

The concern about specific food safety issues was gathered through one survey item that asks respondents whether they were worried about 9 specific food safety issues. These issues covered four aspects of food safety: 1) chemical hazards (pesticide residue, food preservatives, hormone residue, drug residue, and heavy metal), 2) biological contamination (bacterial, micro-toxic contamination), 3) technological hazard (GMO-Genetic Modified Organism), and 4) lifestyle hazard (nutrition imbalance). The number of food safety issues reported by each respondent (ConcernIssue) was counted. We anticipate that the more food safety issues consumers are concerned, the higher level of food safety worry they would have.

Risk perception of common foods (RiskCommon) was captured by six survey questions, asking about the risk rating of six corresponding common food categories: egg, fish, milk, meat, vegetables, and fruit. These products are important in Vietnamese's diet but potentially involve high risk, as they are perishable. Risk perceived of each product was measured by the level of personal health risk, as suggested by Tonsor et al. (2009). We used a 10 point- Likert scale with 1 meaning "not risky at all" and 10 indicating "extremely risky". We are interested in testing whether risk perception of common food produces would translate into consumer perception of food safety risk.

Trust is a multi-dimensional construct (de Jonge et al., 2008) and the impact of trust is different across institutions (Chen, 2013). Hence, we used 4 items to measures trust in institutions that oversee the management of food safety, including local government, central government, farmers, and food retailers. Trust was measured by a 10 point- Likert scale, ranging from 1 (no trust at all) to 10 (complete trust). We expect that trust will reduce the worry about food safety.

Information about food incidents (Inform) reflects the frequency consumers acquire information about food safety incidents through 3 channels: mass media (TV), social media (Facebook), and word of mouth (relatives/friends). Earlier research found that consumers are most interested in these channels to receive food risk information (Rutsaert et al., 2013a, Liu et al., 2014). The responses were coded on a 5-point Likert scale from 1 (never) to 5 (always). To avoid response bias, respondents were given a definition for each response option. For example, "always" means having heard or observed food safety incidents more than three times per week.

"Region" was included in the questionnaire to examine the disparity between rural and urban consumers in food safety evaluation. Spatial differences concerning cultural and social aspects have been found (Beggs et al., 1996). Compared to urban settings, personal networks in rural settings are stronger, more complex, based more on kinship and neighbourhood cohesion. Such differences might contribute to the differences in food safety worry between rural and urban consumers in some research (Verbeke and Viaene, 2000, Liu and Ma, 2016).

Moreover, we were also interested in testing whether demographic characteristics influence food safety risk perception. Hence, the questionnaire contained 5 demographic variables, including age, gender, income, education, and the presence of children in the family. Respondent's age, monthly income, and education were treated as continuous variables while the presence of children in the family and gender were dummy variables.

Direct exposure to risky events often increases consumers' memory and imagination of the hazard (Kasperson et al., 1988). Direct experience with food poisoning increased risk perception in some research (Green et al., 2003). For this reason, the variable "FoodPoison" was included.

4.2.3 Focus group discussion

Three group discussions, including one in urban, two in rural districts were conducted to gain further insight into consumer risk perception by listening to their own words. The definition of the urban and rural districts has been discussed in detail in chapter 2. Each

group discussion had 8 participants who previously engaged in the survey. Further detail about the criteria to select these participants can be found in chapter 2.

4.2.4 Data analysis

The data from group discussions were integrated with survey data into the "result and discussion section" whenever feasible.

For survey data, to evaluate whether risk perception differs between rural and urban regions, Two-sample T-test and Chi-square independent test were employed. The former is to compare the mean of risk rating of risk perceived from selected foods. The latter is to compare the percentage of respondents reporting a particular food safety issue of concern. Since the Two-sample T-test relies on assumptions of normality and homogeneity of variance, the evaluation of normality and variance was conducted.

In order to quantify the determinants of perception of food safety risk in general the analysis was employed through two processes. Firstly, Principle Component Analysis (PCA) using varimax rotation was performed on 13 variables measuring "RiskCommonFood", "Trust", and "Inform". PCA reduces this set of variables into a few main components that can potentially affect consumer perception of food safety risk. Components with the eigenvalue larger than 1 and in the steeper part of the Cattel scree graph were retained, as suggested by Yong and Pearce (2013). Secondly, the retained components and other independent variables including "ConcernIssue", "Region", "FoodPoison", and demographic variables were regressed with the dependent variable "Food safety risk perception in general". Since the dependent variable has more than two ordered response levels, we employed ordered logit regression models.

In order to achieve a precise estimate of regression coefficients, some necessary assumptions for the ordered logit regression model were assessed. Our data have no issue with Multicollinearity. Pearson's correlation coefficients between independent variables were in the range from 0.0 to 0.53, below the threshold of 0.7 (Dormann et al., 2013). The proportional odds assumption was fulfilled, as the evidence of Approximate Likelihood Ratio test (Wolfe and Gould, 1998). This test was insignificant ($\chi 2 = 50.80$, df = 36, $p > 0.05$), indicating that there was the same set of coefficients across different response

levels: “not worried at all”, “a little bit worried”, “worried much”, “worried very much”, or “extremely worried”. Hence, the use of ordered logit regression was appropriate.

4.3 Results and discussions

4.3.1 Consumer perception of food safety risk

Food safety concerns have raised in Hanoi. A vast majority of respondents surveyed (95%) expressed that they either worried much, very much or extremely worried about food safety (Table 4.3). The concern about food safety was substantial in both rural and urban regions.

Table 4.3: Consumer awareness about food safety in Hanoi

To what extent are you worried about food safety today?	Whole sample (n=498)	Rural (n=230)	Urban (n=268)
Not worried at all	0.60	0.87	0.37
A little bit worried	4.82	3.91	5.60
Worried much	25.70	23.48	27.61
Worried very much	33.13	36.52	30.22
Extremely worried	35.74	35.22	36.19

Note: Unit in %

Risk perception is just a feeling (Slovic, 2010). Group discussions revealed that when talking about food safety, the words “fear”, “worry”, and “scary” were cited very often by participants. The anxiety about food safety was often linked with the fear of food poisoning and cancer. Like in Nguyen-Viet et al. (2017), there was a common belief that contaminated food was a primary cause of increasing cancer cases in Vietnam in recent years. Therefore, in the consumers’ eyes, eating became a risky proposition (Caplan, 2000). The risk was believed to be at a very high level because it had severe consequences, was beyond personal control, and invisible.

“There are more cancer people day by day. This is because of yucky food” (The urban group)

"Eating now is so scary, but what I can do?" (The rural group)
"The food now was much more unsafe than before. We buy, wash, and cook them but we cannot check how hazardous they are" (The rural group)

As shown in Table 4.4, many food safety issues caused consumer worry. On average, one respondent surveyed reported 5.47 food safety issues of their concern out of 9 issues listed in the questionnaire. In agreement with previous studies on New Zealand, Australia, and Japan by Worsley and Scott (2000), Smith and Riethmuller (1999), our finding suggests that consumer concern about food safety was broad. Moreover, respondents were concerned about chemical hazards more than biological (e.g., *E. coli*) and lifestyle hazards (nutrition imbalance). This is because chemical hazards are perceived by consumers to be more uncontrollable, dread with unknown consequences (McCarthy et al., 2006, Kher et al., 2013). In particular, pesticide residue, food preservatives, and hormones in livestock were the top three important issues that caused the anxiety of over 80% of respondents.

Table 4.4: Percentage of respondents within rural and urban regions in Hanoi concerned about specific food safety issues

Concerned issues	Total1 (n=498)	Rural2 (n=230)	Urban2 (n=268)
Pesticide residue	92.6	90.4[a]	94.4[a]
Food preservatives	88.8	86.5[a]	90.7[a]
Use of hormone in livestock production	78.9	76.5[a]	81.0[a]
Drug residue in meat	62.2	55.7[a]	67.9[b]
Heavy metal contamination	55.6	45.2[a]	64.6[b]
Bacteria contamination	50.2	47.4[a]	52.6[a]
Micro-toxic contamination	46.4	44.3[a]	48.1[a]
GMO food	43.6	36.5[a]	49.6[b]
Nutrition imbalance	31.1	30.9[a]	31.3[a]

1:% of respondents in the whole sample; 2:% of respondents within the region
[a,b:] Percentages in one row with a different superscript are significant at 5% level, using Chi-Square test.

A higher percentage of urban people concerned about every food hazard (Table 4.4). Chi-Square test results confirm the statistical association between three concerned issues, including "drug residue in meat", "heavy metal contamination" and "GMO food" with "region" ($P < 0.05$). This shows a difference between rural and urban respondents in their attitude toward the three issues above. The number of concerned hazards reported by an average urban respondent was higher than that of an urban participant (5.8 versus 5.08), i indicating that consumer concern about food safety was broader in urban areas. These results suggest that food safety risk was perceived to be higher in the urban region.

Group discussions explored two reasons behind such disparity between the two regions. Firstly, perceived control dampened the worry about food safety in the rural region. Most of the rural participants reported that their families had the capacity to self- produce a multitude of fresh food for their family consumption. Therefore, they felt they were able to control the safety of their family food supply. Subsequently, they were more confident about food safety than urban people who were mostly unable to self-produce. Moreover, some rural families, though they did not produce their own foods, were able to access "safe food" by asking or buying food from their neighbours and kin who they trust. Having better social and kinship networks (Keyes et al., 2014), rural residents perceived better control over food safety, as compared to their urban counterparts. This lowered their worry about food safety, as a result.

"We have lots of homegrown food. Homegrown foods are absolutely safe. We don't need to worry much about pesticides, GMO…" (The rural group).

"If I run out of vegetables, I will go to my fields to pick up some. Sometimes, if the weather is not good, I don't want to go there at all. I just run to the market nearby and buy some from my relatives or local people who live in my village" (The rural group).

In addition to focusing on risk perception at the hazard level, we also attended to risk perception at the product level. The survey results are illustrated in Table 4.5. In the whole sample, four out of six products, including vegetables, fruits, meat, and fish had the mean risk rating higher than the neutral level. Vegetables, fruits, and meat were considered the top three riskiest items with the mean risk perceived at a high level (7.14, 6.74, and 6.70, respectively). Similar to previous research in Vietnam (Van Hoi

et al., 2009, Nguyen-Viet et al., 2017), these results indicate that consumer confidence in the safety of everyday food was low.

Table 4.5: Level of risk perceived from consumption of common products by rural and urban regions in Hanoi

Products	Whole sample (n=498)		Rural (n=230)		Urban (n=268)	
	Mean	SD	Mean	SD	Mean	SD
Vegetables	7.14	2.01	6.77[a]	2.11	7.45[b]	1.86
Fruits	6.74	2.22	6.51[a]	2.25	6.94[b]	2.18
Meat	6.69	2.22	6.31[a]	2.31	7.01[b]	2.10
Fish risk	5.19	2.28	4.88[a]	2.23	5.44[b]	2.29
Milk risk	4.46	2.46	4.33[a]	2.38	4.56[a]	2.53
Egg risk	4.27	2.24	4.13[a]	2.21	4.40[a]	2.26

Note: Risk levels are in 10 point- scale from 1(not risky at all) to 10 (extremely risky)
SD: standard deviation; [a,b] Scores in one row with a different superscript are statistically significantly different at 5% using Two-sample T-test

Group discussions sought explanations for a high level of risk perceived from vegetables, fruits, and meat found in the survey. Vegetables were ranked a top risk because of the fear of pesticide residue. Similar to a study in China by Cheng et al. (2016), we found that pesticides were evaluated as the most dangerous hazard because of its long term effects. When it comes to fruits, a common complaint was preservatives used in various fruits that consumers heard from mass media. In terms of meat, respondents were afraid of growth hormones in livestock production, which was responsible for a huge food scandal in 2015. This finding also explains why pesticide residue, preservatives, and growth hormone were the top three concerned issues of survey participants (see Table 4.4). Consumers believed that vegetables, fruits, and meat exposed the highest level of risk, as they were potentially contaminated by the most concerned hazards: pesticide, preservatives, and animal growth promoters.

"They (vegetables) have pesticide (residues) that accumulate in our bodies day by day. Deadly dangerous!" (The rural group)

"Fruits are very risky because they are often soaked in preservatives. The fresher, shinier they look, the more they are likely to have been deepened in preservatives." (The rural group)

"Livestock is fed by industrial feed containing growth hormone, very dangerous." (The urban group).

Risk perception of common foods differed across regions. As shown in Table 4.4, risk perceived of all food items was lower in the rural region. Noticeably, mean risk ratings of vegetables, fruit, meat, and fish are significantly different between rural and urban settings ($P < 0.05$). This suggests that in general, rural consumers viewed a lower level of risk from everyday food than their urban counterparts did. As mentioned previously, a higher perceived control and stronger social ties in the rural region are the main reasons for the diversity in risk perception related to common food between rural and urban regions.

4.3.2 Determinants of perception of food safety risk in general

Table 4.6 shows the results of PCA. Four retained components include risk perception of protein food, institutional trust, information acquisition about food poisoning, and risk perception of vegetables and fruits. They are potential determinants of the perception of food safety risk. They were unrelated and able to account for a majority of the total variance of the dataset. Risk perceptions of six common food products were not loaded in the same component, confirming that consumers perceived the risk of vegetables and fruits differently from that of protein food.

The Kaiser-Meyer-Olkin (KMO), a measure of sampling adequacy, was 0.754. The Bartlett's test of sphericity was significant at $p < 0.000$, suggesting patterned relationships among variables. Hence, the dataset was adequate for PCA. The Cronbach's Alphas of all the components were 0.7 or higher, suggesting the acceptable construct reliability (Tavakol and Dennick, 2011).

Table 4.6: Principle component analysis for potential factors affecting perception of food safety risk

Observed variables and components	Factor loading	Variance explained	Cronbach's alpha
Component 1: Risk perception of protein food (PerProteinFood)		30.345	0.828
Risk perception of fish	.829		
Risk perception of milk	.816		
Risk perception of egg	.765		
Risk perception of meat	0.650		
Component 2: Trust in responsible institutions (Trust)		17.749	0.813
Farmers	0.844		
Food retailers	0.801		
Local government	0.789		
Central government	0.738		
Component 3: Information acquisition about food poisoning (Inform)		12.167	0.700
Food incident heard from social media (Facebook)	0.799		
Food incident heard from relatives/friends	0.743		
Food incident heard from TV	0.739		
Component 4: Risk perception of vegetables and fruits (PerVegFruit)		8.037	0.762
Risk perception of vegetables	0.708		
Risk perception of fruit	0.661		
Total variance explained (%) = 68.29			
Kaiser-Meyer-Olkin (KMO) = 0.754			

Table 4.7 presents the results of the ordered logit regression model. The model fit was analysed. The likelihood ratio chi-square was 82.76 with a p-value < 0.001. This suggests that the model with predictors as a whole was statistically significant, as compared to the null model with no predictors. Besides, the count R2, a seemingly appealing measure of model fit (Long and Freese, 2006), yielded a value of 0.442. This means 44.2% of the predictions were correct. Furthermore, the Likelihood Ratio test was performed to

determine significant determinants of perception of food safety risk. Four statistically significant predictors ($p < 0.001$) were found (Table 4.7). Moreover, we tested the null hypothesis that the coefficient of "region" equals the coefficient of other significant independent variables. Via the Wald test, these hypotheses were rejected. For simplicity, we only reported here the marginal effect of the highest category of dependent variables: "extremely worry".

Table 4.7: Ordered logit regression results for principle components and demographic factors affecting perception of food safety risk

Variable	Coefficient (SE)	Marginal effect (SE)
Age	0.007 (0.008)	0.001 (0.002)
Gender	0.078 (0.263)	0.015 (0.053)
Income	-0.008 (0.039)	-0.001 (0.008)
Education	0.007 (0.094)	0.001 (0.019)
Children	0.137 (0.202)	0.028 (0.041)
Region	0.530* (0.204)	0.107* (0.041)
ConcernIssue	0.132* (0.037)	0.027* (0.008)
FoodPoison	0.011 (0.178)	0.002 (0.036)
PerProteinFood	0.440* (0.092)	0.089* (0.017)
PerVegFruit	0.426* (0.089)	0.086* (0.017)
Trust	-0.060 (0.090)	-0.012 (0.018)
Inform	0.332* (0.097)	0.067* (0.019)
Log-likelihood ratio = 82.76 (p=0.000)		
Count R2 = 0.4		

*Note: * denotes significance at the 5%-level; Standard errors in parentheses; Marginal effect were calculated for the category "extremely worry"*

None of the demographic variables was statistically significant, demonstrating that demographic characteristics did not determine the level of worry about food safety (Table 4.7). Some related research in developing countries for example, in China (e.g., Liu et al. (2014)), in Vietnam (e.g., Mergenthaler et al. (2009)) pointed out that among various demographic variables of consideration, only the presence of children in the household influenced consumers' perception of food hazards. More research is required to investigate the impact of demographic factors on food risk perception in Vietnam.

Interestingly, the region was the most important determinant of food safety concerns. Urban people tend to worry more about food safety than their rural counterparts. Rural consumers were 10.67 % less likely to report "extremely worry" about food safety than their urban counterparts. This result is in line with Verbeke and Viaene (2000), who reported rural consumers were less concerned about meat safety than urban consumers. Once again, the difference in perceiving food safety risk between rural and urban people can be explained by the effect of perceived control (Redmond and Griffith, 2004). In the rural region, perceived control of food safety was enhanced as a result of subsistence farming. With land and labour available, nearly 90% of rural households surveyed produce their own food. As such, they had a strong belief that they were able to control the safety of their food.

"What I buy from the market may not be safe, but at least, what I produce is safe. I can grow vegetables, fruit trees, raise chickens, ducks, and pigs for my family. We (rural people) produce many things and just buy some things we don't have from wet markets. Our food is absolutely safe." (The rural group)

During group discussions, not only rural but also urban participants frequently expressed their trust in home-grown food which was described as "absolutely safe", as compared to food at the market. With this belief in mind, nearly 40% of urban households surveyed attempted to grow vegetables and fruits indoors. However, due to land constraints, they were unable to produce a range of food for their own family like rural families. Home-grown food in these urban households just accounted for a small proportion of the household food basket. The absence of home-grown food led to the lack of perceived control over food safety, and this thereby heightened urban consumer perception of food safety risk.

Food safety worry was positively and significantly determined by information acquisition about food incidents. One unit increase in information acquisition would result in being 6.7% more likely to express extreme worry about food safety. Whereas food risk information directly shaped food safety concerns in this chapter, the relationship was found to be indirect in chapter 3. This finding supports previous research which shows the positive relationship between risk perception and information about food risk (Rutsaert et al., 2013b, Wachinger et al., 2013). This relationship can be explained by the framework of social amplification of risk developed by Kasperson et al. (1988). Mass

media and social media have played the role of "risk amplifiers" in Vietnam. Similar to Nguyen-Viet et al. (2017), we found that a massive volume of media coverage about food safety incident in Vietnam has accelerated consumers' risk perception. Besides, consumers were not well informed about food risk, as extensive and contradictory information was provided to them. Consequently, there is confusion and distrust among consumers. This was confirmed through group discussions.

"Watermelons were soaked in preservatives, said a lot by T.V. Watermelons for ancestor cult in the New Year festival did not rot for a whole year. If there were no preservatives, why it could last for so long? Apples, pears, dragon fruits, all are the same. Can we trust in fruit now" (The rural group)

"There is too much and different information about food, I don't know who I should trust" (The urban group).

Trust in institutions that are responsible for food safety management has been empirically demonstrated as an important predictor of perception of food safety risk in many studies (Frewer et al., 2007, Liu et al., 2014, Chen, 2013, Lobb et al., 2007). Surprisingly, in this study, trust in institutions was not related to the worry about food safety. Perhaps, as shown in chapter 3, trust influenced perception of food safety risk in general indirectly rather than directly.

Unexpectedly, direct experience with food poisoning did not determine food safety concerns. Perhaps using survey questions to obtain information on food poisoning experience was not an appropriate data collection method. Firstly, food poisoning is not easily identifiable, especially when poisoning symptoms are not clear or being similar to other illnesses. Secondly, consumers might just remember their most recent and severe events. Thus, events that happened a long time ago and were not serious might be forgotten.

Risks perceived of common food were important predictors of perception of food safety risk in general. The effect of risk perceived of protein food and risk perceived of vegetables and fruits were both statistically significant, positive, and large. If the risk perceived of protein food items or of vegetables and fruits increase by 1 unit, the

respondent would be 8.9% and 8.6% more likely to report an extreme worry about food safety, respectively. Hence, from a policy perspective, to reduce consumers' worry about food safety, risk perception of common food must be reduced.

The number of food safety issues of concern was another determinant of perception of food safety risk in general. This suggests that reducing consumer anxiety about food safety requires effort in managing food hazards and in reducing the risk perception of hazards. Moreover, there exists a dearth of research that investigates the relationship between risk perceived of common food, risk perceived of hazards, and the risk perceived from food in general. Thus, more research on this issue is needed.

4.4. Conclusions and policy implications

Using consumer survey and group discussions, we found that food safety was a primary concern for most of food shoppers in Hanoi. Consumers very much worried about various food hazards, particularly chemical hazards that were perceived to be invisible, having long term effects and serious health consequences. Hence, in their eyes, a high risk was involved in several common food categories that can be easily contaminated by chemical hazards. This suggests relationships between risk perception of hazards, risk perception of common food, and the worry about food safety. Therefore, to reduce "food fears" in Vietnam, these relationships must be considered. The concern about food safety can be reduced by reducing risk perception of common food and risk perception of hazards, particularly chemical hazards.

The study sheds more light on regional differences in perception of food safety risk. Risk perception of food was lower in the rural region due to a higher perceived control over food safety and stronger social and kinship networks that are identical in the rural setting. In rural areas, such perceived control was gained through an integrated farming system including garden, fishpond, and animal husbandry which enable small-scale farmers to produce a range of "safe food" for family consumption. To reduce the risk perception of food in the urban region, improving personal perceived control over food safety through the development of urban farming is important.

Perception of food safety risk in general was determined by the number of food safety issues that caused the concern, risk perceived of protein food, and risk perceived of vegetables and fruits. The strong effect of risk perceived of common food products on food safety concerns leads to an important policy implication. To reduce consumers' anxiety about food safety, policy interventions should focus on reducing the risk perceived of common food products in Vietnam, especially products that were considered very risky such as vegetables, fruits, and meat. To do so, better control of the safety of these products is required.

The moderate effect of information acquisition about food incident highlights the importance of adequate risk communication in Vietnam. Risk communication is poor in Vietnam (Nguyen-Viet et al., 2017). Excessive and conflicting information about food risk expressed by media is responsible for consumers' confusion and distrust. Hence, the concern about food safety is growing. To reduce consumers' anxiety about food, there is a need to manage food risk communication, aiming at information provision, which is accurate, evidence-based, and balanced between risk and benefit. In addition, capacity building through a consumer education program focusing on food hazards would support consumers' decision making in reducing risk. Finally, better management of chemical inputs would substantially alleviate consumer distrust in food.

The results of this chapter are similar to those of the previous one (chapter 3). Both of them provide evidence that food risk information, risk perception of common foods and risk perception of hazards shape the concern about food safety in either direct or indirect ways.

This chapter presents an overview of risk perception of food in general. The next chapter (chapter 5) focuses on risk perception and the relationship between risk perception and risk-reducing behavior toward a specific food group - vegetables. Chapter 5 continues to provide an insight into rural and urban differences in factors affecting risk perception.

CHAPTER 5: RISK PERCEPTION OF VEGETABLES AND ITS IMPACT ON VEGETABLE CONSUMPTION

This chapter is based on:

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5.1 Introduction

Urban expansion in developing countries poses challenges to ensuring food safety risks, particularly in perishable categories such as meat, fish, and vegetables. Rapid urbanization has lengthened the distance between primary food producers and final consumers, leading to an "information asymmetry" and increased consumer uncertainty about food quality. Urbanization also affects the way farmers use inputs. The loss of farmland due to urbanization, farmer's poor knowledge, and government failure in managing the use and trade of agrochemical inputs have resulted in the overuse or misuse of chemical fertilizers and pesticides in vegetable production. In recent years, farmers have been found to have used highly toxic- even banned pesticides in growing vegetables (Hoi et al., 2016).

In this chapter, we concentrate on vegetables only. Vegetables are the mainstay of the Vietnamese diet. The awareness of potential chemical contamination associated with vegetables has made vegetable safety a primary concern of many food shoppers. In an earlier study, Figuié et al. (2004) asked a sample of 200 Hanoi consumers to "Mention three foodstuffs which are, in your opinion, the most dangerous to your health." The consumers ranked vegetables as the most dangerous foodstuff, followed by meat, fruit, and then fish. 15 years later, we surveyed 498 Hanoi consumers, asking them to rate their perceived health risks associated with 6 perishable food products. The respondents again rated vegetable as the riskiest foodstuff, then fruit, meat, fish, milk, and egg (chapter 4). The fear of potential risks presented in vegetables remains persistent over this long period though many social, economic, and institutional changes have taken place in Vietnam. Reducing such fear from consumers' minds will be a challenge for policymakers. Risk perception is a subjective judgment that people make about the severity of risk (Slovic et

al., 1982). An understanding of factors that contribute to the heightened risk perception is essential in developing efficient countermeasures to address food safety concerns.

Previous studies have provided valuable insight into the complexity of consumer perception of vegetables. On the one hand, vegetable eating is understood to bring multiple health benefits (Herbert et al., 2010). On the other hand, consumers are worried about vegetable safety, particularly in Asian developing countries like Vietnam and China. Consumers in these countries are noticeably worried about vegetable contamination, especially pesticide residues (Cheng et al., 2016, Wertheim-Heck et al., 2014). Despite this, research that focuses on the determinants of vegetable risk perception in developing countries is limited. This chapter will address this gap.

Over 60% of the population continues to live in rural areas in Vietnam. Rural consumers differ from their urban counterparts in economic activities, social linkages (Durkheim, 1933), and access to healthy food (Larsen and Gilliland, 2008). Thus, factors affecting risk perception of rural people might be different from those of urban consumers. However, most of the empirical studies on food safety risk perception conducted in Vietnam (Figuié et al., 2004, Wertheim- Heck et al., 2014) and outside Vietnam (Liu et al., 2014, Omari et al., 2018) have ignored rural-urban differences in the determinants of food safety risk perception. A few research compared risk perception between rural and urban regions merely by treating the residential location as a dummy predictor of risk perception (Liu and Ma, 2016, Hall and Moran, 2006). Except for one study by McEachern and Warnaby (2008), not many studies explained the reasons for such differences. These authors found that rural consumers were concerned more about the safety of fresh meat, as compared to urban consumers. The reasons offered are that rural consumers have higher involvement in fresh meat purchase and awareness of quality assurance labels. This chapter analyses and compares the underlying drivers of risk perception between the rural and urban regions for a complete understanding of this rural-urban divide.

Risk perception plays a key role in driving food choices (Frewer et al., 2007). In Vietnam, heightened risk perception has prompted consumers to take various precautions such as growing vegetable at home (Van Hoi et al., 2009), purchasing conventional vegetables from regular vendors (Wertheim-Heck et al., 2014) or be willing to pay a premium for organic alternatives (Hai et al., 2013). International experience shows that a high level of

risk perceived from food will immediately translate into lower consumption and avoidance of some food categories (Grunert, 2005). Pennings et al. (2002) and Schroeder et al. (2007) established an association between risk perception of BSE (Bovine spongiform encephalopathy) and the reduction in the consumption of beef in the United States and Europe during and after the BSE crises. Since the concern about vegetable safety is substantial in Vietnam, a similar effect of risk perception might occur. However, the impact of risk perception on food consumption is not fully understood in Vietnam and other developing countries. In this chapter, we investigate changes in food consumption as a consequence of heightened risk perception in a developing country context.

The objectives of this chapter are twofold. First, the chapter investigates and compares the determinants of risk perception of vegetables across the rural and urban regions. Second, it analyses the impact of risk perception of vegetables on self-reported vegetable consumption. The study explores, for the first time, the similarities as well as disparities in influencing factors of risk perception between the rural and urban settings. These insights will enable decision-makers to design effective risk communication strategies that are specific to each region. The information about changes in food consumption due to food safety concerns will assist the development of food safety policies in Vietnam and other developing countries that suffer from consumer distrust in food.

5.2 Conceptual framework

The conceptual framework in Figure 5.1 shows various psychological and social-economic factors influencing risk perception of vegetables. We expect their effects to be different depending on whether the consumers are from rural or urban regions. A high level of risk perceived from vegetables leads to changes in vegetable consumption.

While there is a wide range of vegetable categories in Vietnam, our conceptual framework only focuses on fresh vegetables that are consumed daily. These vegetables can come from different sources such as homegrown, purchasing from the market, or sourcing from relatives and friends.

In this research, we adopt the definition of Schroeder et al. (2007) where food safety risk perception is defined as consumer evaluation of their health risk from consuming food.

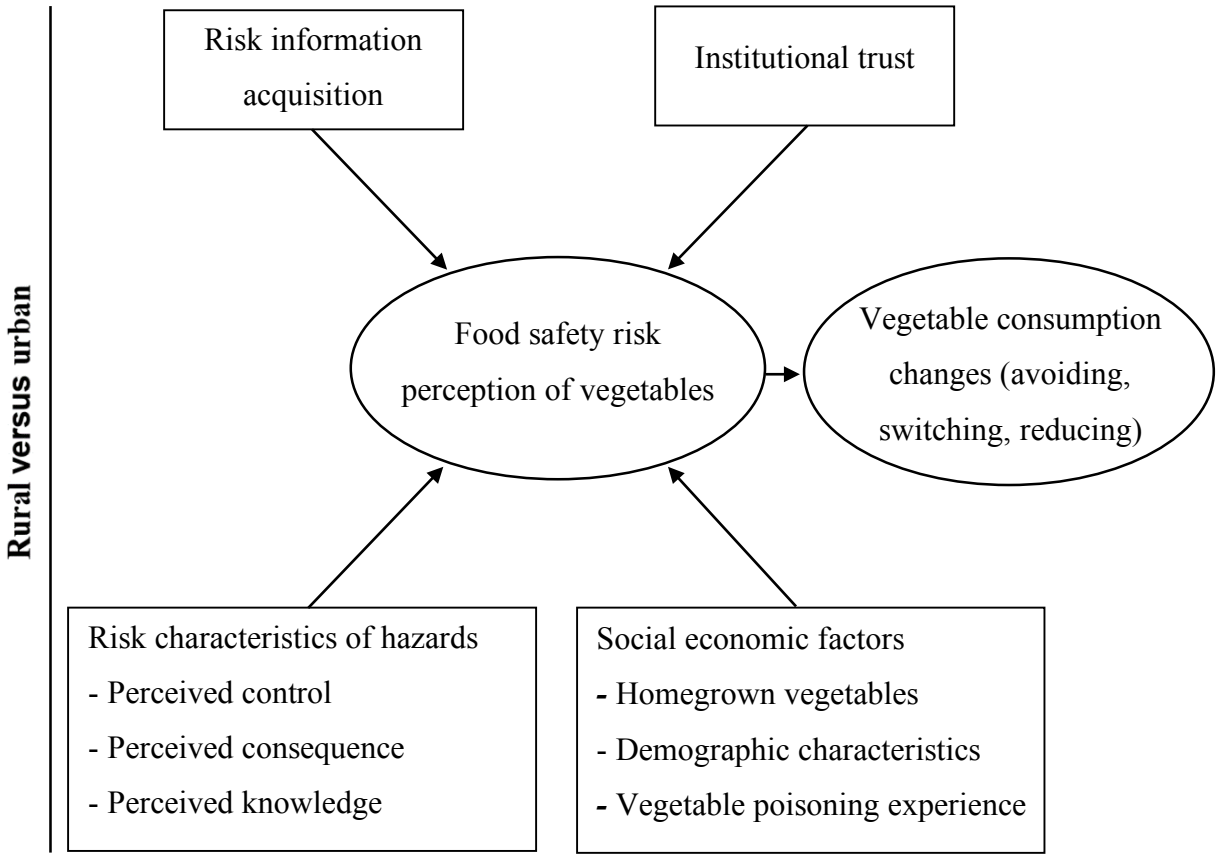

Figure 5.1: Conceptual framework of factors that affect risk perception and the relationship between risk perception and vegetable consumption

5.2.1 Determinants of food safety risk perception

Factors affecting risk perception might be different between rural and urban regions. These are caused by regional differences in social interaction, culture, and economic activities, as stated by Durkheim (1933). The effect on risk perception depends on the particular food safety issue under consideration. Liu and Ma (2016) found that urban dwellers perceived a higher food risk and were concerned more about food safety than rural residents. However, Hall and Moran (2006) indicated that rural people rated a higher level of risk from GMO than urban consumers. Rural and urban regions also differ in their search for health information. Rural people were less likely to use the internet due to lower educational level and income (Hale et al., 2010). There is evidence that trust in institutions is lower in the urban region. Shi (2001) found that more media access eroded urban people's trust in the government. Since rural and urban consumers are dissimilar in

their risk judgment and many other aspects, we expect that factors influencing risk perception might differ between these two consumer groups.

Trust in institutions is an important psychological determinant of risk perception (Hobbs and Goddard, 2015). Since consumers do not possess sufficient knowledge of food hazards, employing trust in parties that are responsible for managing food safety help reduce the complexity that consumers face (Siegrist, 2000). Empirical evidence on the positive association between lack of trust in institutions (e.g., public authorities, food industry) and food safety risk perception was established by Lobb et al. (2007) and Knight and Warland (2005).

The psychometric paradigm developed by Slovic (1992) is one of the major theories on risk perception. This psychological-based theory argues that individuals' risk interpretation of a hazard is formed by risk characteristics - the extent the hazard is perceived to be known, controllable, and severe. Different hazards might contaminate vegetables. Chemical hazards are evaluated to be more dangerous than bacterial hazards because of the belief that they are severer, less familiar, and less controllable (Kher et al., 2013). The concern about vegetable safety is very high in Vietnam and China (Cheng et al., 2016) due to the worry about pesticide, a chemical hazard. We anticipate that perceived control and knowledge of hazards will reduce risk perception while the perceived consequences of hazards will increase risk perception of vegetables.

Another theory, social amplification of risk (Kasperson et al., 1988) provides an understanding of the role of risk information in shaping risk perception. This theory also explains how a small risk, as assessed by experts, results in public concerns with profound impacts. When an incident occurs, information about risk is collected, processed, and interpreted by individuals. Risk is then amplified through the interaction between individuals and social amplification stations (e.g., scientists, the media, and social networks). Thus, having experienced a few episodes of food risks, confidence in food safety will drop dramatically when new information about food risk spreads. Once this information is captured and exploited by mass media, risk perception will be escalated, causing unwarranted panics (Verbeke, 2005). We expect that food risk information acquisition is positively associated with the risk perceived of vegetables.

According to the cultural theory developed by Douglas and Wildavsky (1983), risk perception was a social or cultural construct. Thus, there is a large divergence among different people regarding risk perception and there is great disagreement about the most dangerous risk of society. This might be a reason why risk perception differs across socioeconomic characteristics. Dosman et al. (2001), in their review, revealed the significant influence of some demographic variables such as age, education, income, and the presence of children on risk perception. Homegrown vegetables are believed to be very safe. Possessing homegrown vegetables, therefore, represents a better control over vegetable safety. This thereby reduces risk perception of vegetables. Furthermore, direct experience from food poisoning in the past might recall consumers' memory about the event and increase risk perception (Green et al., 2003).

5.2.2 The influence of risk perception on food consumption

According to the psychological approach, the more a person dreads an activity, the higher its perceived risk, and the more that person wants the risk to be reduced (Slovic et al., 1982). We assume that consumers, in general, are risk-averse who strive to lower the probability and negative impacts of vegetable poisonings. In response to the perceived risk, risk-averse consumers will modify their consumption decision and develop risk-reducing strategies. Consumers tend to avoid eating particular food categories if they view the threat from consuming these foods is great. Avoiding strategy is likely to be implemented if consumers do not like the food, or they can find alternatives to substitute (Järvelä et al., 2006). When avoiding strategy is carried out alongside substituting strategy, the total vegetable consumption will be stable. The total consumption is likely to decline in the absence of safer food alternatives.

There is ample empirical evidence on the association between risk perception and food consumption outcomes. Yeung and Morris (2006) revealed that the likelihood of purchasing chicken was negatively determined by risk perception of chicken meat in Britain. Similarly, Pennings et al. (2002) found the probability that consumers across the US and some European countries reduce beef consumption was positively influenced by risk perception of mad cow disease. Schroeder et al. (2007) in their survey, again on the US and Europe, reported that risk perception of mad cow disease determined not only the probability but also

the percentage of self-reported reduction in beef consumption. We hypothesize a positive correlation between risk perception and vegetable consumption reduction.

In this study, vegetable consumption reduction is defined as the volume of fresh vegetable consumption that consumers have cut down within a period of time due to the concern about vegetable safety.

5.3 Methodology

5.3.1 Consumer survey

Data and the sampling process are the same as those that are comprehensively described in chapter 2. In total, 498 primary food shoppers: 230 from rural and 268 from urban regions were selected. A high level of concern about vegetable safety of Hanoi residents offers an opportunity to study consumer perception of food safety risk and its influence on vegetable consumption.

5.3.2 Variable measurement

5.3.2.1 Variables used to analyse the determinants of risk perception

We measured variables relating to trust and perception by 10-point Likert scale with a higher scale reflecting a higher level of trust and perception (Table 5.1). Many other risk perception studies use either 5 or 7 point scale that was not suitable for our study. Our pilot survey demonstrated that a 10 point scale reminded respondents of the academic grading system in Vietnam that they are familiar with.

Risk perception of vegetable (PV) was measured by the perceived health risk item adapted from Schroeder et al. (2007): "To what extent do you think that you are exposed to the health risk from eating vegetables, in general." Initially, the responses were on a 10-point scale. For a better interpretation of the results from ordered logit regressions, this variable was later transformed into 5 point-scale presenting 5 ordered categories of risk perceived (very low, low, moderate, high, and very high). Such transformation, according to Dawes (2008), would not cause large changes in data characteristics.

Table 5.1: Variable definition and statistics

Variables/ constructs	Variable definition	Scale	Whole sample (n=498) Mean (SD)	Rural (n=230) Mean (SD)	Urban (n=268) Mean (SD)
Risk perception	Risk perception of vegetables	1-5	3.80 (0.96)	3.6* (1.01)	3.9* (0.90)
Trust in	Local government	1-10	4.11 (2.95)	5.28* (3.15)	3.11* (2.34)
	Central government	1-10	3.56 (2.54)	4.32* (2.75)	2.91* (2.14)
	Supermarkets	1-10	4.46 (2.44)	4.50 (2.66)	4.43 (2.25)
	Farmers	1-10	2.77 (2.18)	3.16* (2.44)	2.44* (1.87)
	Food traders at wet markets	1-10	2.42 (1.85)	2.77* (2.13)	2.13* (1.52)
Perceived knowledge of	Pesticides	1-10	5.17 (2.52)	5.09 (2.68)	5.23 (2.38)
	Bacteria	1-10	4.90 (2.33)	4.76* (2.38)	5.02* (2.28)
	Heavy metal	1-10	4.19 (2.38)	3.97* (2.40)	4.39* (2.36)
	GMO vegetables	1-10	3.38 (2.41)	3.13* (2.41)	3.59* (2.40)
Perceived control over	Pesticide residue	1-10	3.45 (2.19)	3.75* (2.31)	3.20* (2.05)
	Bacteria	1-10	4.93 (2.56)	4.73 (2.48)	5.11 (2.62)
	Heavy metal	1-10	2.86 (2.01)	3.0*6 (2.06)	2.70* (1.96)
	GMO vegetables	1-10	2.70 (2.10)	3.09* (2.27)	2.36* (1.88)
Perceived consequence of	Pesticide residues	1-10	8.20 (1.98)	8.13 (2.05)	8.27 (1.91)
	Bacteria	1-10	7.28 (2.19)	7.12 (2.33)	7.42 (2.06)
	Heavy metal	1-10	7.90 (2.09)	7.58* (2.29)	8.19* (1.86)
	GMO vegetables	1-10	7.41 (2.51)	7.01* (2.73)	7.76* (2.25)
Information about	Food incidents from TV	1-5	3.92 (0.82)	3.81* (0.80)	4.01* (0.84)
	Food incidents from social media	1-5	3.34 (1.27)	2.83* (1.35)	3.78* (1.01)
	Food incidents from relatives/friends	1-5	3.68 (0.93)	3.54* (0.91)	3.81* (0.93)
VegGrow	=1 if the family grow vegetables	0-1	0.60 (0.49)	0.85* (0.36)	0.38* (0.48)
Veg Poisoning	=1 if have been poisoned by vegetables	0-1	0.31 (0.46)	0.31 (0.46)	0.30 (0.46)
Elderly	=1 if ≥ 60 years old	0-1	0.37 (0.38)	0.48* (0.50)	0.28* (0.44)
Male	=1 if male	0-1		0.12 (0.33)	0.13 (0.33)
Rich	=1 if individual monthly income ≥15 mil VND	0-1	0.25 (0.43)	0.09* (0.28)	0.40* (0.49)
Children	=1 if there was at least 01 child in the family	0-1	0.76 (0.43)	0.69* (0.46)	0.81* (0.39)
University	=1 if have a university degree or higher	0-1	0.51 (0.50)	0.25* (0.43)	0.74* (0.44)

*Note: PV denotes perception of food safety risk of vegetables. GMO denotes genetically modified organisms. 23 thousand VND = 1 USD. * the mean scores at the same row are statistically different at 5%, using independent sample T-test.*

We proposed 5 constructs. Since trust is different across actors (Hobbs and Goddard, 2015), we included three institutions (government, food retailers, and farmers) to reflect institutional trust. We used the item adapted from Siegrist (2000) to measure trust: "To what extent do you trust institutions below?" Trust in food traders in the wet market was the lowest. Urban people placed a lower level of trust than rural residents (Table 5.1).

"Perceived Knowledge" conveys knowledge level respondents believed they have across various hazards. "Perceived Control" reflects consumers' view about the extent they were able to reduce particular hazards through washing and cooking vegetables. "Perceived Consequence" refers to the evaluation of negative health impacts from hazards. Three constructs above included some recognised scales designed by Yeung and Morris (2006) to measure risk characteristics of food hazards.

"Information" measures the frequency of information acquisitions about food incidents via mass media (T.V), social media (Facebook), and personal sources (relatives and friends). These are the top three preferred information channels by consumers to access food safety news (Rutsaert et al., 2013a). Responses ranged from 1 to 5, where 1 means "never" and 5 means "always" - having heard nearly every day. The rest are dummy variables presenting socioeconomic factors that are potential explanatory variables of risk perception.

5.3.2.2 Variables used to analyse changes in self- reported vegetable consumption and the impact of risk perception on vegetable consumption

To reflect changes in food consumption caused by risk perception, our questionnaire began with a filter item, asking whether respondents worry about vegetable safety. Those having a positive response then answered the question: "Due to the concern about food safety, have you avoided eating any particular vegetables in the last two years? "If yes, please list their names". Food consumption patterns may vary over time for other reasons like price fluctuations, change in marital status or parenting. The filter above eliminates response errors, as it captures only the consumption changes due to food safety reasons.

Two items adapted from Schroeder et al. (2007) were used to reveal 1) whether the respondent reduced vegetable consumption during the last two years due to the concern about food safety, and 2) the estimated percentage reduction in vegetable consumption

by volume. The chosen period witnessed some major scandals on vegetable safety in 2015 that can potentially impact on vegetable consumption. These two scandals are discussed later in section 5. The variables used in the analysis are shown in Table 2. The first four were used to examine changes in vegetable consumption. The remaining two were to analyse the impact of risk perception on the consumption.

All variables used in the analysis are shown in Table 5.2. We classified 4 levels of consumption reduction. Level 1 implies a decrease of less than 20% of total vegetable consumption, level 2 (from 20 to 39%), level 3 (from 40 to 59%), and level 4 (more than 60%).

Table 5.2: Variables and measurement scale

Aspects	Variables	Min	Max
Changes in vegetable consumption	% of respondents reduced vegetable consumption	n/a	n/a
	% of total vegetable consumption to be reduced/respondent	0	80
	% of respondents avoided eating at least one vegetable	n/a	n/a
	Number of vegetable species to be avoided/respondent	0	7
Impact of risk perception on the consumption	Risk perception	1	5
	Level of consumption reduction	4	4

Note: n/a denotes not available.

5.3.3 Data analysis

5.3.3.1 Analysing the determinants of risk perception of vegetables

The determinants of risk perception were identified through 2 steps: 1) principal component analysis (PCA) and 2) ordered logit regression. PCA helps reduce the large and correlated dataset into a fewer number of uncorrelated principal components while retaining large information of the dataset (Jolliffe, 2002). 20 independent variables measuring 5 constructs in Table 5.1 were subject to PCA as they are highly correlated.

The analysis was performed on the pooled dataset as there were no much differences in the results of separate PCA for the rural and urban subsample.

The components retained from PCA are potential determinants of risk perception. We performed VARIMAX rotation on PCA. In each component, only variables with a factor loading above 0.4 were selected (Matsunaga, 2010). Three criteria to select the components were 1) Eigenvalue of the component greater than one, 2) total variance explained by all components selected higher than 60%, and 3) each component retained accounting for at least 1% of the total variance (Jolliffe, 2002).

The components extracted from PCA, together with socio-economic variables (the last 7 variables in Table 5.1) were regressed separately for the rural and urban regions. Since risk perception of vegetables has 5 ordinal outcomes (very low, low, moderate, high, or very high), ordered logit regression was employed.

We assessed two assumptions of ordered logit regression: multicollinearity and proportional odds. Correlation coefficients of all pairs of independent variables were smaller than 0.6, demonstrating that multicollinearity was not a problem. The approximate likelihood-ratio test was significant for the rural ($\chi^2(39) = 66.69$, $p = 0.003$) as well as the urban sample ($\chi^2(35) = 54.85$, $p = 0.017$). The second assumption was met, suggesting that there is the same set of coefficients across different outcomes of risk perception across rural and urban models.

5.3.3.2 Analysing the influence of risk perception on vegetable consumption

We used Kruskal-Wallis test (Kruskal and Wallis, 1952) to examine the impact of risk perception on vegetable consumption. This nonparametric statistical test compares several independent groups on a particular variable that does not follow the normal distribution. Since the level of consumption reduction (Table 5.2) was non-normalized, the use of the Kruskal-Wallis test was appropriate. The test helps identify whether vegetable consumption reduction levels differ among different groups of respondents, based on their risk perception of vegetables. Respondents were classified into 5 groups according to 5 corresponding risk perception outcomes (1 to 5). “Consumption reduction level” would be ranked for the whole sample ascendingly from 1 to 498 (as n = 498) with

a higher mean rank is associated with a higher level of consumption reduction. This is followed by the calculation of the mean rank for each group. The post hoc test was then conducted to examine whether the rank means are statistically significantly different between each pair within 5 groups.

5.4. Results

5.4.1 Determinants of risk perception of vegetables

Table 5.3 shows the results of the PCA analysis. The Kaiser-Meyer-Olkin (KMO) that measures sampling adequacy was at an acceptable level (0.72). Cronbach's alphas of all the components were higher than 0.6, suggesting adequate construct reliability (Tavakol and Dennick, 2011). 5 retained components were: "Institutional Trust," "Perceived Knowledge," "Perceived Consequence," "Perceived Control," and "Information.". These components were able to explain about 65% of the total variance of the data set. For convenience, we only reported factor loadings with values higher than 0.4.

Table 5. 1: Results of Principal Components Analysis

n = 498

Items	Components				
	1	2	3	4	5
	Trust	Perceived knowledge	Perceived consequence	Perceived control	Inform
Trust in central government	0.83				
Trust in local government	0.81				
Trust in supermarkets	0.78				
Trust in retailers at wet markets	0.71				
Trust in farmers	0.63				
Perceived knowledge of heavy metals		0.89			
Perceived knowledge of pesticides		0.85			
Perceived knowledge of bacteria		0.83			
Perceived knowledge of GMO		0.71			
Perceived consequence of heavy metal			0.88		
Perceived consequences of pesticides			0.73		
Perceived consequences of bacteria			0.87		

Perceived consequences of GMO			0.77		
Perceived control over heavy metal				0.89	
Perceived control over pesticide				0.77	
Perceived control over bacteria				0.79	
Perceived control over GMO				0.72	
Food incidence heard from relatives					0.75
Food incidence heard from social media					.78
Food incidence heard from TV					0.72
% of total variance explained	19.95	17.78	12.81	8.46	6.84

Note: The Cronbach's alpha of the 1st, 2nd, 3rd, 4th, 5th component are 0.81, 0.85, 0.84, 0.75, 0.65, respectively.

Table 5.4 provides the results of ordered logit regression by region. For brevity, we only reported marginal effects of the highest category of dependent variables - "very high risk." The likelihood ratio chi-square of the rural and urban model was 36.84 and 51.68, respectively, with $p < 0.001$. This suggests that the two models as a whole were statistically significant, as compared to the null model with no predictors. For brevity, we only reported marginal effects of the highest category of dependent variables - "very high risk."

No demographic variable exerts a significant effect on the urban region, while only age and education affected risk perception in the rural region. Urban residents who experienced vegetable poisoning was 10.6% more likely to report a very high-risk of vegetables than those who have not. Self-provisioning of vegetables and perceived control over hazards reduced the chance that urban respondents reported "very high risk".

In both regions, the more frequently respondents heard about food safety events, the higher was the probability they cited a very high risk. Trust caused a negative effect, while the perceived consequence of hazards generated a positive effect on risk perception of vegetables.

Table 5.3: Ordered logit regression results

Variables	Rural		Urban	
	Coefficient (SE)	Marginal effect (SE)	Coefficient (SE)	Marginal effect (SE)
Male	-0.442	-0.063	-0.255	-0.047
	(0.406)	(0.058)	(0.358)	(0.066)
Elderly	0.668*	0.096	-0.056	-0.010
	(0.354)	(0.050)	(0.496)	(0.092)
University	0.692**	0.099	-0.025	-0.004
	(0.323)	(0.045)	(0.283)	(0.052)
Children	0.025	0.003	-0.252	-0.047
	(0.271)	(0.038)	(0.303)	(0.056)
Rich	0.035	0.005	0.193	-0.036
	(0.452)	(0.065)	(0.253)	(0.047)
Veg Poisoning	0.163	0.023	0.570***	0.106
	(0.293)	(0.042)	(0.260)	(0.047)
Veg Grow	-0.430	-0.061	-0.408**	-0.076
	(0.352)	(0.050)	(0.206)	(0.045)
Perceived Knowledge	0.117	0.017	0.201	0.037
	(0.127)	(0.018)	(0.125)	(0.023)
Perceived Consequence	0.287**	0.041	0.591***	0.110
	(0.121)	(0.017)	(0.138)	(0.024)
Perceived Control	-0.088	-0.013	-0.472***	-0.088
	(0.128)	(0.018)	(0.126)	(0.022)
Information	0.512***	0.073	0.284**	0.053
	(0.143)	(0.021)	(0.140)	(0.025)
Trust	-0.293**	-0.042	-0.265*	-0.049
	(0.124)	(0.018)	(0.143)	(0.026)
Log-likelihood ratio (p=0.000)	36.84		51.68	
Count R^2	40.00		49.60	

*Note: Numbers in brackets are standard errors;*** , * : *significant at 5%, 10% level, respectively*

5.4.2 Risk perception of vegetables and their impact on vegetable consumption

All surveyed consumers stated that they were worried about vegetable safety. Risk perception of vegetables was high for the whole sample (mean = 3.8 (out of 5) ± 0.96). Urban consumers viewed a relatively higher level of food safety risk from vegetables. The two-sample T-test shows a statistically significant difference between the two regions regarding risk perception (3.9 ±0.9 for the urban and 3.6 ± 1.00 for the rural, p = 0.00) (Table 5.1).

Table 5.4: Changes in vegetable consumption due to food safety concerns

Indicators	Whole sample	Rural	Urban
% of respondents reported vegetable consumption reduction	33.50	34.34	33.84
% of vegetable consumption has been reduced/respondent	8.47	8.46	8.54
% of respondents avoided eating at least one vegetable	89.36	87.50	88.79
Number of vegetable species that were avoided eating/respondent	2.23	2.16	2.29
Top 10 vegetables that were frequently avoided eating	pak choy, choy sum, cabbage, broccoli, morning grow, watercress, Thai brinjal, cucumber, bean sprout, and lettuce		

Note: The scientific names of pak choy, choy sum, morning grow, and Thai brinjal are Brassica rapa *L. var. chinensis, Brassica rapa* var. *parachinensis, Ipomoea aquatic Forsk, and Solanum macrocarpon L., respectively.*

About one-third of respondents reported a decrease in the volume of vegetable intake during the last 2 years because of food safety concerns (Table 5.5). The self-reported reduction was about 8.5% for an average respondent. 89% of them cited that they had excluded some vegetable species in their diet. Among the top 10 frequent-cited vegetables, 7 of them belong to a leafy category (pak choy, choy sum, cabbage, broccoli, morning grow, watercress, lettuce). In respect to the type of consumption, 4 of them are often eaten as a salad (Thai brinjal, cucumber, bean sprout, and lettuce) while the rest 6 are usually cooked before consuming.

Though risk perception of vegetables was higher in the urban region, the self-reported decrease in vegetable consumption tends to be similar between the rural and urban regions. The values of all four indicators in Table 5.5 are not much different across the two regions. The chi-square test (for the first and the third indicator and two sample T-test (for the second and the fourth indicator) between rural and urban groups were insignificant, indicating that the two regions shared the same trend in the reduction of vegetable consumption.

Table 5.5: Risk perception level and vegetable consumption reduction

n = 498

Risk perception outcome	N	Mean rank of the consumption reduction level
1	10	178.00
2	34	198.78
3	128	233.01
4	197	237.05
5	129	303.79
$\chi^2(4) = 45.135$, P = 0.000		

Note: Reduction in vegetables consumption is in scale 1-4 with 1 (reduce less than 20%), 2 (reduce 20% -39 %), 3(reduce 40% - 59%), 4(reduce more than 60%); risk perception for vegetables was in a 1-5 scale with 1(very low) and 5(very high). The mean rank of consumption reduction level is calculated by the Kruskal-Wallis test.

The Kruskal- Wallis test illustrated in Table 5.6 shows a statistically significant difference in vegetable consumption reduction between different levels of risk perceived from vegetables ($\chi^2(4) = 45.135$, P = 0.000). This suggests that at least one group had the mean rank of vegetable consumption reduction different from other groups. The mean rank of consumption reduction level increased with risk perception levels suggesting a positive relationship between risk perception and consumption reduction. The Dunn-Bonferroni post hoc test in Table 5.7 further revealed that the mean rank of vegetable consumption reduction differed significantly across risk perception outcomes either at 5% or 10% level. All of these results confirm that a higher risk perceived led to a higher level of vegetable consumption reduction.

Table 5.7: Results of Dunn-Bonferroni post hoc test

Compare the mean rank of consumption reduction between risk perception outcome	$\chi^2(1)$	P
1 and 2	0.93	0.34
1 and 3	2.88	0.09*
1 and 4	3.04	0.08*
1 and 5	8.50	0.04**
2 and 3	3.30	0.07*
2 and 4	4.00	0.04**
2 and 5	18.41	0.00**
3 and 4	0.10	0.74
3 and 5	21.95	0.00**

Note**, *: significant at 5% and 10% level, respectively, using Kruskal- Wallis test

5.5. Discussion

5.5.1 Factors affecting risk perception of vegetables

We found notable differences in the determinants of vegetable risk perception between the rural and urban regions. These are the effects of 1) demographic variables, 2) personal experience with vegetable poisonings, 3) self-provisioning of vegetables, and 4) perceived control of hazards.

While age and education shaped vegetable risk perception in the rural area, none of the demographic characteristics influenced risk evaluation in the urban region. Unlike Lee et al. (2012) who found a negative association between education and food safety risk perception, we found a positive result, but significant only for the rural subsample. We believe a better education might be associated with more exposure to risk information, leading to higher risk perception. For urban consumers, their personal experience with food poisoning raised their risk perception, as direct exposure to risk events often enhances consumers' memory and imagination of the hazard (Kasperson et al., 1988). More research is needed to examine the reasons behind these disparities between rural and urban settings.

The significant effect of homegrown vegetables in the urban area can be caused by the perceived control over vegetable safety. Despite land scarcity, 38% of urban households in our sample were growing vegetables for family consumption. These households undertook many initiatives to grow pesticide-free vegetables on rooftops, or strips of public land around residential buildings, or along roads. Some of them applied chemical fertilizers but in a minimal quantity. Believing that they had better control over the safety of home-grown vegetables, their perceived risk, therefore, was lower than others.

The feeling of having control over food safety also explains why vegetable self-provisioning did not determine risk perception in the rural region. 85% of rural households growing vegetables (Table 5.1). Believing that safe cultivation methods have been used to grow own vegetables, these families might think that they are able to eliminate risks from vegetables. Households that did not grow vegetables can also manage food safety owing to strong social ties in the rural area (Mair and Thivierge-Rikard, 2010). These families might obtain "safe vegetables" easily by asking or buying vegetables from their kin or friends whom they trust.

Perceived control over hazards statistically decreased risk perception in only the urban region, suggesting that improving perceived control over hazards of urban consumers will help reduce their anxiety about vegetable safety.

Rural and urban regions shared three similar predictors of risk perception: 1) food risk information acquisition, 2) trust, and 3) perceived consequence of hazards.

Risk perception in both regions increased with information acquisition about food safety incidents. This finding revealed poor risk communication in Vietnam. The social amplification of risk developed Kasperson et al. (1988) indicates that media and social groups interact with each other to escalate a marginal risk into a heightened risk. Such media effect is also found in Vietnam. Nguyen-Viet et al. (2017) pointed out that a massive volume of media coverage of inappropriate food safety practices has escalated public perception of food risk in the country. Observing a national television program titled "Say No With Contaminated Food", we found that though negative news about food safety (e.g., foodborne outbreaks), as well as good remedial news (e.g., adoption of Good

Agricultural Practices), were disseminated, negative news was reported more frequently than remedial news. Since bad news is often believed to be more trusted, visible, and noticeable than good news (Slovic, 1993), frequent food safety scandals alongside media effects have caused unnecessary anxiety in public.

A negative relationship between risk perception and trust was found across the regions. This result is consistent with other studies (Kuttschreuter and Hilverda, 2019). Trust in the food system acts as a coping mechanism that helps consumers reduce the complexity of risk assessment and therefore eliminate their concerns (Knight and Warland, 2005). The finding above suggests that reducing risk perception requires an improvement in institutional trust.

Perceived consequence of hazards accelerated risk perception across regions. This finding confirms the linkage between risk characteristics of hazards and risk perception. However, other risk characteristics, for example, perceived knowledge of hazards did not translate into risk perception of vegetables. More empirical research on other food products is needed to retest the link between perceived knowledge, perceived control of hazards with risk perception across regions.

5.5.2. Risk perception of vegetables and its impact on vegetable consumption

Risk perception of vegetables was higher in the urban region. Perhaps, this is due to the absence of homegrown vegetables in 62% of urban households, comparing to 15% of rural families, as mentioned previously. Furthermore, urban residents might have better access to food safety information (Hale et al., 2010), which probably leads to a higher perceived risk. High level of risk perceived from vegetables made consumers selective in consumption by avoiding to eat some products. When confronted with a high-perceived risk from vegetables, consumers tend to employ optimal risk reduction strategies: maximizing their utility given their available resources. Rather than engaging in a costly information search, many survey participants chose an uncomplicated strategy: eating fewer vegetables than before or stop consuming some species of risky vegetables. The percentage of consumers that avoided eating at least one vegetable was higher than the proportion of consumers that reduced the total vegetable consumption (Table 5.5). This result suggests that when postponing the

consumption of some vegetables that are perceived to be risky, the majority of consumers have switched to the alternatives that are regarded as safer.

Similar to a survey conducted in a small city of Vietnam by Wertheim-Heck et al. (2014), our survey uncovered that leafy vegetables were believed to be relatively unsafe as compared to root vegetables (carrot, potato) and fruit vegetables (hairy melon, guava bean, sponge luffa). Consumers believed that root and fruit vegetables had skin that can prevent these vegetables from absorbing chemicals. They also thought that if the skin is peeled off before eating, then the chance of contamination in these vegetables is reduced. Because of this perception, consumers might have shifted from leafy vegetables into fruit and root categories. This risk-reducing behaviour has been well-documented in previous research. For example, Green et al. (2003) found that consumers avoided food, which was considered to be risky, such as frozen, imported, ready to eat food or takeaway food. Our research complements previous studies that present a common characteristic of most of the consumers: the risk-averse behaviour in food consumption.

Our survey uncovered that among the top ten riskiest vegetables listed in Table 5.5, the first seven were thought to be contaminated by insecticides while the next two were believed to be associated with growth regulators that are commonly used during vegetable production in Vietnam. For lettuce, the last item in Table 5.5, consumers believed that contamination is caused by eating them raw, which, unfortunately, is the usual way of consuming the product. In line with some studies conducted in Vietnam (Nguyen-Viet et al., 2017), this research suggests that pesticide residues in vegetables (insecticides, growth regulators) are considerable concerns of consumers. As a result, one-third of them chose to eat fewer vegetables than before, while the rest of them decided to shift to safer alternatives. Both of these responses can lead to less diverse vegetable intakes.

We found an increase in risk perception led to a reduction in vegetable consumption. Consumer reaction to heightened risk perception was also found in a study conducted in Vietnam by Figuié and Fournier (2008). The authors indicated that during the first outbreak of Avian Influenza Virus, H5N1 in January 2004, 74% of consumers stopped eating chicken due to fear of the virus. 3 months later, most of them began to consume but in a smaller quantity. Until May 2006, 6% of consumers still avoided chicken meat. Our study found that the average reduction percentage in vegetable consumption per

consumer was rather small at 8.5%. Consolidating related studies, we argue that the small amount of reduction in vegetable consumption in Vietnam might be due to vegetable safety scandals reported in mass media. There is evidence of cheating behaviour in the safe vegetable business of supermarkets and food shops in Vietnam (Le and Nguyen, 2018, Vo and Arato, 2020). Conventional vegetables are purchased from the wet market, labelled "safe vegetables", then sold by food stores and supermarkets (Le and Nguyen, 2018). In January 2015, some big supermarkets in Hanoi were reported to trade conventional vegetables but claimed these vegetables "safe". The incident publicised by various media outlets impacted negatively on supermarkets' image[3]. In our survey conducted two years after these scandals, we found that these scandals have increased risk perception and led to a reduction in vegetable consumption. Our study suggests that vegetable consumption per capita in Hanoi is declining as a consequence of heightened risk perception. On a positive note, reducing the perception of vegetable safety risk would help boost demand, contributing to the sustainability of vegetable production in Vietnam.

5.6 Conclusions

Perception of food safety risk is formed by a complex process involving psychological, social, and economic factors. The rural-urban disparity in the determinants of risk perception is a topic that has been largely ignored in the literature. We found that some of the factors influencing risk perception of vegetables were similar while others differed significantly across regions. Food incident information, perceived consequence over the hazards, and trust shaped vegetable risk perception in both regions. However, age and education influenced the risk perception of vegetables of rural consumers only. Personal experiences with vegetable poisoning, whether the household grows vegetables, and perceived control over the hazards were predictors in the urban region. While trust in actors at the wet markets determined rural consumers' vegetable risk perception, trust in all institutions affected urban respondents' risk evaluation.

[3] https://vietnamnews.vn/society/265631/supermarkets-sell-dubious-veggies.html
https://vietnamnews.vn/society/265770/city-asked-to-set-up-food-control-and-ensure-safety.html

Risk perception of vegetables was augmented by inadequate risk information sharing across regions. From a policy perspective, a better risk communication strategy is urgently needed to alleviate the crisis. Prudent risk communication should be based on the factual evidence about the risk, not just focusing on bad or negative news but also educating consumers on remedial aspects of food safety. Consumers need unbiased information to form a balanced assessment of risk. Accurate information about food hazards should be easily accessible and understandable to consumers. Since trust in government and food industry is low, risk information should not be communicated by them but by the most trusted sources such as health professionals and environmental organizations.

Improving trust is essential for both regions, as trust determined risk perception and trust has severely eroded. Building trust, according to de Jonge et al. (2008), requires three elements: care, competence, and openness. Trust in an actor is influenced by the extent to which the actor is perceived by consumers to be competent, honest, and caring about public welfare. In Vietnam, "care," "competence," and "openness" in food safety management is lacking. Consumers' trust in regulators is very low as they have observed corruption and widespread rent-seeking behaviour of government authorities such as food inspectors (Van Hoi et al., 2009). A series of food scandals have severely destroyed consumers' trust in the food industry. To restore trust, the government needs to demonstrate its commitment to reduce corruption. Trust in the food industry can be rebuilt by providing truthful information about food products, complying with food safety regulations, and showing genuine concern to consumer health.

Given the urban-rural differences found in this research, policy intervention should be tailored to each region. In the rural area, risk communication should reach older adults that are concerned more about vegetable safety. Also, since people with higher education assessed a higher risk of vegetables, there is an opportunity for the food industry and regulators to develop the organic market in the rural region.

This chapter highlights the importance of urban farming, as the self-provisioning of vegetables becomes a norm in big cities in Vietnam. Hanoi has a current population of over 8.5 million, with an annual growth rate of 3.5%. Ensuring food security and food safety for such a growing population remains a challenging task. Pulliat (2015) found that Hanoi households that engaged in urban agriculture were mainly low-income families.

Self-provision of food, a livelihood strategy for these families contributed to household food security. Our survey revealed that due to food safety concerns, growing own vegetables was a practice not only of low-income but also wealthy families in the urban region. In the urban region, the monthly family expense was not statistically significantly different between vegetable-growing households and non-vegetable growing households. We found that urban farming, a casual household food production practice, can contribute to sustainable food consumption in metropolitan cities by enhancing food safety and reducing food fears. Environmentally-friendly urban agriculture, such as integrated rooftops (Weidner et al., 2018) should be encouraged.

A high level of risk perceived from vegetables has resulted in behavioural changes to vegetable consumption. To cope with a risk perceived from vegetables, consumers developed some risk relievers. A substitution strategy was employed when consumers found alternatives such as fruit or root vegetables that are regarded as safe. When there were no alternatives, eating fewer vegetables (reducing strategy) or even not consuming some leafy vegetables was common. Being selective in choosing vegetables and reducing vegetable consumption imply that consumers have limited their freedom in eating vegetables. This might also negatively influence the diversity of their vegetable intake. Attenuating consumer fear of vegetable safety, therefore, becomes essential to enhance the sustainability of vegetable production in Vietnam.

This chapter investigates factors influencing the risk perception of vegetables and the relationship between risk perception and vegetable consumption reduction, one of the strategies to reduce the perceived risk. The following chapter (chapter 6) seeks to explain the willingness to pay for organic vegetables. While this chapter highlights regional differences in risk perception, the next chapter reveals the rural-urban divide in the willingness to pay for organic food.

CHAPTER 6: WILLINGNESS TO PAY FOR ORGANIC VEGETABLES

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6.1 Introduction

In emerging and developing countries, household food consumption pattern is experiencing a gradual switch from cereal-based foods to nutrition-rich items such as meat, fish, and vegetables. This is attributable to globalization, urbanization, and rising living standards (Mottaleb et al., 2018). At the same time, food safety and quality standards are becoming important to consumers in these countries (Henson and Reardon, 2005). Many recent food safety incidents, such as melamine-contaminated milk in China (2008), Taiwan food crisis (2013, 2014), South African *listeriosis* outbreak (2017-2018), to name a few, has eroded consumer confidence in food safety in developing countries. Like consumers everywhere, concerns over food safety is leading Vietnamese consumers to shift preference towards safer alternatives. Similar to their global peers, Vietnamese consumers also view organic products to be superior in terms of safety, taste, nutrition, and environmental values than conventionally grown cheaper alternatives. A burgeoning middle class is already showing much promise for a sizeable market for organic food in Vietnam. Agricultural land under organic production expanded eight-fold, from 11, 365ha in 2009 to 93,545 ha in 2017. However, the production of organic vegetables still constitutes a very small area, 151ha, in 2015 (Willer et al., 2009, 2017).

There are many opportunities as well as challenges to the development of the organic vegetable market in Vietnam. Vegetable is one of the dominant foods in Vietnamese cuisine, where the demand for organic vegetables is growing (Willer and Lernoud, 2017). Concerned about food hygiene and safety, particularly those related to pesticide use in agriculture, buying organic vegetables is the first experience in the organic market for most of the organic shoppers. There are many barriers to organic purchase such as high price, lack of market information, and distrust about product quality (Hai et al., 2013). Organic food is still limited to a niche market in Vietnam and mainly sold in the metropolitan areas

(My et al., 2017). The future of organic farming in Vietnam depends on consumer demand for organic food. Understanding consumers' preference for organic food, therefore, would help both producers and policymakers prepare a better plan for the future.

A rich body of literature already uncovered some key determinants of willingness to pay (WTP) for food safety attributes. Negative information about conventional products and positive information about organic alternative shapes consumer perception of organic products (Smed, 2012). The perception that organic products have unique values, as compared to conventionally grown alternatives, is what leads a majority of consumers to buy them (Shaharudin et al., 2010). According to Wier et al. (2008), organic foods consist of 'use values" or "non-use" values. "Use values" are private attributes derived by consuming the product such as taste, nutrition, health or food safety, and freshness. 'Non-use values' are public good values such as environmental improvement and animal welfare. In general, use values tend to be more important than non-use values in driving organic purchase. This view is supported by Yadav and Pathak (2016). Researching a sample of 220 young adults (18-30 years), the authors found that Indian consumers regarded health-related issues to be more important than environmental issues in purchasing organic foods. Moreover, consumer trust or distrust in food safety labeling also exerts an influence on consumer WTP of safer food. Consumer trust in food labels increases WTP for certified food products (Angulo et al., 2005), while the distrust would prevent organic purchase (Padel and Foster, 2005). Since food safety stands out as a credence characteristic, to distinguish organic food from non-organic alternatives, consumers have to rely on quality signals, such as product labels (Yiridoe et al., 2005).

Risk perception was another determinant of WTP for safety attributes. Risk perception or the concern about food safety was found to influence WTP for organic and pesticide-free food in Iran (Haghjou et al., 2013), Italy (Boccaletti and Nardella, 2000), and the United States (Misra et al., 1991). Currently, food safety risk perceived from vegetables in Vietnam is alarming (Ha et al., 2019). We, therefore, expect that WTP for organic vegetables in the country might be explained by such risk perception. Our expectation is supported by two related studies on Vietnam by Mergenthaler et al. (2009) and Hai et al. (2013). Mergenthaler et al. (2009) found the concern about food safety, a measurement of food safety risk perception had the largest impact on WTP for agrochemical-free-vegetables. Nevertheless, a thorough discussion of the effect of food safety concern was

missing in that study. Hai et al. (2013) considered two predictors of WTP – perceptions of vegetable safety and chemical residues. Surprisingly, perception about chemical residues, not perception about vegetable safety influenced the WTP for organic vegetables. Since both of these independent variables are related to food safety risk perception, it is unclear why only one of them determined the WTP. The examples above suggest that the link between risk perception and WTP for organic food was not thoroughly investigated in Vietnam. Using risk perception theory to explain the influence of food safety risk perception on WTP for organic vegetables, this chapter contributes to filling this gap.

The insight into rural-urban differences in WTP for organic food is also important. If such differences exist, then marketing strategies and agricultural policies relating to organic food must cater to each region. Despite this important implication, rural-urban differences in consumers' preferences for food safety are not well researched in the international literature. Some studies found that rural and urban consumers possess different attitudes and behaviour toward organic food purchases. For example, urban people perceived better benefits of organic food, and their willingness to use organic food was higher than rural residents (Yazdanpanah et al., 2015). With a better income, it was not surprising that urban households had higher organic shares than their rural counterparts (Midmore et al., 2005). In developing and emerging countries, in particular, research on rural consumers' preferences for food safety is lacking. Hasimu et al. (2017) studied the perception of organic food, and the main concepts associated with organic attributes only among urban consumers of Shanghai, China. Our study highlights the similarities and differences between urban and rural consumers of organic vegetables. While Hasimu et al. (2017) used an exploratory approach to set up a qualitative study, we use the contingent valuation method (CVM) to elicit WTP responses in this research. Another research on Vietnam compared WTP for organic vegetables between rural and urban regions by treating "region" merely as a dummy variable (Mergenthaler et al., 2009). The authors did not go on to find the determinants of WTP for each region. Socio-economic profiles differ in rural versus urban areas. These differences suggest that factors affecting consumer preference for food safety in rural regions might be different from those in urban regions. However, there is no empirical evidence on this issue. Hence, Ortega et al. (2017) in their review of the literature, called for research on the demand for food safety in rural and peri-urban areas in emerging countries.

By examining the differences as well as similarities in the underlying drivers of WTP for organic food in rural and urban regions, this chapter fulfills the gap above. Specifically, in Vietnam, due to the concern about food safety, growing vegetables for family consumption is becoming a norm not only in the rural but also in urban areas where land is scarce. Here again, this research is the first to consider the presence of home-grown vegetables as a predictor of WTP for organic vegetables. All of these are undertaken to draw a comprehensive picture of consumer preferences for food safety.

The objective of this chapter is to investigate the regional differences in the determinants of willingness to pay (WTP) for organic vegetables in Hanoi, Vietnam. We are particularly interested in comparing how risk perception and other factors influence the price that consumers are willing to pay for organic vegetables between the rural and urban regions.

6.2 Material and methods

6.2.1 Survey design and data collection

6.2.1.1 Survey design

This chapter uses the survey data. Detail information about the survey and sampling procedure can be found in chapter 2. The total sample size is 498 food shoppers in Hanoi. 230 of them are rural people, and the rest are urban residents. The rural and urban regions used in this chapter are the same as those in the original survey (see chapter 2).

6.2.1.2 Eliciting WTP responses

In this chapter, we used the contingent valuation method (CVM) to elicit WTP responses. The CVM, a stated preference method, has proven to be a useful technique for determining the monetary valuation of non-market goods and services (Bateman et al., 2002). CVM directly asks respondents how much they are willing to pay for a specific product. This method is now widely used to evaluate the WTP for credence attributes such as local food (Sanjuán et al., 2012), the origin of the variety (Botelho et al., 2017) and organic food (Zhang et al., 2018, Romano et al., 2016).

Organic food is characterised as a private good but presents an improvement in food safety. This is because the product contains higher levels of certain nutrients, lower levels of pesticides, and may provide health benefits for consumers (Crinnion, 2010). Since food safety is a non-market good and also a credence attribute (Swinbank, 1993) of organic food, the use of CVM in this study to elicit WTP for organic vegetables is appropriate.

We chose choy sum - a popular vegetable in the Vietnamese diet for our survey. Respondent's familiarity with the product meant we eliminated possible hypothetical bias - the disparity between the reported and actual WTP of contingent valuation. Within CVM, there are several techniques to elicit WTP response. Among them, we chose Double-Bounded Dichotomous Choice (DBDC). Comparing to single-bounded choice, DBDC gains higher efficiency in WTP estimation since more information about each respondent's WTP is elicited (Hanemann et al., 1991).

In this survey, a bidding process was designed as presented in Figure 6.1. Two consecutive bids (Q1 and Q2) were provided to reveal the upper bound and lower bound of respondents' true WTP for organic vegetables. If the respondent says "yes" for the first bid (P*), the follow-up bid (P^h), which is higher than the first bid would be given. If she/he says "no" for the first bid, the second bid (P^l) lower than the first bid would be asked. In total, there are four possible responses: Yes-Yes, Yes-No, No-Yes, and No-No. Also, we modified the traditional DBDC by introducing an open-ended question asking about the maximum WTP (Q3) to end the evaluation process.

The open-ended question (Q3) enabled us to exclude the yea-saying effect (Bateman et al., 2002). When asked Q3, respondents could not continue to say "yea" automatically (if their responses are likely to follow a yea-saying pattern in previous questions). Instead, they must clarify and confirm their true WTP. This helped detect inconsistent responses during the interviews, thereby improving the validity of WTP responses. The maximum WTP (P^{max}) revealed in the open-ended question would put a closure to the true WTP and provide for a better model fit, as shown in Sriwaranun et al. (2015).

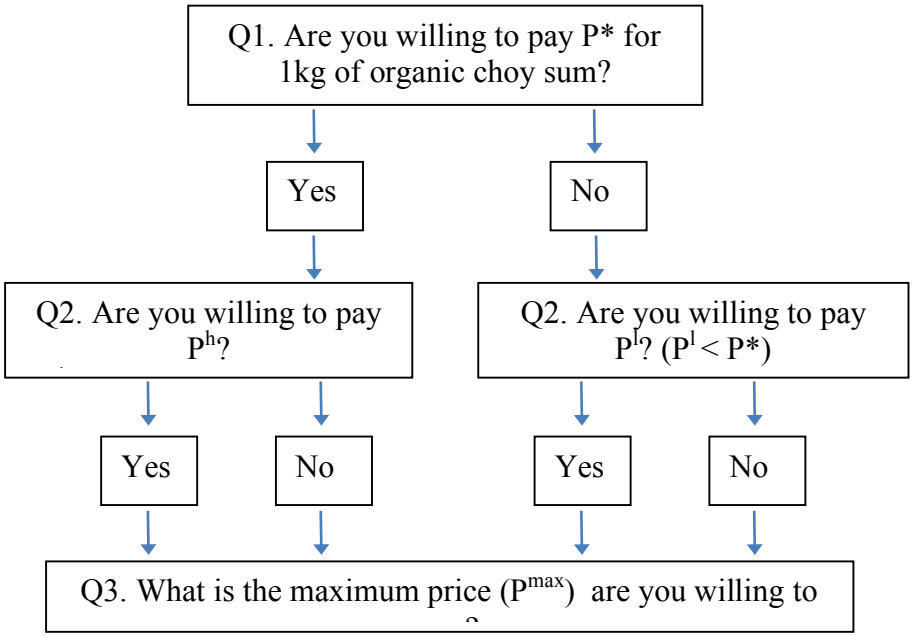

Figure 6.1: Bidding process

Note: first bid (P), the second higher bid (P^h), the second lower bid (P^l)*

Table 6.1: Bid design

Bid name	Initial bid (thousand VND)	Lower bid (thousand VND)	Higher bid (thousand VND)
A	15	11	19
B	20	15	25
C	25	19	31
D	30	23	37
E	35	27	43

Note: 1 USD=23 thousand VND

Following the bidding process illustrated in Figure 6.1, sets of bids were designed as various bid sets would help gather more information about the WTP distribution. We based on the information acquired from a pilot study on 30 respondents to design bid sets. The highest reported WTP in the pilot study was 50 thousand VND with 70% of the respondents expressing their maximum WTP in the range from 15 thousand VND to 30 thousand VND (23 thousand VND = 1USD). Hence, 4 out of 5 bid sets had the first bid (P*) ranged between 15 thousand VND to 30 thousand VND and the second higher bid (P^h) up to 43 thousand VND. The smallest bid was set at 11 thousand VND, slightly

higher than the average price of conventionally grown vegetables at the survey time (10 thousand VND). By doing so, we had various bid sets that are realistic enough to encourage true responses from respondents. The description for each set of the bid is presented in Table 6.1.

Five sets of bid above were randomly provided to respondents. Table 6.2 presents the distribution of WTP responses. When the initial bid values increased, the percentage of No-No responses presented an upward trend while the share of Yes-Yes responses experienced a downward trend. This result is in line with the economic theory that would suggest the negative relationship between demand for organic vegetables and price.

Table 6.2: Distribution of WTP answers by bid

n = 498

Initial Bid (thousand VND)	Yes-Yes		Yes-No		No-Yes		No-No		Total	
	N	%	N	%	N	%	N	%	N	%
15	58	62.4	30	32.2	5	5.4	0	0.0	93	100
20	39	44.3	25	28.4	19	21.6	5	5.7	88	100
25	28	35.9	21	26.9	18	23.1	11	14.1	78	100
30	11	14.9	17	22.0	19	25.7	27	36.4	74	100
35	13	11.4	39	34.2	33	29.0	29	25.4	114	100

6.2.1.3 Measurement of determinants of WTP

Empirical literature validated many determinants of WTP for organic vegetables. These determinants cover not only psychological factors (risk perception, trust, and perceived use values) but also socio-economic factors (e.g., education, income). We retained many of these determinants in the current research. Table 6.3 presents the measurement and statistics of the independent variables that we used.

In this chapter, risk perception is defined as the amount of health risk individuals perceive they would face from consuming a food product (Schroeder et al., 2007). Following this definition, we use one survey item to measure risk perception of conventionally grown vegetables "To what extent do you think that eating conventional vegetables, in general, might cause the health risk to you". The responses were coded from 1 (not risky at all) to

10 (extremely risky). As shown in Table 6.3, the mean risk perception from conventional vegetables was quite high (7.14). We expect that such high-risk perception would prompt respondents to report a higher WTP for organic vegetables.

Table 6.3: Descriptive statistics of independent variables used in the analysis

Variable	Variable definition	Scale	Mean (SD)
VegetableRisk	Perception of food safety risk from conventional vegetables	[1-10]	7.14 (2.01)
UseValue	Perceived health value of organic vegetables	[1-10]	6.85 (1.97)
	Perceived safety value of organic vegetables	[1-10]	7.05 (1.96)
	Perceived nutrition value of organic vegetables	[1-10]	6.59 (1.98)
	Perceived taste value of organic vegetables	[1-10]	6.41 (1.93)
TrustLabel	Trust in organic label	[1-10]	5.17 (2.35)
University	=1 if holding university degree	[0-1]	0.74 (NA)
VegGrow	Percentage of homegrown vegetables	%	27.0 (1.5)
Income	Monthly family expense	million VND	8.99 (5.67)
Bid1	Value of the first bid	thousand VND	25.25 (7.37)

Note: values in brackets denote standard deviations; University is a binary variable, the reported mean, therefore, should be interpreted as a proportion. NA: standard deviations are not applicable.

We used four attributes to capture different aspects of use values from organic produce. These are health, safety, nutrition, and taste. The mean scores of these items were in the range from 6.4 to 7.0, indicating that the respondents highly valued the attributes of organic vegetables. These four items generated a good construct, namely UseValue, with the Cronbach's alpha of 0.945. The score of UseValue was calculated as the average score of these four items. It is expected that UseValue would positively influence WTP.

TrustLabel was also measured by a 10 point- scale with 1 meaning “no trust at all” and 10 meaning “completely trust.” With a mean score of 5.7, consumer trust in organic labels

was just at a neutral level in Hanoi. This can be considered a deterrent to organic food consumption. We expect a low level of trust to be associated with a low WTP.

The self-reported percentage of homegrown vegetables (VegGrow) might determine consumers' participation in the organic market. The demand for organic vegetables would be lower for households that have a substitute such as homegrown vegetables. In other words, respondents whose family has a higher proportion of the homegrown vegetables will be less likely to cite a lower WTP for organic vegetables, compared with those having a lower share of homegrown vegetables.

Among various demographic characteristics, we were interested in only income and education (University). Household income represents the capacity to pay. Education has been regarded as one of the personal determinants of organic food consumption and WTP for organic food in literature such as that of Xu and Wu (2010) and Hughner et al. (2007). WTP for organic vegetables is expected to be positively associated with both of these variables.

Furthermore, we included the value of the first bid (Bid1) in our models to detect the anchoring effect that leads to the overestimation of the true WTP in CVM studies. A significant coefficient of the first bid would suggest the existence of the effect. It means the WTP responses are influenced by the price offered in the first bid.

6.2.1.4 Characteristics of surveyed consumers

Background information of survey participants presented in Table 6.4 demonstrates regional inequality. Perhaps because of income and education disparities, the urban sample had a higher percentage of organic purchasers (52.6% for the urban region versus 14.8% for the rural region). The family structure was also typical for each region. Urban families had younger main food shoppers, more children, and smaller household size.

Table 6.4: Characteristics of the respondents by region

Indicators	Rural Mean (SD)	Urban Mean (SD)
Female (%)	87.4	87.3
Having university degree(%)	25.2*	73.9*
Organic purchasers (%)	14.8*	52.6*
Household monthly expense (million VND)	6.09* (3.89)	11.5* (5.79)
Age	46.0* (14.0)	38.3* (10.0)
Number of children/household	1.13* (0.97)	1.38* (0.85)
Household size	4.63* (1.60)	4.22* (1.12)

Note: 1 USD = 23 thousand VND;

** Scores in one row are statistically significantly different at 5% using Chi-square test (for the first three indicators from the top) or two-sample T-test (for the rest); Numbers in brackets are standard deviation; Only percentage is reported for the first three indicators*

6.2.2 Empirical models

Respondents' WTP was elicited via Questions 1-3 in Figure 1. The true WTP of the respondent i, WTP_i^*, is a latent variable, which is given in equation (1) below:

$$WTP_i^* = \beta X_i + \varepsilon_i \quad (1)$$

where β is a vector of the coefficient and ε is an error term. X_i is a vector of 7 potential determinants of the WTP that are listed in Table 6.5.

Since the true WTP (WTP^*) is unobserved, it needs to be estimated based on a range of observed data. Using an open-ended question in a DBDC framework allowed us to investigate 2 models (Model 1 and Model 2). They have the same set of independent variables but are different in terms of dependent variables (the values of the upper bounds of WTP). Table 6.5 presents such differences between these two models. Model 1 follows a traditional model where upper bounds of WTP are determined from DBDC. Model 2 is a modified model where the upper bounds of WTP in Yes-Yes and No-No responses are

obtained from the open-ended question (Q3 in figure 1). We would compare the two models and select the one with better goodness of fit. WTP values were positive, as all the maximum WTP gathered from the open-ended question were higher than zero. Thus, for No-No responses, the lower bound of the true WTP is zero.

Table 6.5: Lower bound and upper bound of the true WTP of two models

WTP Responses	Model 1		Model 2	
	Lower bound (L)	Upper bound (U)	Lower bound (L)	Upper bound (U)
Yes-Yes	P^h	∞	P^h	P^{max}
Yes-No	P^*	P^h	P^*	P^h
No-Yes	P^l	P*	P^l	P*
No-No	0	P^l	0	P^{max}

Note: P^*= first bid; P^h = second higher bid; P^l= second lower bid; P^{max} = max WTP revealed from open-ended question.

For each model in Table 6.5, the true WTP of the respondent i, WTP*, lies in the range from a lower bound (L_i) to an upper bound (U_i). As an example from Model 1, WTP values are in the form of right-censored data (for Yes-Yes response) and interval data (for Yes-No, No-Yes, Yes-No responses). Since WTP, the dependent variable, is interval and censored data, we used the interval regression model to estimate it.

In Model 1, let $WTP_i = \beta X_i + \varepsilon_i$ (equation 1) and $\varepsilon_i \sim N(0,\sigma^2)$. If a respondent has "Yes-Yes" response, the probability his/her true WTP $\subset [P^h, \infty]$ is:

$$\Pr(P^h \leq \text{WTP}) = \Pr(P^h \leq \beta X_i + \varepsilon_i) = \Pr(P^h - \beta X_i \leq \varepsilon_i) = 1 - \Phi\left(\frac{P^h - \beta x}{\sigma}\right) \qquad (2)$$

where $\Phi(.)$ is the standard normal cumulative distribution function.

If the respondent has "Yes-No" answer, the probability his/her true WTP $\subset [P^*, P^h]$ is:

$$\Pr(P^* \leq \text{WTP} \leq P^h) = \Pr(P^* \leq \beta X_i + \varepsilon_i \leq P^h) = \Pr(P^* - \beta X_i \leq \varepsilon_i \leq P^h - \beta X_i)$$

$$= \left(\Phi\left(\frac{P^h - \beta X_i}{\sigma}\right) - \Phi\left(\frac{P^* - \beta X_i}{\sigma}\right)\right) \qquad (3)$$

The same rule is applied for No-Yes and No-No responses of which the WTP values are interval data.

Maximum likelihood estimation was used to estimate β and σ. The log-likelihood for the model 1 is:

$$\text{LnL}=\sum_1^n\left[w_i^{yy}\ln\left(1-\Phi\left(\frac{P^h-\beta X_i}{\sigma}\right)\right)+w_i^{yn}\ln\left(\Phi\left(\frac{P^h-\beta X_i}{\sigma}\right)-\Phi\left(\frac{P^*-\beta X_i}{\sigma}\right)\right)+\right.$$

$$\left.w_i^{ny}\ln\left(\Phi\left(\frac{P^*-\beta X_i}{\sigma}\right)-\Phi\left(\frac{P^l-\beta X_i}{\sigma}\right)\right)+w_i^{nn}\ln\left(\Phi\left(\frac{P^l-\beta X_i}{\sigma}\right)-\Phi\left(\frac{-\beta X_i}{\sigma}\right)\right)\right] \quad (4)$$

Where n is the number of observations, $w_i^{yy}, w_i^{yn}, w_i^{ny}, w_i^{nn}$ are dummy variables for ith observation, presenting "Yes-Yes", "Yes-No", "No-Yes" and "No-No" answers of this observation, respectively. If a respondent selects "Yes-Yes", $w_i^{yy}=1$ and other weights equal to zero.

For Model 2, since all WTP responses are interval data (see Table 6.5), its log-likelihood function is:

$$\text{LnL} = \sum_1^n\left[w_i^{yy}ln\left(\Phi\left(\frac{P^{max}-\beta X_i}{\sigma}\right)-\Phi\left(\frac{P^h-\beta X_i}{\sigma}\right)\right)+w_i^{yn}ln\left(\Phi\left(\frac{P^h-\beta X_i}{\sigma}\right)-\right.$$

$$\left.\Phi\left(\frac{P^*-\beta X_i}{\sigma}\right)\right)+w_i^{ny}ln\left(\Phi\left(\frac{P^*-\beta X_i}{\sigma}\right)-\Phi\left(\frac{P^l-\beta X_i}{\sigma}\right)\right)+w_i^{nn}ln\left(\Phi\left(\frac{P^{max}-\beta X_i}{\sigma}\right)-\right.$$

$$\left.\Phi\left(\frac{-\beta X_i}{\sigma}\right)\right)\Bigg] \quad (5)$$

To correct for any potential bias in our estimated mean and median WTP from an anchoring effect described earlier in section 2.3.3, we employed the correcting method developed by Herriges and Shogren (1996) and Liou (2015). We let WTP^t denote the true WTP of a respondent. If he/she is uncertain about their WTP, his/her reported WTP, WTP^r, might be altered by the value of the first bid, as the respondent may perceive that the first bid provides information on the "correct" WTP value. The link between the true WTP and the reported WTP is as:

$$WTP^r = (1-k)WTP^t + kBid1 \quad (6)$$

where k is an anchoring effect - the coefficient of the variable Bid1 estimated from interval regression model. Based on the equation (6), the true WTP was calculated as below:

$$WTP^t = (WTP^r - kBid1)/(1-k) \quad (7)$$

We calculate the true WTP for each observation from (7). We then obtained the mean and median of these true WTP values after controlling for bias.

6.3 Results

6.3.1 Diagnostic results

We fitted the two competing models to our observed rural and urban datasets. Likelihood ratio test confirms that both models under consideration, as a whole, are statistically significant (Likelihood ratio chi-square > 0, p <0.001, Table 6.6).

Table 6.6: Goodness of fit of the competing Models

Indicators	Rural (n = 230)		Urban (n = 268)	
	Model 1	Model 2	Model 1	Model 2
Likelihood ratio chi-square (df = 8) (p < 0.000)	86.42	68.86	68.60	118.67
Likelihood Value	-259.95	-535.01	-317.99	-664.62
Pseudo R2 (%)	17.21	6.11	14.84	8.38
BIC (Bayesian information criterion)	568.84	1118.97	686.30	1379.56
AIC (Akaike information criterion)	537.90	1088.02	653.98	1347.24

Note: df denotes degree of freedom.

We assessed the goodness of fit of each model based on four commonly used criteria. These are Likelihood Value, Pseudo R2, Bayesian information criterion (BIC), and Akaike information criterion (AIC). The Model 1 had a higher Likelihood value and Pseudo R2 than the Model 2, suggesting that the former provides a better fit both for the urban and the rural sample (Table 6.6). In addition, BIC and AIC that refer to information

lost when an approximating model is used to generate observed data (full reality), was lower for the Model 1. Moreover, Pseudo R2 of WTP models should not be less than 10% (Bateman et al., 2002). Thus, Model 2, with Pseudo R2 of 6.11% for the rural data set and 8.38% for urban data set, suffered from a weaker explanatory power. All these suggest that the Model 1, the traditional DBDC, yields a better explanatory power. Hence, we selected model 1.

6.3.2 Empirical results

Table 6.7 illustrates the results of interval regression for the selected model (Model 1) separately for the rural and urban regions. The effect of risk perception, the share of homegrown vegetables, and education on the WTP differed between regions. A significant effect of risk perception was observed for only the rural data ($\beta = 917.63$, $p < 0.01$). Similarly, the percentage of homegrown vegetables influenced the WTP in the rural region but not the urban region. Education affected the WTP in the urban region, but its effect was not significant in the rural region.

Table 6.7: Result of interval regression on WTP

Variables	Rural		Urban	
	Coefficient	Standard Error	Coefficient	Standard Error
VegetableRisk	917.60**	265.82	239.00	290.99
UseValue	1423.68**	325.90	774.46*	334.30
TrustLabel	772.38**	252.49	574.59*	259.40
VegGrow	32.19*	16.48	-1.23	22.08
Income	585.29**	150.09	367.06**	101.54
University	-1173.41	1371.76	2487.76*	1277.21
Bid1	0.41**	0.08	0.461**	0.08
Constant	-11336.23	3459.73	49.61	3620.66
Lnsigma_cons	8.881**	0.07	8.963**	0.07
Log likelihood Value	-259.95		-317.99	
Pseudo R2	17.21		14.81	

*Note: * p < 0.05, **p <0.01*

Perceived use values of organic food, trust in organic labels, and disposable family income were all significant predictors of the WTP in both regions. Perceived use values exert a positive influence on the WTP. Interestingly, the effect is more pronounced-almost twice as much in rural compared to the urban region. A higher level of trust in organic labels was associated with a larger WTP across regions. The effect of trust was both large and significant. The family's disposable income increased WTP in both regions. The effect was relatively larger for rural consumers.

The coefficient of the variable Bid1 was positive and statistically significant, suggesting that the value of the first bid positively influenced respondents' WTP. This is evidence of starting point bias. We took this bias into account when estimating the mean and median of predicted WTP.

We used bootstrapping with 5000 replications to construct confidence intervals of the mean and the median WTP. Bootstrapping is a robust technique that does not require any prior assumptions about the nature of the data (Bateman et al., 2002). Table 6.8 reports these estimation results. Based on the coefficients estimated in the interval model (Table 6.7), we predicted the WTP value for each observation. Mean, and median of WTP before controlling starting point bias were then obtained from those predicted WTP values.

Table 6.8: Mean and median of predicted WTP

Mean and median (thousand VND)	Rural	Urban
Before controlling bias		
Mean WTP [95% of CI]	22.98* [22.26 - 23.70]	28.48* [27.84 - 29.12]
Median [95% of CI]	23.10* [22.02 - 24.72]	28.47* [27.70 - 29.52]
After controlling bias		
Mean WTP [95% of CI]	22.13* [21.04 - 23.22]	30.48* [29.71- 31.21]
Median [95% of CI]	21.81* [20.63 - 22.90]	31.00* [29.70 - 32.21]

*Note: CI denotes confidence interval; * Scores in one row are statistically significantly different at 5% using two-sample T-test.*

After controlling for starting point bias, the mean WTP of rural consumers was about 22 thousand VND while the corresponding figure for their urban counterparts was approximately 30 thousand VND. The two-sample T-test confirms that the mean and median WTP of urban consumers were higher than those of rural consumers ($p < 0.000$). This was expected.

6.4 Discussion

Our collected sample supported rural-urban differences regarding the underlying drivers of WTP for organic vegetables. Risk perception, the share of homegrown vegetables and education were driving forces of WTP for organic vegetables in only one region but not the other.

In the rural area, risk perceived from conventionally grown vegetables was considerably high (mean score of 6.77) and such risk perception motivated WTP for organic food. Marketing literature suggests that when the risk perceived was higher than an acceptable level; consumers would develop risk reduction strategies (Yeung and Morris, 2006). Being willing to pay a higher price for organic vegetables might be one of the strategies pursued by rural consumers to reduce risks from unsafe vegetables. Rural consumers know more about conventional vegetable production methods to associate possible health risks from them. Such awareness or risk perception possibly translated into higher WTP for organic vegetables. This result is consistent with earlier literature, suggesting that heightened risk perception was the main driver of the demand for safe food (Angulo and Gil, 2007, Hsu et al., 2016).

Although risk perception in the urban region was higher than in the rural region (mean score of 7.45), this alone did not translate into their higher WTP for urban respondents. Related studies conducted on urban regions in Vietnam provided mixed results. Mergenthaler et al. (2009) found that concern about food safety, an aspect of risk perception, exerted the largest impact on the WTP for free-of-chemical-residue vegetables in Hanoi and Ho Chi Minh City. In contrast, another study conducted on central districts of Hanoi by Hai et al. (2013) reported an insignificant effect of food safety perception on WTP for organic vegetables. A potential reason for the result in our urban sample is that risk perception in the urban region might be not sufficient to influence the WTP. This is

corroborated by Angulo et al. (2005). Other factors, such as income and trust in organic labels might be more powerful in explaining and predicting WTP in the urban region. Overall, risk perception might not be an important consideration of urban consumers when they evaluated the benefit of consuming organic vegetables against its high costs.

In recent years, concern about food safety has motivated many Vietnamese consumers, both rural and urban, to grow vegetables for family consumption. According to Ha et al. (2019), homegrown vegetables were perceived to be very safe. We, therefore, argue that homegrown vegetables can be substituted for organic vegetables from the market. We expected that consumers whose family had a higher share of homegrown vegetables would demand less organic vegetables, and therefore, report a lower WTP for organic vegetables. Our survey of rural consumers (but not urban) tells the opposite. Households with a higher proportion of homegrown vegetables were willing to pay a higher price for organic vegetables. Perhaps, the experience from growing vegetables to serve family needs might enhance rural consumers' understanding of organic farming. This would mean a higher WTP.

Homegrown vegetables positively influenced the WTP in the rural region but not the urban region, as a consequence of our sample structure. Sample variance in the variable percentage of home-grown vegetables was rather low for the urban data but not for rural data. The majority of the rural families in our sample engaged in growing vegetables and the proportion of homegrown vegetables varied a lot. In contrast, only about 30% of urban households showed an interest in growing vegetables. Besides, among those that did, homegrown vegetables contributed only a small share of the total family vegetable consumption.

Education determined the WTP in the urban region only. The result from our urban sample matches the finding of another research in Vietnam by Hai et al. (2013) that also found a significant positive effect of education on WTP for organic vegetables. Since education might correlate with income, we took account of this in our analysis by evaluating the correlation coefficient between these two variables and including the interaction term between them in the WTP model. We found a weak correlation between these variables, and the interaction term was not significant. Doing so, we controlled for the potential interlink between education and income.

Comparing the two regions, apart from some of the differences noted above, rural and urban areas are largely similar in that they share some common determinants of the WTP including the perceived use values of organic food, trust in organic labels, and disposable family income.

As expected, perceived use value was an important determinant of the WTP in both regions. Rural consumers, as well as urban consumers who had a higher evaluation of the safety, health, nutrition, and taste attributes of organic vegetables were likely to report a higher WTP for organic vegetables. This result suggests that consumers demand organic food because of the perception that organic food brings unique values that cannot be achieved from conventionally grown alternatives (Shaharudin et al., 2010). A further investigation of our data provided evidence that respondents, in general, held a positive attitude toward organic vegetables. The mean scores of perceived use value from the rural and urban data were 6.71 and 6.73, respectively. The positive effect of perceived use values on the WTP coupled with a moderate mean score of perceived use values from organic vegetables would suggest that organic market growth in Vietnam can be achieved by enhancing consumers' perception of the use values of organic vegetables.

In this chapter, we found that trust in organic labels would significantly increase WTP for organic vegetables across regions. One of the reasons why the majority of Hanoi consumers did not buy organic vegetables was a low level of trust in organic labels (see Table 6.3). In Vietnam, organic vegetables are mainly sold in supermarkets. We also found that trust in supermarkets was also low (mean = 4.45 out of 10, SD = 2.44). A significant correlation between trust in supermarkets and trust in organic labels was revealed ($r = 0.465$, $p = 0.01$). Consumers' trust in organic labels was low because of their distrust in supermarkets. Recent supermarket scandals relating to vegetable mislabelling has dampened consumers' trust in food retailers in Vietnam. Hence, to stimulate demand for organic food, building trust in food retailers, particularly supermarkets is critical.

Income had a significant positive effect on WTP for organic food in both regions. As with other studies (Hai et al., 2013, Owusua and Anifori, 2013), this is expected. A higher relative effect of income from rural data implies that for a given level of income increased in both regions, rural regions would exhibit a larger increase in demand for organic vegetables. Organic vegetables are thought to be a luxury good by consumers (Poulston

and Yiu, 2011). Theoretically then, the income elasticity of demand for organic vegetables is expected to be high. In contrast, we found a very small effect of income on the WTP. In their review of related literature, Yiridoe et al. (2005) also concluded that income elasticity of demand for organic food is often small or insignificant. For Vietnam and other faster-growing economies around the world, this implies that increasing income by itself may not be enough to stimulate the demand for organic food. Other accompanying measures would be necessary. These are discussed in the concluding section.

There was a large difference between the price consumers were willing to pay for organic vegetables and the market price of conventional vegetables. When the survey was conducted in 2017, the average price of conventionally grown choy sum was 10 thousand VND/kg. We found consumers were willing to pay for organic choy sum at a price far above the price of conventional vegetables (about 22 thousand VND for rural consumers and 30 thousand VND for urban consumers). In other words, the accepted price premium for organic vegetables of rural and urban respondents was 109% and 205% above the price of conventional vegetables, respectively. This result is close to the estimation of Hai et al. (2013). In a survey on about 200 respondents in urban districts of Hanoi, the authors revealed that consumers were willing to pay a price premium of 155% to 210% for organic vegetables. Surprisingly, Vietnamese's WTP was higher than that of their counterparts in emerging countries where income per capita is higher. For example, Nandi et al. (2017) found that 90% of Indian consumers surveyed were willing to pay a premium price ranged from 5% to more than 100% for organic fruits and vegetables. A high price premium of WTP found in this chapter suggests a high potential for a viable organic vegetable market in Vietnam.

Consumers in our survey were willing to pay a high premium for organic vegetables, but the market price of organic vegetables was much higher than their WTP. During the survey, the average market price of organic choy sum was about 40 thousand VND/kg. WTP on organic choy sum of rural and urban consumers was far below the market price of organic vegetables (56% for rural and 76% for urban consumers). Reducing the price of organic vegetables remains an important challenge in Vietnam.

6.5 Conclusions

The anxiety about food safety, particularly the use of pesticides in conventional vegetable production has led many Vietnamese consumers to seek safer vegetables. Organic vegetables with their superior perceived attributes are already the preferred choice of a proportion of these consumers. The organic vegetable market currently remains a niche market amid many barriers. An understanding of the determinants of WTP will not only help organic producers and marketers expand the organic reach but also assist policymakers in designing policies on organic farming in Vietnam.

In this chapter, data obtained through a contingent valuation survey were incorporated into an interval model. The aim was to predict WTP separately for the rural and urban regions. A comparison of the determinants of WTP for organic vegetables across the regions can extract useful information for stakeholders. In this study, the two regions were found to have some similarities as well as important differences regarding the underlying drivers of WTP for organic food. Since rural and urban consumers have different preferences toward organic food, they should not be treated as a homogenous group when designing marketing strategies and policies to develop the organic market. By thoroughly investigating rural-urban differences in WTP, this chapter contributed to the existing literature on consumer preference for food safety.

Our results indicate that a higher level of risk perception increased WTP significantly in the rural region, but not in the urban region. This suggests that when evaluating the economic values of organic vegetables, risk perception was an important consideration of rural but not urban consumers. Applying risk perception theory to explain the effect of risk perception on WTP, our study provided better insight into the existing literature on consumer demand for food safety.

There is a potential to develop the organic vegetable market in Vietnam. As shown in this chapter, a majority of consumers were willing to pay for organic food with a price that is double or triple the price of conventional products. With strong economic growth, the rise of the middle class, rapid urbanization, and a growing concern about food safety, the demand for high-quality food such as organic food is expected to rise in Vietnam. However, contrary to popular belief, we found that a higher income might contribute

very little to the development of the organic market, as the effect of income on the WTP was marginal. Instead, many existing barriers to demand must be removed to facilitate higher organic vegetable intake.

First among these barriers is the high price. We found that although a majority of consumers were willing to pay the premium for organic vegetables, only a small percentage of them were able to access them because of a very high price. Secondly, a very low level of trust in organic labels, which is related to trust in supermarkets tend to be another key barrier. Such a level of trust has dampened willingness to pay for organic food. Thus, improving trust in organic food labels and lowering of the price should be considered as priorities for higher acceptance of the organic market. Price reduction for organic food can be made by reducing the certification cost. Currently, Vietnam has no national certification bodies. Hence, organic producers have to rely on international certification organizations that are costly. Since food safety is a public good, it requires government intervention in areas like certification regimes in support of organic market initiatives. Trust in organic food labels can be built when supermarkets communicate trustworthy and transparent product information to consumers and the government enforces better surveillance of food labeling.

The following chapter presents some conclusions and policy implications of this doctoral thesis.

CHAPTER 7: CONCLUSIONS

This chapter incorporates the findings from previous chapters to illustrate general discussions and conclusions. The chapter comprises of three sections. The first section restates the research objectives and the method to achieve each corresponding objective. The second section highlights the key findings of the thesis and draws policy implications. The final section provides limitations of the thesis and recommendations for future studies.

7.1 Revisitation of research objectives and methods

Food safety has become a public concern in Vietnam. Consumers view most of the marketed foods to be unsafe (World Bank, 2017). Perceiving a high level of risk associated with food, consumers are making many attempts to reduce such risk. Producers are facing challenges to convince consumers due to very low consumer confidence in food. To solve the problem caused by the heightened risk perception, it is crucial to understand how consumers evaluate their food safety risk and which factors shaping risk perception. To support consumer decision making, there is a need to obtain an insight into the influence of their risk perception on risk-reducing behaviour. Gaining these understandings is the overall aim of this thesis.

This thesis consists of four specific objectives. The first objective focused on the linkages among risk perception, trust, and food risk information (chapter 3). Rather than investigating risk perception at only one level like previous studies, chapter 3 considered risk perception at three levels: at hazard level, product level, and general level. In this chapter, we investigated how trust, risk information, risk perception of hazards, risk perception of common foods were linked together to form risk perception of food in general. Using Structural Equation Modelling on the data from our survey of 498 consumers in Hanoi, these linkages were revealed.

The second objective was to analyse consumer perception of food safety risk in general together with its determinants. This was accomplished in chapter 4, where we applied the mixed method on the integrated data from the consumer survey and three group

discussions. Since risk perception is a social and psychological concept, the integration of both qualitative data (from group discussions) and quantitative data (from consumer survey) explain this concept better. Complementary to chapter 3, the explanatory sequential mixed method used in this chapter is another way to investigate the concept of risk perception. Furthermore, regional differences in risk perception have important policy implications that were not comprehensively investigated in previous research. Chapter 4, therefore, analysed how rural and urban people differ in interpreting their food safety risk.

Vegetable is a product that was chosen for closer scrutiny in this research due to its dominance in the Asian diet. At the same time, a high level of anxiety about vegetable safety prevailed across Asian developing countries. Accordingly, our third objective was to investigate consumer perception of vegetable risk and its impact on vegetable consumption. In chapter 5, we focused on not only risk perception but also a risk-reducing behaviour that is the change in vegetable consumption due to food safety concerns. Chapter 5 also took into account regional diversities by investigating and comparing the predictors of vegetable risk perception between the rural and urban regions. The determinants of risk perception of vegetables were uncovered through the use of Principle Component Analysis (PCA), followed by ordered logit regression on the data from our consumer survey. The impact of risk perception on vegetable consumption was analysed by the implementation of Kruskal-Wallis test on the survey data.

The fourth objective was to identify the effect of vegetable risk perception and related factors on willingness to pay (WTP) for organic vegetables (chapter 6). Being willing to pay a higher price for organic vegetables is another risk reliever of consumers when they believe that the health risk from conventionally grown vegetables is high. Since rural and urban consumers are not a homogenous group concerning social and economic conditions, chapter 6, compared the WTP and its influencing factors across regions. We used interval regression on contingent valuation data to predict their WTP.

7.2 Key findings and policy implications

Chapter 3 confirmed the linkages among constructs of risk information, trust, and risk perception. A high level of trust in the government and actors involved in the food chain lowered risk perception of common foods directly. Trust also reduced risk perception of

food in general but through an indirect mechanism. Information acquisition on food scandals directly augmented risk perceived of common food, of hazards, and indirectly increased perception of food safety risk in general. This result supports the social amplification of risk framework developed by Kasperson et al. (1988), implying that media has played a role as a risk amplifier that develops a few food incidents into public concern about food safety in Vietnam. This is evident by the relationships found among risk perception constructs. Holding a belief that all food hazards were dangerous, consumers also viewed the common foods were unsafe. This, in turn, led to a high level of risk perceived from food, in general.

Chapter 4 highlights four key findings from the survey and group discussions. Firstly, surveyed consumers were very worried about various food hazards. Group discussion further revealed that respondents were concerned more about chemical hazards as these hazards were regarded to be invisible, causing long-term effects and serious health consequences. Secondly, survey respondents were also concerned about the safety of many food groups, particularly vegetables, which were rated the riskiest among 6 selected common foods. Thirdly, data from the survey indicated that rural residents perceived a lower food safety risk than their urban counterparts. Group discussions later revealed that a better perceived control over food safety is the reason for this survey result. Stronger kinship networks made it easier for rural residents to source foods that were believed to be safe from relatives and friends. Rural households with land and labours available had a capacity to self-supply of food. Since homemade foods and food from trustworthy peoples like relatives and friends were regarded as safe, rural consumers felt they were better off in controlling food safety. This, in turn, reduced their perceived risk. Lastly, risk perception of food, in general, was found to be dependent on the number of food safety issues of concern that respondents reported, risk perceived of protein food, of vegetables and fruits, and information about food safety incidents. This finding was consistent with that from chapter 3. Again, it provides another evidence of the influence of risk information and risk perception of common foods on food safety concerns.

The finding of chapter 5 shows that the food safety risk perceived from vegetables was high across regions but lower in the rural setting. As explained previously in chapter 4, the ability to grow own vegetables of rural consumers contributed to this result. This chapter found some similarities as well as differences in underlying drivers of risk

perception of vegetables across regions. Risk information acquisition and perceived consequence over the hazards were positively associated with risk perception of vegetables while trust decreased it in both regions. However, age and education influenced risk perception in only the rural region. Perceived control over hazards and self-provisioning of vegetables lessened risk perception in the urban region only. We found that despite land scarcity, 38% of urban households were growing pesticide-free vegetables for family consumption on rooftops or strips of adjacent public land. Having home-grown vegetables that were perceived to be safe has led to decreased risk perception of vegetables in these families.

The result of chapter 5 supports the psychological approach, suggesting that the more a person perceives a risk from an activity, the more that person wants the risk to be reduced (Slovic et al., 1982). Perceiving a high health risk from contaminated vegetables, consumers have modified vegetable consumption. One-third of them have reduced vegetable consumption during the last two years. The volume of reduction was about 8% per respondent in the whole sample. 88% of them have avoided at least one variety of vegetables that were believed to be risky. We found risk perception increased with the level of reduction in vegetable consumption. With food safety issues in mind, consumers avoided vegetables that were perceived to be dangerous, shifting to the safer alternatives. These precautions may limit their freedom in eating and diet diversity.

Chapter 6 found some disparities in willingness to pay (WTP) for organic vegetables between rural and urban settings. WTP for organic vegetables was higher in the urban region. Urban consumers were willing to pay 205% above the price of conventional vegetables for rural, while the corresponding figure for rural respondents was 109%. A higher income and better access to supermarkets and safe food stores in the urban region are potential reasons for this price gap. These WTPs were high, as compared to the price of conventional vegetables but still far below the market price of organic vegetables. Rural and urban respondent's WTP equal 56% and 67% of the organic vegetable price, respectively. The research findings suggest that there is a potential to develop the organic vegetable market in Vietnam. However, the high price of organic vegetables will be a big barrier to this development.

It is found in chapter 6 that rural and urban regions also differed in some determinants of the WTP. Risk perception in the urban region, though higher than the urban area, did not lead to a higher WTP of urban respondents. This implies that perceived risk from conventional vegetables might be an unimportant consideration of urban consumers but not rural respondents. The proportion of homegrown vegetables influenced the WTP in the rural region only. Perhaps, the experience from self-provisioning of vegetables enhanced rural consumers' understanding of organic farming, resulting in a higher WTP of those who were growing own vegetables.

Lastly, chapter 6 indicated that rural and urban areas shared some common determinants of the WTP. Across regions, consumers who acknowledge the attributes of organic vegetables more were likely to report a higher WTP. Consumers demand organic food because of the perception that organic food brings superior values, as compared to conventionally grown alternatives (Shaharudin et al., 2010). Trust in organic labels and household income both increased WTP for organic vegetables across regions. However, the marginal effect of income highlights that a single solution like increasing income may be ineffective to stimulate the demand for organic food. Other accompanying measures would be essential to lead the organic market growth.

Throughout this research, food safety risk perception was found to be heightened, persistent over time, and pose some potential consequences. To reduce the perceived risk, consumers modified their food choice like self-supplying own food, reducing the consumption of perceived-unsafe foods, and switching to organic alternatives. This reflects a market failure and implies the loss to the food sector as a high-risk perception is associated with low consumer confidence in food. Attenuating food safety risk perception becomes crucial for Vietnam to eliminate potential economic losses. The development of organic farming will help improve food safety and the sustainability of agricultural production.

This research drew some policy implications. Improving trust is essential to address food scares and foster demand for organic food in Vietnam. This is because trust in the government and the food industry was low and trust was found to moderate risk perception (chapters 3, 5). To build trust, according to de Jonge et al. (2008), institutions should show their care, competence, and openness. The Vietnamese government needs to

demonstrate its commitment to control food safety. Since common food products such as vegetables, fruits, and meat are important in the Vietnamese diet but perceived to be very risky, as found in chapters 3 and 4, enhancing the safety of this food group should be a priority of food safety policies. Furthermore, the government should provide clearer legal frameworks, including both the establishment and control of production and product standards. Trust in the food industry can be rebuilt by providing truthful information about food products, complying with food safety regulations, and showing genuine concern to consumer health.

Better risk communication is urgently needed since poor food risk communication has resulted in heightened risk perception and food safety worries (chapters 3 to 5). Because trust in responsible institutions is low (chapter 4, 5), risk information should not be communicated by them but by more trustworthy channels such as health care professionals or scientists. Risk communication via media must be based on factual evidence about the risk and must be neutral, not just focusing on negative news, as shown in chapter 5, but also educating consumers on remedial aspects of food safety. Consumers need unbiased information to form a balanced assessment of risk. Accurate information about food hazards should be easily accessible and understandable to consumers through the government's websites.

Urban farming should be developed due to its important role in feeding cities and moderating food scares. Urban farming, such as root top gardens is a source of local fresh and healthy foods that enhance food and nutrition security at the household level in metropolitan areas (Rezai[a] et al., 2016). Homegrown food, the product of urban farming was highly acknowledged by Vietnamese consumers because of its safety attributes. Having this type of food in the diet means better control over food safety, which results in less worry about food safety (chapter 4). This explains why growing own vegetables has been an interest of not only the urban poor but also the rich in big cities like Hanoi despite the lack of farming land (chapter 5). Due to multiple benefits urban farming could offer to the urban food system, policies to support urban farming is required. Since access to suitable land is the largest constraint to the adoption of urban agriculture, one of the policy supports might be reserving a certain proportion of public land for designated community gardens for urban residents who are interested in self supplying food. Moreover, education on horticulture and farming will be useful for those who are

inexperienced in farming (Lovell, 2010). Moreover, ecological urban planning that integrates extensive farming with other urban spaces such as Architect Vincent Callbaut[4] can be a useful idea to learn for Vietnam.

A high willingness to pay for organic vegetables implies the development of the organic market in Vietnam. However, existing barriers such as high price and the erosion of trust in organic labels must be addressed to facilitate demand for organic food. The price issue can be handled by the establishment of national certification bodies. Better government surveillance of food labeling and transparent product information provided by supermarkets would reinforce the trust in organic labels. Moreover, the positive relationship between the willingness to pay and perceived use values of organic vegetables suggests that the increased perception of the multiple attributes of organic vegetables would foster the demand. Marketing strategies, therefore, should provide clear and convincing communication about these benefits to enhance consumers' perception of organic vegetables.

Lastly, the existence of rural-urban differences in risk perception and the willingness to pay suggests that policies in food risk communication and organic farming should adopt the regional approach, in which interventions are tailored to each rural and urban region. It would be more challenging to address food safety worries in the urban region where food safety risk perception is higher, as compared to the rural region (chapters 4 and 5). As perceived control over hazards moderated urban residents' risk perception (chapter 5), enhancing their knowledge of food hazards through education programs will be essential. Some marketing measures to promote demand for organic vegetables should be region-specific. Obviously, the urban region with a higher WTP will occupy a major market share of organic food. However, it is still potential to expand the organic market to rural areas where income is rapidly increasing due to many off-farm job opportunities. Rural areas in which industry zones are allocated can be a good place to kick off marketing campaigns.

[4] http://vincent.callebaut.org/object/181214_soprema/soprema/projects

7.3 Limitations and suggestions for future research

This research has some limitations. Our sample is biased as it is limited to consumers who live in Hanoi. Perhaps, due to this bias, the effect of demographic factors was likely to be inconsistent across regions. For example, the effect of age and income was significant in the rural setting only. Hence, any generalization of our findings, referring to the whole population of Vietnam may be taken with caution. Future related research that is based on a national representative sample is required.

Risk perception is a multi-dimension construct (Slovic, 2010). Previous studies therefore often used several survey items to measure perception of food safety risk. We originally selected three survey items to measure risk perception of vegetables. However, these items did not constitute adequate construct reliability and validity. Thus, the variable was measured by only one item that was the best in capturing the concept. Future studies on risk perception should pay attention to the use of valid multiple scales in measuring risk perception of a specific food category like vegetables.

This research did not fully address the causality issue, a common problem of cross-sectional data. Causal analysis of multivariate data using Structural Equation Modelling as suggested by Pearl (2009) has been implemented in chapter 3 but not in the remaining chapters. In this research, there are some relationships in which causality might exit. The two-way relationship between risk information and risk perception is an example. The more information about food incidents consumers received, the higher perceived risk they would hold. Inversely, consumers who perceived a high level of risk would be more motivated to seek food information. As a result, they would receive more information about food risk. Unfortunately, this inverse relationship has not been considered in our research. Upcoming research on the related topic should address the causality issue by using experimental design (Stuart, 2010) or introducing instrumental variables (Pearl, 2009).

Lastly, using CVM to estimate the WTP might cause hypothetical bias (Loomis, 2014) that we have tried to eliminate. Respondents might overestimate the value of the product since they do not confront an actual choice. Future studies should employ a discrete choice experiment, which is a better alternative to elicit WTP (Kjær, 2005).

The above limitations are stated in the hope of continued research on this dynamic area of food safety. This research opens a new door for future studies. There are opportunities to investigate the relationship between risk perception and food handling practices at home or dining out behaviour. Future studies can also look at other factors that might explain rural-urban differences in risk perception, such as lifestyle, cultural values, and beliefs. At this stage, we are happy with the findings contained in the thesis. We believe that this research adequately contributes to the underlying literature on consumer perception and behaviour toward food safety risk.

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APPENDIX

8.1 Approval letter for the use of published papers in the thesis

Fri 7/06/2019 5:57 PM

Researcher Support support@elsevier.com

Re: Asking approval letter to use the published paper in PhD thesis [190607-000327]

Dear Ha Thanh Mai,

Article reference: APPET_4273

Title: Rural-urban differences in willingness to pay for organic vegetables: Evidence from Vietnam

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Researcher Support

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8.2 Survey questionaire

Interviewer:	Bid number: 2

Thank you for agreeing to participate in this survey. We are a group of researchers from Vietnam National University of Agriculture. We are conducting a survey on consumers' perception and behavior toward food safety in Vietnam. We make sure that your responses will remain completely anonymous. The survey should take about 25 minutes to complete. If you have any questions about the survey, please contact hathanhmai@vnua.edu.vn. Thank you for your time.

SECTION 1: PERCEPTIONS OF THE SAFETY OF VEGETABLES

Q1. Do you think that today's food quality is worse, the same or better as compared to 10 years ago?

(Tick like this ☑ in only 1 option that best applies)

1. A lot better ☐ 2. A little better ☐ 3. About the same ☐ 4. A little worse ☐
5. A lot worse ☐

Q2. To what extent are you concerned about the safety of today's food?

1. Not concerned at all ☐ → **Go to Q4**
2. Slightly concerned ☐ 3. Moderately concerned ☐ 4. Very concerned ☐
5. Extremely concerned ☐

(From 2- 5, if the answer "Yes" → go to Q3, then Q4)

Q3. What issues below of today's food are of concern to you? (Prompt answers, can choose ≥ 1 options)

1. Microbial contamination ☐ 4. Pesticide residue ☐ 7. Antibiotic residue ☐
2. Toxic ☐ 5. Nutrition quality ☐ 8. Hormone ☐
3. Food additives ☐ 6. (GMO) Technology ☐
9. Other (specify)…… ☐

Q4. During the last 2 years, how many times you felt sick after eating? …….. times

Q5. During the last 2 years, how many times you felt sick from eating vegetables? ……. times

Q6. Consuming unsafe food leads to health risks. The impacts might be short term (e.g., food poisoning) or long term (e.g., illness due to the accumulation of toxic substances in the human body for a long time)**.** How do you rate your health risk from consuming products below?

	Not risky at all									Extremely risky
a. Fruit	1☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10 ☐
b. Vegetables	1☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10 ☐
c. Egg	1☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10 ☐
d. Meat	1☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10 ☐
e. Fish	1☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10 ☐
f. Milk	1☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10 ☐

Q7. Of the total vegetable quantity consumed by your household, please estimate the proportion of each type of vegetables following:

- Q9a. Vegetables are offered by relatives/friends [……] %
- Q9b. Vegetables are home-grown [……..…..] %
- Q9c. Vegetables bought from supermarkets and safe food stores […..……] %
- Q9d. Vegetables bought from wet markets near your current address [……] %
- Q9e. Vegetables purchase from your home village/town that differs from your current address […..……] %

Total: ……100%

Q8. Have you reduced vegetable consumption compared to 2 years ago due to the worries about vegetable safety?

1. Yes ☐ → goes to **Q9, then Q10** 0. No ☐ → go to **Q10**

Q9. How many % vegetable consumption you have reduced compared to 2 years ago? [**……..……**] **%**

Q10. Assume that if the safety of vegetables is ensured and other factors such as vegetable price, your income is unchanged, how many % vegetable consumption you will increase, as compared to your current consumption ……. % [ ]

Q11. Vegetables might be contaminated by hazards such as pesticide residue, bacteria (*E. Coli* and Salmonella), pathogens, and heavy metals (nitrate, lead). Some vegetables might be genetically modified organism (GMO) products. Now we are asking you about those

hazards and the production technology of vegetables. To what extent are you able to control the hazards below by thorough cooking and washing vegetables?

	Completely controllable									Uncontrollable at all
a. Pesticide residue	1☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10☐
b. Bacteria and pathogens	1☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10☐
c. Heavy metals	1☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10☐
d. GMO varieties	1☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10☐

Q12. To what extent do you know about these hazards?

	Know thoroughly									Don't know at all
a. Pesticide residue	1☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10☐
b. Bacteria and pathogens	1☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10☐
c. Heavy metals	1☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10☐
d. GMO varieties	1☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10☐

Q13. How do you think about the consequences of these hazards in vegetables to your health?

	Not dangerous at all									Extremely dangerous
a. Pesticide residue	1☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10☐
b. Bacteria and pathogens	1☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10☐

c. Heavy metals	1☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10☐
d. GMO varieties	1☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10☐

Q14. How often have you heard about food incidents from the channels below?

	Never	Rarely	Sometimes	Very often	Always
a. TV	1☐	2☐	3☐	4☐	5☐
b. Internet	1☐	2☐	3☐	4☐	5☐
c. Friends and relatives	1☐	2☐	3☐	4☐	5☐

Never = 1 Rarely = 2 Sometimes = 3 Very often = 4 Always = 5

Q15. To what extent do you trust organisations below in managing vegetable safety

	Don't trust at all									Completely trust
a. Central government	1☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10☐
b. Provincial government	1☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10☐
c. Farmers	1☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10☐
d. Food traders at wet markets	1☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10☐
e. Supermarkets/ safe food stores	1☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10☐

SECTION 2: WILLINGNESS TO PAY FOR ORGANIC VEGETABLES

Q16. Organic vegetables are pesticide-free products. During vegetable production, vegetable growers do not use pesticide and chemical fertilisers. The products are often certified. Have you ever purchased organic vegetables?

1. Yes ☐ → go to **Q18** 0. No ☐ → go to **Q17, then Q18**

Q17. Why don't you buy organic vegetables?

1. Organic vegetables are not available ☐ 4. I don't know about organic vegetables ☐

2. The price of organic vegetable is too high ☐

3. The quality of organic vegetables is not good ☐

5. It is inconvenient to buy organic vegetables ☐

6. Types of organic vegetables are not various ☐

7. Others (specify)…… ☐

Q18. How much do you trust organic vegetable labels?

1. Don't trust at all ☐ 2.☐ 3.☐ 4.☐ 5☐ 6☐ 7☐ 8☐ 9☐

10. Completely trust ☐

19. To what level do you think that organic vegetables are…

a. Good for health	1.Extremely bad ☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10.☐ Extremely good
b. Safe	1. Extremely bad unsafe ☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10.☐ Extremely safe
c. Nutritious	1.Extremely unnutritious ☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10.☐ Extremely nutritious
d. Tasty	1. Extremely untasty ☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10.☐ Extremely nutritious
e. Good for environment	1. Extremely bad ☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10.☐ Extremely good

Q20. How frequently do you buy choy sum?

Never	Rarely	Sometimes	Very often	Always
1. ☐	2. ☐	3. ☐	4. ☐	5. ☐

Q21. Are you willing to pay **VND 20,000 per kg of organic choy sum?**

1. Yes ☐ → go to **Q23** 0. No ☐ → go to **Q22**

Q22. Are you willing to pay **VND 15,000** per kg of organic choy sum?

1. Yes ☐ → go to **Section 3** 0. No ☐ → go to **Q23**

Q23. Are you willing to pay **VND 25,000** per kg of organic choy sum**?**

1. Yes ☐ → go to **Q then Section 3** 0. No ☐ → go to **Section 3**

Q24. What is **the maximum price** are you willing to pay for 01 kg of organic choy sum?

……..… **VND**

Q25. How many family members are there in your household? …… people

Q26. How many children (under 12 years old) are in your family? …….. children.

Q27. How many elderly people (60 years old and older) are there in your family? ……. people

Q28. Please tell me your age: ……... years old

Q29. Your address: Village/Commune ……..... District ……..……

1. Rural ☐ 0. Urban ☐

Q30. Your education:

0. No schooling ☐ 2. Secondary school ☐ 4. Univesity ☐
1. Primary school ☐ 3. High school ☐ 5. Postgraduate ☐

Q31. Your monthly income: …….. VND

Q32. Your household's expense per month: …….. VND

Q32. Your gender: 1.Male ☐ 0. Female ☐

Thank you very much for completing the questionnaire

8.3 Statement of Contribution Doctorate with Pulications/Manuscripts

DRC 16

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STATEMENT OF CONTRIBUTION
DOCTORATE WITH PUBLICATIONS/MANUSCRIPTS

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Name of candidate:	Ha Thi Thanh Mai
Name/title of Primary Supervisor:	Shamim Shakur/Dr
Name of Research Output and full reference:	
Manuscript Ha, T. M., Shakur, S. & Pham Do, K.H. 2020. Food safety in consumer's eye: evidence from Hanoi survey. Journal of Asian Business and Economics Studies. Under revision. Resubmitted.	
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Published article Ha, T. M., Shakur, S. & Pham Do, K.H. 2020. Linkages among risk perception, trust, and information: Evidence from Hanoi consumers. Food control.110 (2020) 106905	
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Published article Ha, T. M., Shakur, S. & Pham Do, K. H. 2019.Consumer concern about food safety in Hanoi, Vietnam. Food Control, 98, 238-244	
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Name/title of Primary Supervisor:	Shamim Shakur/Dr
Name of Research Output and full reference:	
Manuscript Ha, T. M., Shakur, S. & Pham Do, K. H. 2020. Risk perception and its impact on vegetable consumption: A case study from Hanoi, Vietnam. Cleaner Production. Under revision. Resubmitted with minor revisions.	
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Published article Ha, T.M., Shakur, S. & Pham Do, K.H. 2019. Rural-urban differences in willingness to pay for organic vegetables: Evidence from Vietnam. Appetite.141, 104273	
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