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**WILLINGNESS-TO-PAY FOR SAFER FOOD PRESERVATIVES IN MOON
CAKE: EVIDENCE FROM A CONSUMER SURVEY IN BEIJING**

A Thesis in

Agricultural, Environmental and Regional Economics

by

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ABSTRACT

In the global economy, food safety is gaining increasing attention as a purchase criterion in food consumption decisions. This thesis estimates consumers' willingness-to-pay (WTP) and assesses consumers' preferences for moon cake containing a safer preservative in Beijing, China. The contingent valuation method was selected to estimate WTP. Data are from a survey of 23 different stores located in eight different geographic locations (districts) in Beijing. The parameters of the WTP model were estimated using tobit analysis and ordered probit analysis. The results indicate that most consumers (84%) are willing to pay a premium for a safer moon cake. The mean WTP per safer moon cake is 5.35 *yuan* (\$0.79). This thesis also estimates the factors that influence individual WTP for moon cake containing a safer preservative.

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ACRONYMS AND SYMBOLS

\$: U.S. dollar

¥: China *yuan* (RMB)

CVM: Contingent valuation method

WTP: Willingness-to-pay

U.S.: United States of America

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DEDICATION

I wish to dedicate this thesis to my respected parents Mr. Yi Jin and Mrs. Jingfang Li. I also wish to dedicate this thesis to my dear husband Mr. Jianfeng Guo.

Chapter 1

INTRODUCTION

1.1. Introduction to Moon Cake and Preservatives

Moon cake is a traditional food eaten during the Mid-Autumn Festival in China. This tradition has been ongoing for more than two thousand years. Generally speaking, moon cakes are made of flour, sugar, and different stuffings, such as fruit, nuts, ice cream, yogurt, pork, eggs, green tea, flowers, vegetables, jelly, etc. Given the limitations of home-cooking conditions and the complexity of the moon cake's cooking process, most people purchase moon cake in stores instead of cooking themselves at home. Most moon cakes have a very short shelf life. Appropriate preservatives can help inhibit the growth of bacteria and fungi, avoid the oxidation of food constituents that cause quick decay, and prolong shelf life. Currently, there are more than 50 different kinds of preservatives in the United States and more than 40 kinds of preservatives in Japan [Liu et al., 2004].

Twenty-eight kinds of preservatives have been publicized in "Food Preservatives Use of Sanitation GB2760-1996", which is a national standard in China. The standard is widely used in several different fields there [Liu et al., 2004]. Moreover, the importance of preservatives has gradually been acknowledged.

1.2. Food Safety

Food safety issues are global in scale and can affect consumer confidence in food purchased in retail outlets around the world. At the same time, the quality and safety of food is a major benchmark of the economic development of and people's living conditions in a country. Global warming and pollution may result in more food contamination; a recent series of food safety emergencies such as outbreaks of mad cow and hoof-and-mouth diseases have reminded the world of the importance of information sharing and an early warning system. In 2008, China exported 24 million tons of food to more than 200 countries and regions [Ministry of Foreign Affairs, People's Republic of China, 2007]. But questions about the quality of Chinese food have been raised in recent months after a string of product recalls and import bans. To improve food safety and product quality, the government has issued measures, including the introduction of recall systems for food. The overall level of food quality in China is being steadily enhanced and the situation in food safety is continuously improving.

In light of these changes in attitude toward food safety, food content labels with "Pollution Free" or "Green Food" have become more and more prevalent. Many research papers in the food sciences have focused on topics such as genetically modified vegetables, green food, or organic food. Due to food characteristics, food preservatives may be added to a food product to help guarantee its quality in the food distribution system. There has been keen debate about the use of food preservatives in the food

engineering and food science fields. However, the safety of food preservatives, which is an issue that is as important as other issues in the food sciences, has seldom been referred to in research work. Moreover, the use of safe food preservatives has sometimes not occurred for a variety of reasons such as cost, production processes, and limited food preservative options available. It is important for food marketers and policymakers to understand that consumer perceptions of food with safer preservatives affect willingness-to-pay for safer food in developing countries.

1.3. Objectives of the Research

Many Chinese consumers have become more wary of the quality of their food and concerned about food safety issues, but their willingness-to-pay for safer food is still uncertain and evolving. The goal of this thesis is to analyze and measure research participants' preferences for, perceptions of, and willingness-to-pay for moon cake with safer preservatives in Beijing, China. The specific objectives of this study are to answer the following questions:

1. How much would consumers be willing to pay for moon cake with a safer preservative?
2. Which factors influence individual consumption behavior and determine consumer preferences with regard to safer moon cake?
3. What kinds of consumers are more concerned about food safety and would be willing to pay more money for safer food?

Chapter 2

LITERATURE REVIEW

2.1 Food Safety Studies

2.1.1 General Information about Food Safety

Public perceptions of food safety benefits and health concerns have drawn extensive attention from economists since the late 20th century [Wang, 2003]. Economists have begun to investigate consumer demand-related issues such as consumer perceptions of risks to food safety, ways to affect consumers' receipt of useful information on food safety, the relationship between income levels of consumers and their willingness-to-pay for food safety, and food demand behavior. At the same time, cost-efficiency and economic benefits are being emphasized in management decision-making as the main rationales for increasing demand for food safety and quality [Caswell, 1991]. Clancy [1986] explored and explained this view in his book, which focuses on how consumers respond to public policy. In 1987, several research projects on public policy, strategic marketing, industrial organization, and food systems were conducted by the Food Marketing Policy Center at the University of Connecticut [Caswell, 1991]. The main

goals of these research projects were to analyze how well the food system works and evaluate how government policy affects its operation and performance. A book entitled *Economics of Food Safety* was written and published by Caswell [1991] based on the research results from these projects. The book put forward theories and methods for measuring consumer demand for safer, more nutritious products. Moreover, it carried out specific and concrete analyses of how individual consumer characteristics, such as education and income levels, affect the ability to apply risk information with regard to food safety. Antle [1995] also carried out in-depth research on food policy in his book, *Choice and Efficiency in Food Safety Policy*.

Many economists have targeted meat, eggs, milk, soybeans, grapefruit, and orange juice, in studies of the impacts of product prices and demographic characteristics (such as age, gender, income, education level, and family size) on consumer perceptions, willingness-to-pay, and consumption behavior [Caswell et al., 1992; Gao et al., 1993; Buzby et al., 1995; Boccalett et al., 2000]. In Japan, food safety problems have received widespread attention from researchers since the 1990s [Wang, 2004]. Some economists such as Satoshi Kai have published a number of comparisons of the differences or similarities in food safety systems around the world. These studies have concluded that the time is ripe to promote food quality and safety, considering that competitive concerns in the food processing industry have shifted from production costs to food quality and safety [Satoshi, 1999].

Recently, economic research on food safety has mainly focused on two principal aspects. One aspect is research from the perspective of government management—that is, how to supervise food production processes in a rational and economical way. Credence foods have high pre-buying costs and high post-buying costs stemming from detecting safer and better quality foods. Low pre-buying costs related to quality detection are a feature of goods that have been analyzed by researchers. Research results indicate that it is a good idea to enhance the visibility of effective information via mechanisms such as labeling to ensure that the goods' characteristics have changed from credence goods to search goods based on food safety [Caswell and Padberg ,1992 ; Caswell and Mojdzuska ,1996]. Wang et al. [2008] indicated that receiving relevant and useful information on food safety is a very important issue in understanding and determining consumer behavior. Zhen and Wohlegant [2006] investigated rational habit formation and the effects of food safety information on meat consumption in the United States. Their results showed that meat demand was positively affected by food safety information, and habit persistence was found to dominate inventory adjustment in the dynamics of beef demand. In other words, consumers may increase their consumption of meat via long-run habit formation after receiving positive food safety information [Zhen and Wohlgenant, 2006]. In the United States, Piggott and Marsh [2004] investigated the impacts of food safety information for beef, pork, and poultry on meat consumption over the last several decades. Using an economic and empirical framework that involved consumer response to food safety information, they found that the impact of food safety information on demand was limited to a “contemporaneous effect” and that negative food safety information had a negative effect on demand for meat products [Piggott and Marsh, 2004]. Radwan et al.

[2008] investigated the effects of food safety information during the “mad-cow” crisis on Spanish consumers’ demand for different types of fresh meat and fish. The research was the first study of meat demand after the discovery of Bovine Spongiform Encephalopathy (BSE). Their paper precisely focused on the impact on consumer demand for fish and other fresh meat products after BSE information was published in the newspapers [Radwan et al., 2008]. As time progressed, they found that food safety information had a very significant impact on consumer demand for fish and other fresh meat products in Spain [Radwan et al., 2008]. This research shows that effective management of food safety information can have a significant impact on consumer demand for food products.

The second aspect has to do with research conducted from the point of view of consumer demand. Obviously, the consumer is the ultimate arbiter of food safety. It is important to understand consumer demand for food safety and base policy on that understanding. Doing so would, for example, ensure that food safety concerns do not lead to wasted food and resources [Riston and Weimai, 1998]. Artuso [2003] indicated that more stringent regulatory requirements may be assessed if regulatory policies have a significant impact on consumer risk perceptions. Grunert [2005] indicated that consumer perception and preferences are the two main distinguishable determinants that are informing consumer demand. Consumers’ purchasing decisions are supposed to be based on connecting perceptions of the product’s characteristics with self-relevant consequences and values [Grunert, 2005]. Consumer preferences for food safety would suggest improvements in food safety standards and regulation of the food industry [Garcia Martinez, 2007]. Overemphasis on food safety policies would affect consumers’ offsetting behavior and

increase pressure to sustain consumers' trust [Ndembe et al., 2008]. Generally, consumers' purchasing decisions are difficult to measure through personal perceptions and preferences. This has led to the use of several direct methodologies such as contingent valuation and auctions in measuring consumers' purchasing decisions relating to safer food.

2.1.2. Food Safety in China

Food safety is an important issue for Chinese consumers. Economists have done empirical research on consumer perception and consumption behavior and made much progress in recent years in China [Wang, 2003; Wilcocky et al., 2004]. Zhang [2003] investigated consumer perceptions, preferences, willingness-to-pay, and consumption behavior with regard to food safety. In investigating consumer perceptions and willingness-to-pay for safe vegetables in Zhejiang Province, Zhou [2004] found that consumers would be willing to pay extra money for safe vegetables, with the percentage price difference between regular vegetables and safe vegetables being 10–20%. Based on research in Tianjing, Zhang [2003] concluded that China's consumers are very concerned about food safety, especially for vegetables and dairy products. For vegetables, the greatest concern was expressed about pesticide residues, followed by harmful bacteria. Based on a survey of 200 consumers and supermarket sales data, Yang [2004] analyzed consumer willingness-to-pay and the market value of pollution-free vegetables. The results indicated that pollution-free vegetables had a price premium compared to regular vegetables. The magnitude of the price premium differed by season, region, and

vegetable variety. Consumers' gender, age, and income level also affected their willingness-to-pay for pollution-free vegetables. Gale and Huang [2007] indicated that demand for food safety is increasing because Chinese incomes are increasing. Moreover, most of the growing demand for food quality is coming from rural and low-income urban households that previously had not been in a position to pay for higher quality food.

Domestic food self-sufficiency has been an issue of significant concern to the Chinese government over the last several years. At the same time, crises in food quality and safety have emerged periodically, making the safety of domestically produced food a vital and urgent issue. In China, food safety-related research in economics began after the appearance in the market of green food. Most of the research elaborated on the importance of food quality and safety, compared relevant policy systems among developed countries around the world, and proposed suggestions for food safety based on conditions in China [Li, 1998]. Food safety management systems were theoretically analyzed by Xie and Yu [2000]. However, the responses of individual consumers concerning food safety have not received as close examination. In 2003, research conducted by Wang [2003] was the first to look at individual consumer responses to food safety issues in China. Chen and Yang [2008] estimated that China's agricultural products would be negatively affected by increasing global food safety standards. They came to that conclusion after conducting regression analyses using a gravity model. Econometric results showed that China's agricultural product trade was sensitive to variations in food safety standards.

In China, economic research on food safety is still in its early stages. In empirical research, Wang [2003] investigated Tianjing City consumers' responses to food safety based on respondents' demographic characteristics. Due to the relatively high income elasticity of demand for food safety attributes [Swinbank, 1993], with improvements in people's living standards, consumers are paying much more attention to food quality and standards governing agricultural production and food processing. The current food safety situation is very serious in light of dramatically increasing consumer demand for safe food versus the shortage of a safe food supply. Therefore, the study of the impact of consumer perceptions, consumer's willingness-to-pay, and consumer's consumption as affected by concerns for food safety has important theoretical and practical significance.

2.1.3 Preservative Study in Food Safety

2.1.3.1 Introduction to Preservatives

Traditional preservatives include natural substances, such as salt, sugar, and vinegar. In China, traditional food preservation methods involve processes of treating and handling food such as drying, smoking, freezing, marinating, salting, and pickling. These methods have been used for thousands of years. Newly developed preservatives isolate some of the enzymes found in fruits and vegetables and let the enzymes continue to metabolize. These types of enzymes can be used to prevent bacterial and microbial growth and preserve the flavor of products or improve their taste and appearance, such as sorbic acid [Sun, 2004].

2.1.3.1.1 Introduction to Sorbic Acid

As one type of antimicrobial agent for preservation purposes, sorbic acid is a white or yellowish crystalline powder and has a distinctive smell. Recognized as a safe and efficient organic preservative, sorbic acid was first isolated by A. W. Van Hoffman from the berries of the mountain ash tree in the year 1859 [Lueck, 1980]. Sorbic acid is typically soluble in ethanol and may be dissolved in ether. However, the solubility of sorbic acid in water and sucrose is extremely small. Therefore, the potassium salt of sorbic acid is commercially available as a powder or granules, such as sodium sorbate, potassium sorbate and calcium sorbate; even though undissociated sorbic acid is the more effective antimicrobial agent [Kinderlerer and Hatton, 1990].

Table 2.1 Sorbic acid and potassium sorbate solubilities

Solvent	% Solubility Sorbic Acid	% Solubility Potassium Sorbate
Water		
20 °C (68 °F)	0.16	58.20
50 °C (112 °F)	0.55	61.00
100 °C (212 °F)	4.00	64.00
Ethanol		
5%	0.16	57.40
100%	12.90	2.00
Sucrose		
10%	0.15	58.00
40%	0.10	45.00

60%

0.08

28.00

Source: Sofos and Busta (1993)

The scope of application of sorbic acid has increased dramatically over the years. Sorbic acid and the potassium salt of sorbic acid can be used in beverages, wine, seasoning, meat products, aquatic products, sauce pickles, preserved fresh fruit, and many other products [Liu, 2004]. It is easy to see the utility of sorbic acid. In using sorbic acid and potassium sorbate, direct adjunction, impregnation, or spray may be available. The result of use is typically the prevention of the growth of mold, yeast, and fungi. The capacity to inhibit mold using sorbic acid and potassium sorbate was much greater than that found for benzoic acid. The mildew-proof capacity of sorbic acid is 5–10 times that of benzoic acid [Liang, 2004].

The addition of sorbic acid does not change a food's characteristics. The metabolite of sorbic acid is carbon dioxide and water. Therefore, sorbic acid may be regarded as part of the food. In its application to food, sorbic acid does not disrupt food color, flavor, tastes, smell, or nutrient content.

2.1.3.2 Safety Issues for Preservatives

Generally, a preservative is a natural or synthetic chemical that is added to products such as foods, biological samples, or pharmaceuticals. Its use prevents product decomposition by microbial growth or by undesirable chemical changes. Due to safety concerns, many countries have passed legislation to regulate the application of preservatives. In some

cases, food preservatives have led to general consumer mistrust, such as in the case of boric acid. Some legislation was passed to ban the use of boric acid after the 1910s because its toxicity was demonstrated in animal and human studies. However, boric acid had been widely used as a food preservative for more than 50 years from the 1870s to the 1920s before the banning legislation was established. Due to its benefits as a preservative, boric acid was used again until the 1950s [Bucci, 1995].

2.2 Health Concerns

Safety is the most important characteristic of food preservatives. Some artificial food preservatives have been tested and linked with cancer, digestive problems, and neurological conditions, or diseases such as heart disease or obesity [McCann et al., 2007]. As one type of preservative, benzoic acid is widely available and low cost, and can be used on a widespread basis in China. Benzoic acid is a colorless crystalline with a strong odor and is produced by many plants as an intermediate in the formation of other compounds [United Nations Environment Programme, 2001].

As a food preservative, generally, benzoic acid is harmful only in very large quantities. Large oral doses may cause abdominal pain, sore throat, nausea, and vomiting [Environmental Health & Safety, 2005]. The toxicity of sorbic acid is much lower and its safety is higher than that of benzoic acid [Environmental Health & Safety, 2005]. The toxicity effect of potassium sorbate was one quarter that of benzoic acid and had half the harmful effect of salt. Sorbic acid has been included on the list of safe and efficient food

preservatives in the publication, “Food Preservatives Use of Sanitation GB2760” in 1996 [Liu et al., 2004]. Moreover, the crystallite and powder forms of benzoic acid may cause mild irritation to the skin. Benzoic acid and benzyl alcohol irritate the upper respiratory tract, eyes, and skin [United Nations Environment Programme, 2001].

Chapter 3

CONCEPTUAL FRAMEWORK

3.1 Willingness-to-pay

During a period of globalization and technological progress, food safety has become an increasingly important and prominent problem [Pinstrup-Andersen, 2000], and one that has received a great deal of research and policy attention. In the 1980s, after harmful bacteria and viruses were found in food such as *Escherichia coli*, Bovine spongiform encephalopathy (mad cow disease), and salmonella, and caused serious public health problems, consumer confidence in food safety dropped to its lowest point in history. Research has been conducted to investigate consumers' perceptions of food safety and their willingness to pay for safer food [Caswell, 1995; Wessells and Anderson, 1995; Nayga, 1996; Latouche et al., 1998; Henson and Northen, 2000]. As consumer surplus derived from a Hicksian demand curve, the notion of willingness-to-pay (WTP) can be defined as the maximum amount of money that an individual would be willing to pay, sacrifice or exchange for a commodity, or different services level. The issue is whether the consumer would be willing to spend extra money for food safety benefits—the perception is that the consumer decides on the trade-off among health, safety, and other

commodities or services. The reason that consumers would be willing to pay extra money for safer and healthier food such as organic food, pollution-free food and so on, is to reduce the potential health risks that may be found in conventional agricultural products. Grunert [2005] indicated that food quality and safety are the main issues in today's food economics, although many research questions remain to be addressed. Some major issues were summarized in his paper, such as how consumers perceive food quality and food safety, and how to affect consumer demand. De Jonge et al. [2007] used a survey-based study to analyze how different factors affect WTP for, and to determine consumer confidence in, food safety. Socio-demographic variables and personality characteristics were part of the main determining factors. In this study, optimists and pessimists were analyzed separately as simultaneously affecting consumer confidence. The research results implied that consumer confidence in food safety may be increased by improving both consumer trust in societal actors and consumer perceptions of the safety of particular product groups [de Jonge et al. 2007, 2008]. Wang et al.'s study [2008] explored Chinese consumers' increasing demand for food safety standards.

A survey is a common and effective way to estimate WTP for food safety and consumer awareness of food safety information. A survey of Beijing consumers in China found that few respondents (20%) were aware of Hazard Analysis Critical Control Point (HACCP) management but most respondents had heard of the term HACCP [Wang, 2008]. Wang [2008] investigated the information on consumer awareness, willingness-to-pay, and price premiums for milk products through HACCP management used to reduce food safety risks. In this survey, hedonic regression analysis was used to analyze the

determinants of supermarket milk prices. The study found that there was a slight price premium from HACCP certification and most of the HACCP-aware respondents were willing to pay a modest premium for HACCP certification [Wang, 2008]. Ho et al. [2006] used a survey of 1,000 urban respondents to estimate consumers' understanding, awareness, and WTP for genetically modified (GM) food. The results showed that the acceptance of GM foods and understanding of the biotechnology were comparatively low in China. Most respondents (51%) were neutral about consuming GM food even though only a small number of Chinese consumers said that they definitely would not purchase GM food. After both positive and negative information on GM food risks was provided, the results showed that the proportion of WTP for GM food product dropped sharply [Ho et al., 2006]. Thus, providing more information and including both positive and negative information was deemed very important in improving estimates of consumer WTP for GM food and estimating WTP for food safety.

3.2 Determinants of WTP

Many factors can influence consumer willingness to pay, such as income, gender, age, education, whether or not there are children or elderly at home, as well as the type and size of food safety risks [Golan and Kuchler, 1999]. Differences in consumers' understanding and experience of policy or assessments of goods may also have an impact [Nestor, 1998; Grannis and Thilmany, 2002]. In research on ways to reduce the risk of pesticide residue, Buzby et al. [1995] discovered that consumers' willingness to pay was related to their age, income level, and perceptions of safer grapefruits. This research indicated that elderly consumers had a lower WTP than younger consumers to have safer

food because generally it is difficult to change elderly consumers' habits. Moreover, even if they would be willing to pay more for safer food, elderly consumers may be unable to pay too much based upon their current income level. According to Buzby et al. [1995], a negative relationship between consumers' willingness to pay and income level might be due to the possibility that as consumer income increases, the concern about food safety decreases. Fu et al. [1999] found that these types of consumers, who in particular cared about their health conditions (e.g., would be willing to purchase vegetables stemming from soilless cultivation), would be willing to pay more to reduce the risk of cancers caused by pesticide residue. Their research also indicated that the respondents' health status as well as their concerns about the price and quality of vegetables was the most significant factors in determining WTP. In terms of organic vegetables in Italy, Boccaletti and Nardella [2000] indicated that the higher the income and consumers' awareness of the risk of pesticides residue, the higher was their WTP. However, the higher the education degrees held by the consumer, the less likely they were to pay more for organic vegetables. The reason may be that consumers with higher education degrees have more knowledge about the safety of conventional products. In addition, socio-demographic characteristics were the most important factors affecting information acquisition and consumption behavior of consumers. Moreover, two factors—education degree [Schultz, 1975] and family economics ability [Becker, 1977]—were emphasized as very important to individual information acquisition and consumption patterns. Consumers' different health states also affect their sensitivity to new information on food safety [Grossman, 1972].

Generally speaking, after consumers form a perception of a product, they make a decision about whether to purchase the product based on their perception and attitude. However, the real situation is quite complex. It is possible that a consumer may purchase the product first and then form a perception and awareness of the product. Consumption behavior and consumer attitudes may be inconsistent in many situations. The main reasons for inconsistent consumption behavior are purchase motive, purchase ability, and condition constraints such as time and place which affect the realization of consumption behavior. In addition to the impact of socio-demographic characteristics, whether the consumer would be willing to pay extra money for the safer products depended primarily on the following factors:

1. Consumers' risk perception of products. Price and the observed risk of food would primarily affect consumers' preference for food safety performance. Different consumers have different abilities and methods for gaining, processing, and handling information. One-sided knowledge and information would let the risk enlarge and even treat the risk description as dangerous. Therefore, different consumers with different individual characteristics, such as different educational degrees, would have different understandings of the degree of food safety and the harmful effects of food preservatives on health. Usually, the higher the consumers' risk perception is, the more aware they are of the need to avoid risk.

2. Level of understanding of food preservative characteristics. Many consumers have little knowledge of the ingredients in and safety of food preservatives. In the short term,

the consumer may be unable to detect health effects caused by safe and unsafe food preservatives. Therefore, consumers' willingness to pay may be reduced due to the high price of safer food preservatives. If consumers could understand clearly the elements of safer food preservatives and their effects on human health, they might develop greater trust for safer food preservatives and pay more for them.

3. Environmental concerns. If consumers are environment-aware and recognize the damage from unsafe food preservatives to the environment, it is more likely that consumers will pay more for safer food preservatives to protect the environment. However, if they lack knowledge about the relationship between food preservatives and the environment, or do not care much about the environment, their consumption behavior would not significantly change.

4. Human health concerns. At present, health and food safety problems have been drawing remarkable attention from consumers. The greater the concern expressed by consumers about health, the more attention they pay to food security, nutrition, and balance. Therefore, health concerns affect consumers' consumption of food preservatives.

5. Price responsiveness. Food consumption is an essential activity every day. Consumers in developing countries are very sensitive to changes in food prices. Because per-capita income in China is not high, prices are a major point of concern among consumers [Wang 2003].

6. Convenient shopping place. A more convenient shopping place will lead to a greater premium on consumer's WTP [Dai, 2005]. In Dai's (2005) survey, eight main districts and twenty-three different levels of stores in Beijing were selected by the investigators; this investigation covered a wide range of geographic locations and customers in Beijing.

Chapter 4

DATA AND METHODOLOGY

4.1 Survey Description

The data used here are from the “Survey of consumer’s willingness-to-pay and perception in terms of preservative safety of moon cakes” conducted by the Food Safety Research Center at Renmin University in China in 2003. The survey sought to obtain willingness-to-pay information about moon cakes made with a safer preservative. A total of 464 respondents filled out the survey; the number of useable questionnaires was 443, for a very high retrieval rate of 95%. The main purpose of this survey was to measure respondents’ preference for, perception of, and willingness to pay for moon cakes produced using a safer preservative. Moreover, factors believed to influence individual purchasing behavior were examined in this research.

The questionnaire was organized into three sections. The first section was dedicated to understanding the degree of each respondent’s preference. The questionnaire also covered the food market and geographic area in which the consumer shopped. In the

second section, respondent's willingness to pay for moon cake with safer preservatives was examined using open-ended and follow-up questions. In order to obtain reliable answers from the respondents, some explanatory information about preservatives and food safety was provided to respondents. Questions about respondent's perceptions and awareness were also included in the questionnaire. Finally, the third section contained questions about respondent's socio-demographic characteristics. This section sought respondent information such as gender, age, education, health condition, income, marital status, children under 12, and elderly family members older than 65. The following tables provide summary statistics on the dependent and independent variables in this survey data. Histograms help illustrate the distribution of dependent and independent variables.

4.2 Information Provided In the Questionnaire

Information provided to respondents in the questionnaire was as follows: "Most moon cakes have a very short period in which the quality is guaranteed. Appropriate preservatives could help inhibit the growth of bacteria and fungi, avoid food constituents oxidizing and decaying quickly, and prolong shelf life. As one kind of preservative, benzoic acid is widely used in many fields in China because of its low cost and availability. However, the hazards identification of benzoic acid indicates that it can cause a lot of irritation to the upper respiratory tract, eyes, and skin. Therefore, we are planning to use sorbic acid, a safer preservative, to replace benzoic acid. The toxicity of sorbic acid is extremely low compared to that of benzoic acid. After sorbic acid is added, characteristics of the food are not be changed or affected by it. However, the cost of

sorbic acid is much higher than benzoic acid. Consequently, the cost of this safer moon cake with sorbic acid will be higher than that with benzoic acid.”

4.3 Data Resources

4.3.1 Respondent Preference

As a kind of traditional food during the Chinese moon festival, moon cake is very popular in China. Among 443 survey respondents, approximately one-half liked foods similar to moon cake. About 83% ate moon cake during the moon festival, with 64% of them eating it very often. This is because, traditionally, people buy moon cakes to share with their families to celebrate the festival and family reunions even though some people dislike the food. People also buy moon cakes to friends as gifts during the moon festival for cultural reasons. The safety of moon cake is a critical issue due to the huge annual sales volume. Table 4.1 presents summary statistics for survey questions on respondents' preferences toward moon cake, factors affecting purchase decisions, and preference for a purchase place. Table 4.2 summarizes responses and shows that production date, expiration date, brand, and taste are the largest concerns when purchasing moon cake. This shows that people care most about the taste of moon cake and its quality (good-to-eat period). Brand is also an indicator of quality to some degree and brand differentiation is basically the differentiation of quality. About 68% of respondents preferred purchasing moon cake from a supermarket or shopping center which is usually considered to offer a better guarantee of food quality and safety than smaller retailers such as stalls and bakeries.

Interestingly, only 24% of the respondents took food preservatives into account when making a purchase decision.

Table 4.1: Summary of respondent preferences

<i>Independent Variable</i>	<i>Type</i>	<i>Level</i>	<i>Description</i>
Favoritism1	Categorical	5	Do respondents like to eat foods like moon cake?
Favoritism2	Categorical	3	Do respondents like to eat moon cake during the moon festival?
Product characteristics	Categorical	9	Characteristics of concern to respondents when purchasing moon cake
Purchase place	Categorical	7	Where do respondents usually buy moon cake?

Table 4.2: Variables definitions and summary statistics for variables in Table 4.1

Independent Variable	Definition	Numbers	Percentage (%)	Mean	Std. dev.
	like very much =1	40	9.03		
	like =2	96	21.67		
Favoritism1	neither like or dislike =3	125	28.22	3.36	1.38
	dislike =4	28	6.32		
	dislike very much =5	154	34.76		
Favoritism2	often =1	285	64.33	1.52	0.76

	occasionally =2	84	18.96		
	never =3	74	16.70		
<hr/>					
Product characteristics (multiple choices)	production date =1	311	70.20	**	**
	expiration date =2	285	64.33	**	**
	brand =3	230	51.92	**	**
	production place =4	43	9.71	**	**
	preservative content =5	105	23.70	**	**
	packaging =6	44	9.93	**	**
	appearance =7	40	9.03	**	**
	taste =8	244	55.08	**	**
	price =9	119	26.86	**	**
<hr/>					
Purchase place	supermarket =1	273	61.90	**	**
	store =2	12	2.72	**	**
	bakery =3	92	20.86	**	**
	shopping center =4	28	6.35	**	**
	farm market =5	7	1.59	**	**
	home-made store =6	18	4.08	**	**
	stalls =7	11	2.49	**	**
<hr/>					

Fig. 4.1. Do respondents like to eat foods like moon cake?

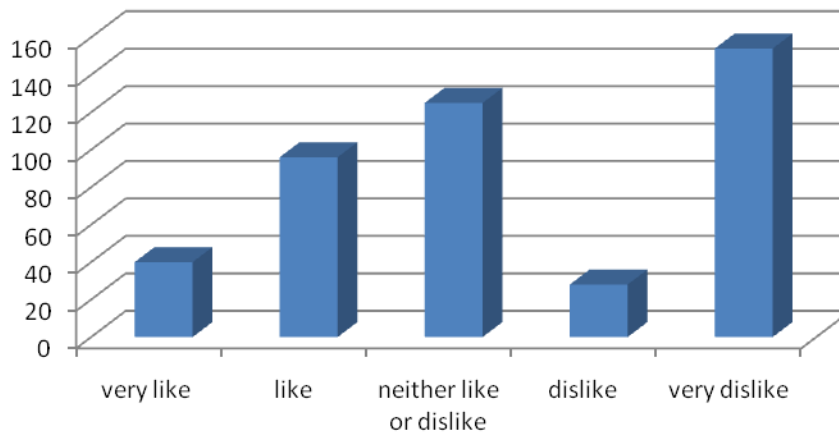


Fig. 4.2. Do respondents like to eat moon cake during moon festival?

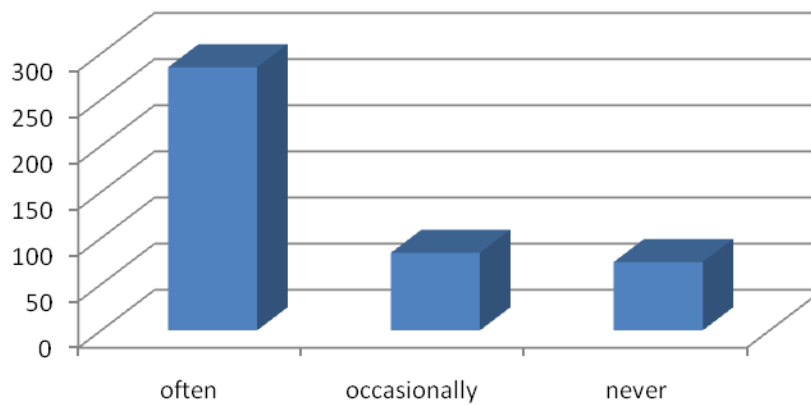


Fig. 4.3. Product characteristics of concern to respondents when purchasing moon cake

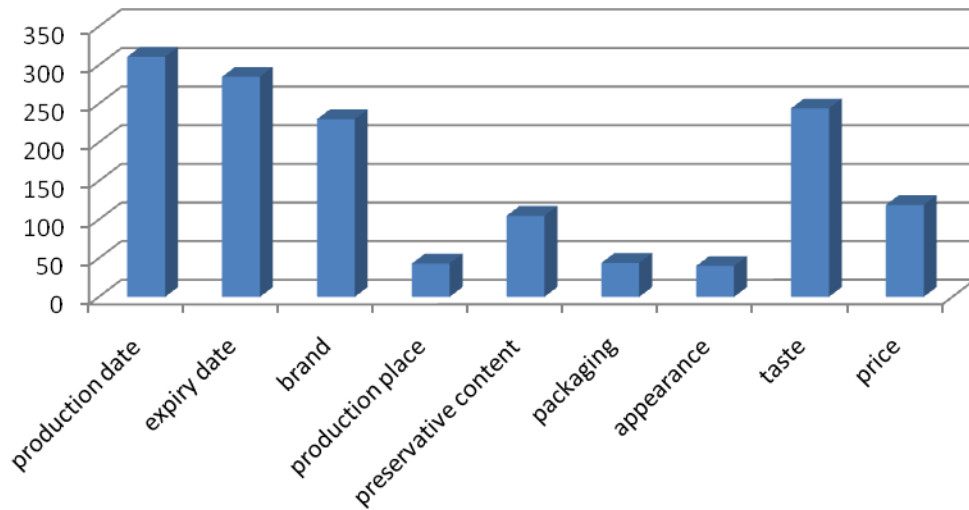
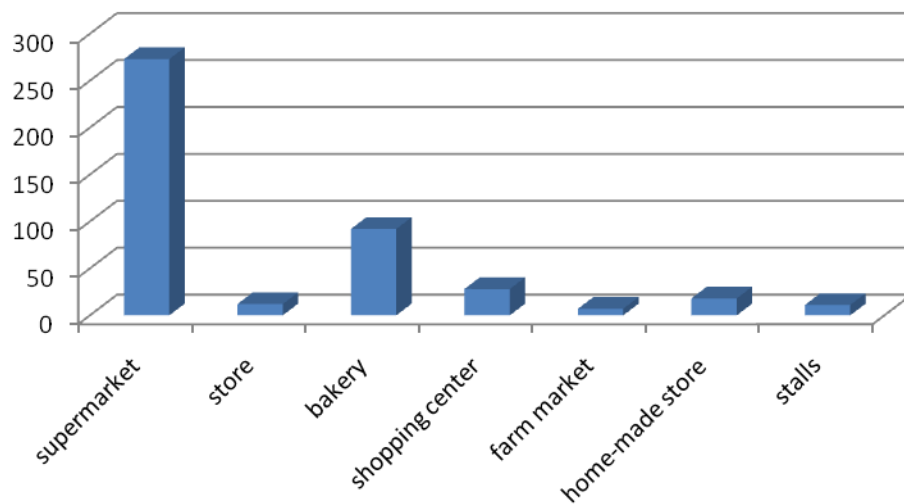


Fig. 4. 4. Where do respondents usually buy moon cake?



4.3.2 Survey Locations

The survey was conducted in 23 different shopping stores located in eight different geographical locations (districts) in Beijing, China. The stores were categorized into 3 different levels according to their sizes. As we can see in Figs. 4.5 and 4.6 (Area and Size), survey samples were uniformly distributed in these 8 districts to avoid geographical bias. In order to randomize subjects with different backgrounds, preferences, or loyalty to a certain store, subjects were chosen from different-sized stores. Around half of the stores chosen as survey locations were large while the other half was medium or small in size.

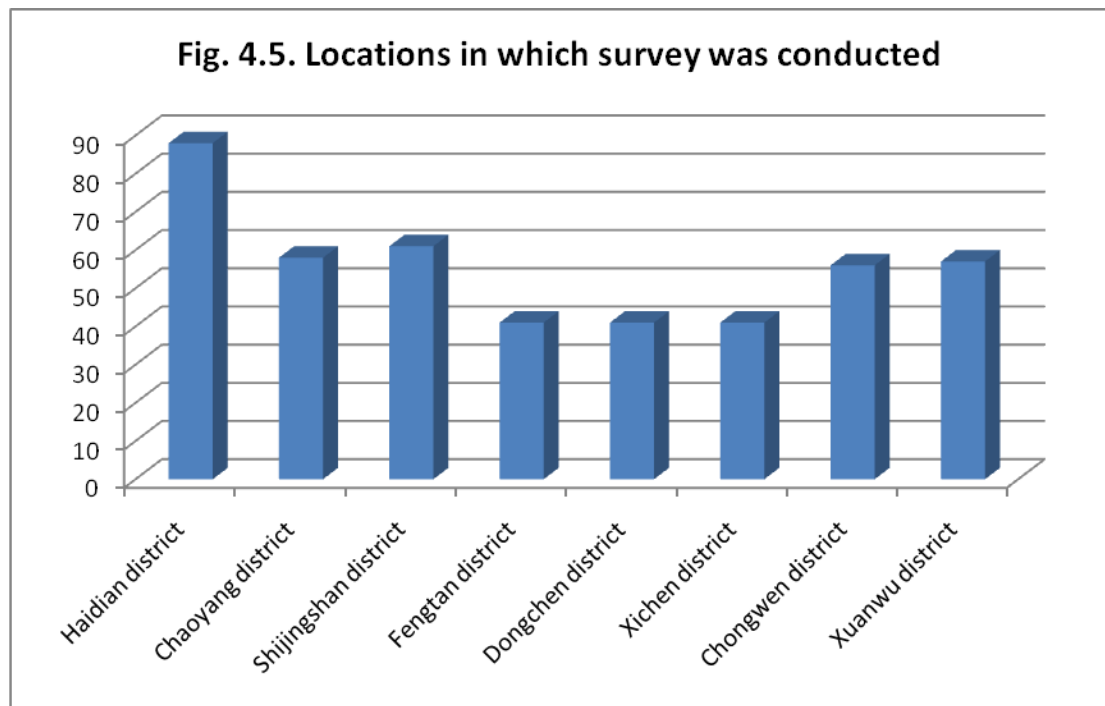
Table 4.3: Summary of survey locations

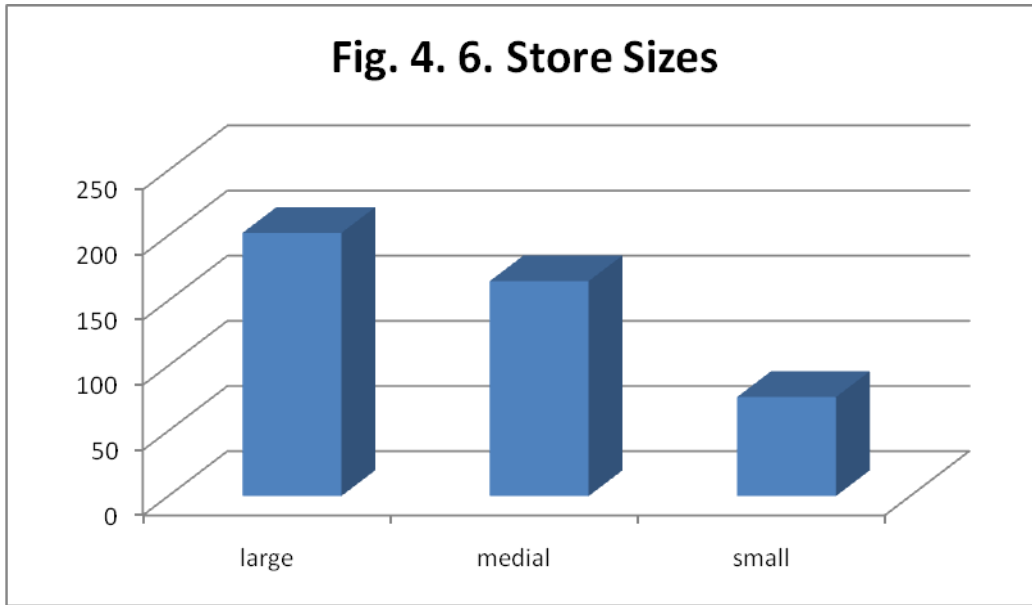
<i>Independent Variable</i>	<i>Type</i>	<i>Levels</i>	<i>Description</i>
Area	Categorical	8	Locations in which survey was conducted
Size	Categorical	3	Store sizes

Table 4.4: Variable definitions and summary statistics for variables in Table 4.3

<i>Independent Variable</i>	<i>Definition</i>	<i>Numbers</i>	<i>Percentage (%)</i>	<i>Mean</i>	<i>Std. dev.</i>
Area	Haidian district =1	88	19.86	**	**

	Chaoyang district =2	58	13.09	**	**
	Shijingshan district =3	61	13.77	**	**
	Fengtian district =4	41	9.26	**	**
	Dongchen district =5	41	9.26	**	**
	Xichen district =6	41	9.26	**	**
	Chongwen district =7	56	12.64	**	**
	Xuanwu district= 8	57	12.87	**	**
	large =1	202	45.60		
Size	medial =2	165	37.25	1.72	0.74
	small =3	76	17.16		





4.3.3 Concern, Worry and Willingness-to-pay

Table 4.5 lists another group of questions on the survey. As can be seen in Table 4.6 and Fig.4.7, more than 80% of respondents stated a concern about food safety issues and about 45% respondents worried about the quality and safety of moon cake. The discrepancy between “concern” and “worry” was mainly due to education level. The sample statistics for education level in Table 4.8 show that respondents with degrees from technical institutes and colleges accounted for about 76% of all respondents. The higher the education level, the more comprehensive the knowledge obtained, and the less “worry” one has. So it makes sense that most of the respondents were concerned about the food safety issue but only half worried about the quality and security of moon cake. The mean WTP for a safer moon cake was 5.35 *yuan*.

Table 4.5. Summary of dependent variables (Concern, Worry, and WTP)

<i>Dependent Variable</i>	<i>Type</i>	<i>Levels</i>	<i>Description</i>
Concern	Categorical	3	Were respondents concerned about food safety?
Worry	Categorical	4	Were respondents worried about the quality and safety of moon cake?
WTP	Numerical	/	Respondents' WTP for safer moon cake (<i>yuan</i>)

Table 4.6. Variable definitions and summary statistics for dependent variables

<i>Dependent Variable</i>	<i>Definition</i>	<i>Numbers</i>	<i>Percentage (%)</i>	<i>Mean</i>	<i>Std. dev.</i>
Concern	unconcerned =1	79	2.76	1.85	0.92
	concern =2	185	46.48		
	very concerned =3	179	44.97		
Worry	not worried =1	149	33.71	2.79	1.10
	neither worried nor not worried =2	95	21.49		
	worried =3	142	32.13		
	very worried =4	56	12.67		
WTP	<1	88	20.47	5.35	9.01
	1 – 5	250	58.14		
	5 – 10	61	14.19		

Fig. 4.7. Are respondents concerned about food safety?

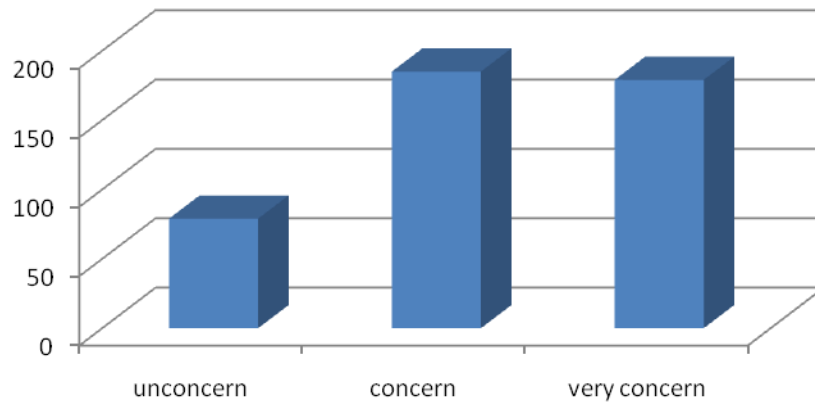
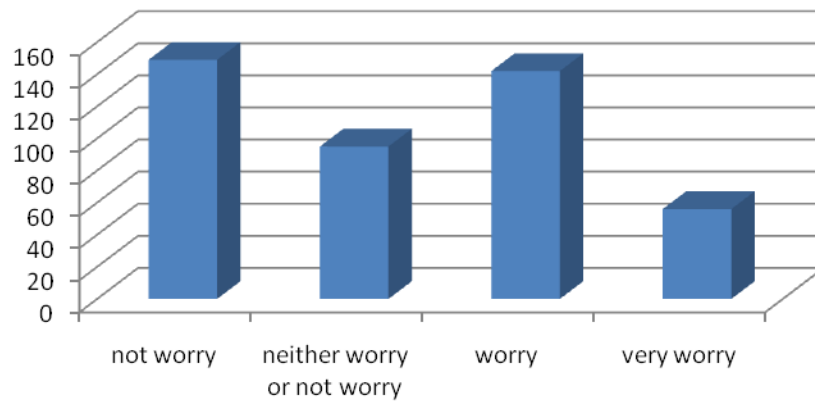
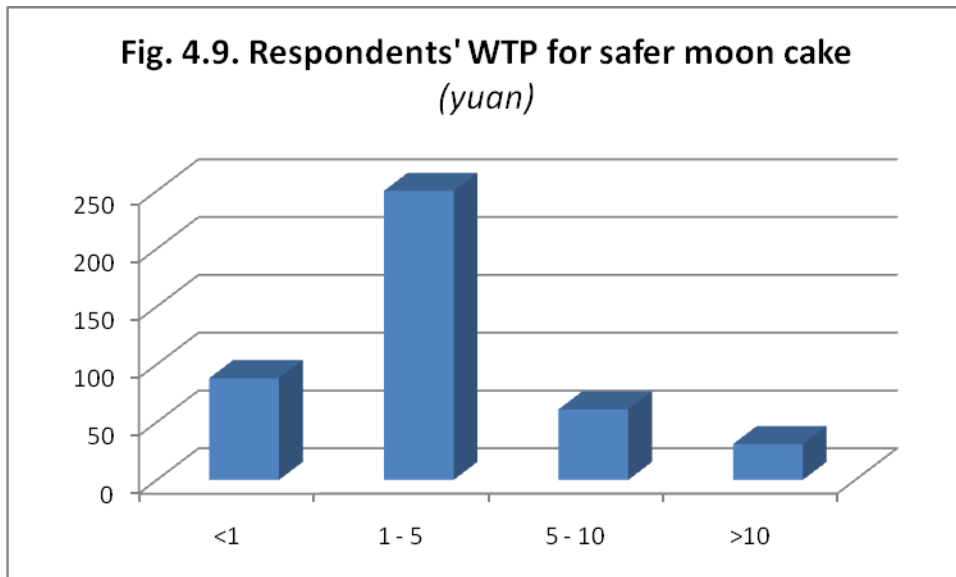
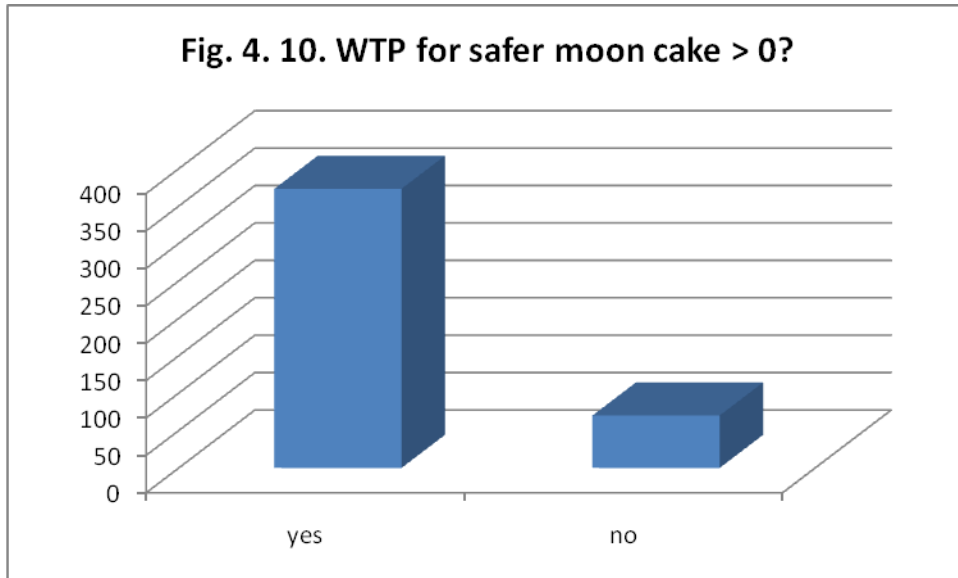


Fig. 4.8. Are respondents worried about the quality and safety of moon cake?





Whether or not respondents would be willing to pay a price premium for moon cake with a safer preservative was one subject of inquiry. The results show that most respondents (84%) would be willing to pay some price premium. Only 16% would not be willing to pay more money for a safer moon cake.



4.3.4 Socio-demographic Characteristics

The socio-demographic characteristics of respondents are shown in Tables 4.7 and 4.8.

With regard to gender, males accounted for 40% of respondents and females 60%. This is because females generally undertake housework such as cooking and shopping. Over one-half of the respondents were under 30 and the mean respondent age was about 35. This may be due to survey locations (shopping malls, supermarkets and similar places) where young people appear more frequent than elders. The mean for respondents' monthly income is 3513RMB.

Table 4.7: Socio-demographic characteristics of survey respondents

<i>Independent Variable</i>	<i>Type</i>	<i>Levels</i>	<i>Description</i>

Gender	Categorical	2	Gender of respondents
Age	Numerical	/	Age of respondents
Marriage	Categorical	2	Marital status of respondents
Education	Categorical	6	Education level of respondents
Children	Categorical	2	Do the respondents have children under 12?
Elder	Categorical	2	Do the respondents have a person who is older than 65 in the household?
Health condition	Categorical	4	Health condition of respondents
Income	Numerical	/	Monthly total income of respondents (<i>yuan</i>)

Table 4.8: Variables definitions and summary statistics for variables in Table 4.7

<i>Variable</i>	<i>Definition</i>	<i>Numbers</i>	<i>Percentage (%)</i>	<i>Mean</i>	<i>Std. dev.</i>
Gender	male = 1	176	40.46	1.60	0.49
	female = 2	259	59.54		
Age	under 30	236	53.51	34.57	15.29
	30-39	62	14.06		
	40-54	87	19.73		
	above 55	56	12.70		
Marriage	married = 1	243	55.48	1.44	0.02
	single and other = 2	195	44.52		
Education	uneducated = 1	6	1.37	4.20	0.99
	Elementary school = 2	11	2.51		
	High school = 3	89	20.32		

	Technical institute = 4	133	30.37		
	College = 5	180	41.10		
	Graduate school =6	19	4.34		
Children	Yes =1	142	32.05	0.32	0.47
	No =2	301	67.95		
Elder	Yes =1	267	60.27	0.60	0.49
	No =2	176	39.73		
Health condition	extremely good = 1	135	30.47	1.98	0.82
	very good = 2	201	45.37		
	good = 3	89	20.09		
	not good = 4	18	4.06		
Income	Less than 500	5	1.16	3513	2363
	500-1000	32	7.41		
	1000-2000	77	17.82		
	2000-3000	122	28.24		
	3000-4000	65	15.05		
	4000-5000	53	12.27		
	5000-8000	50	11.57		
	Greater than 8000	28	6.48		

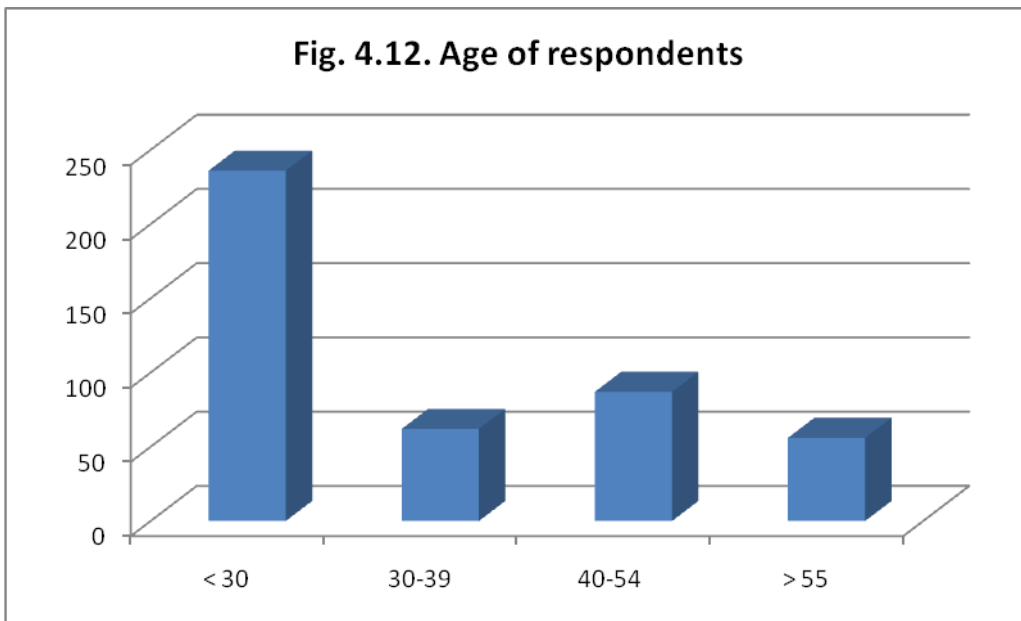
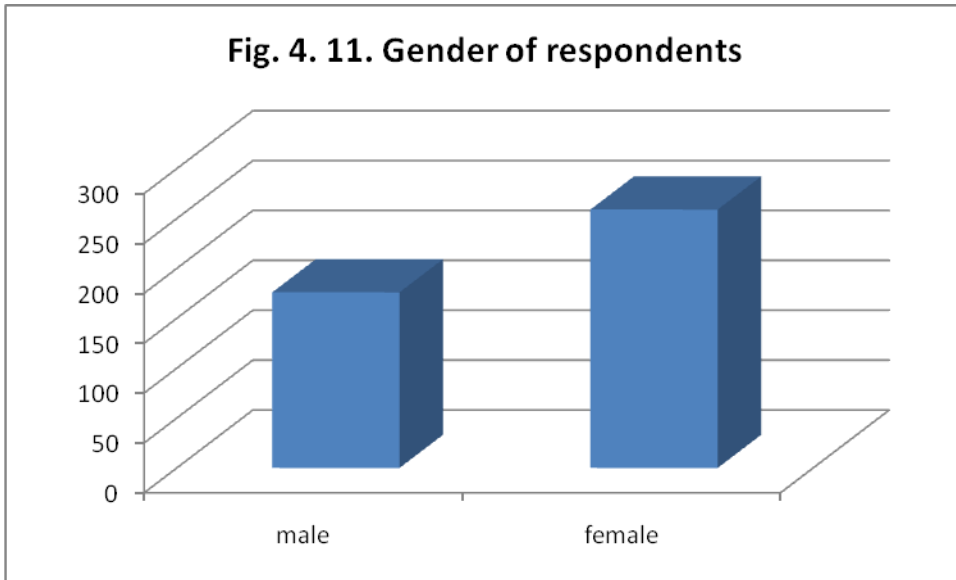
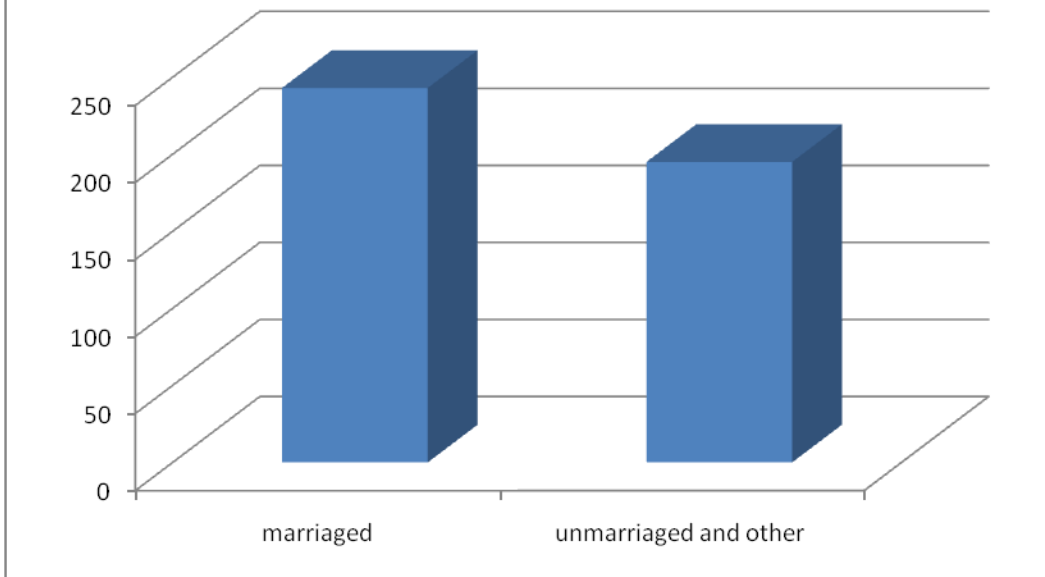
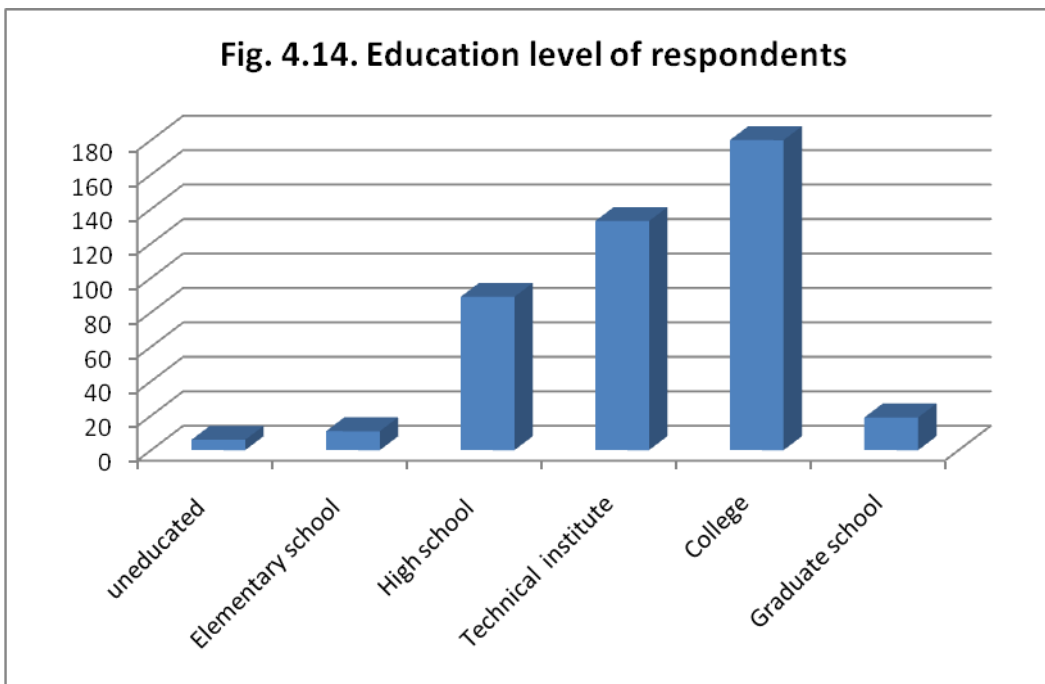
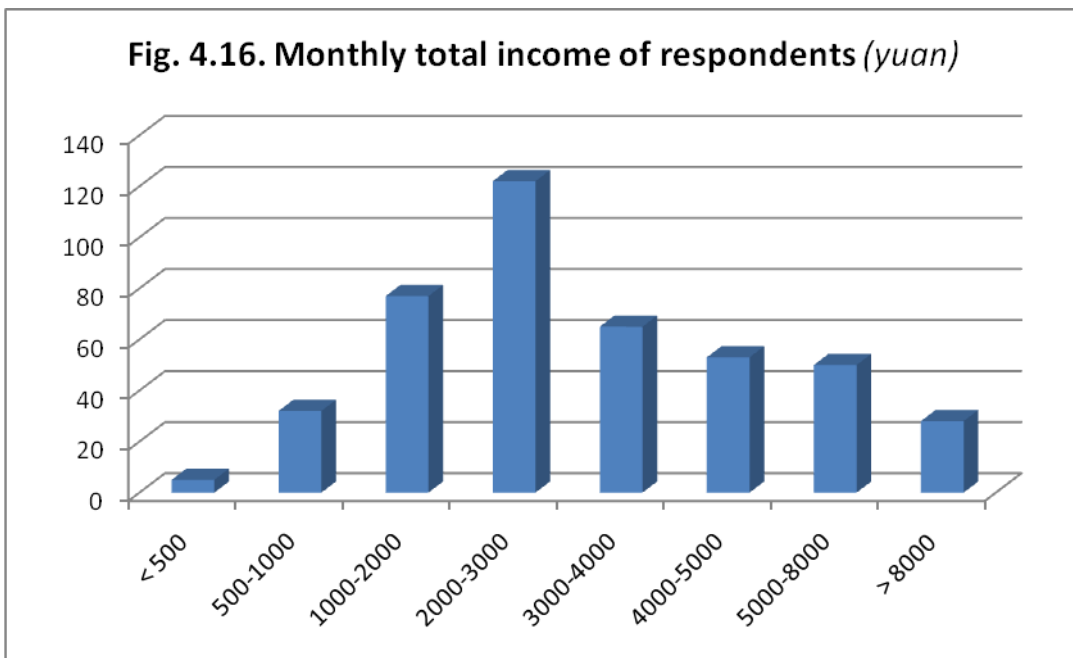
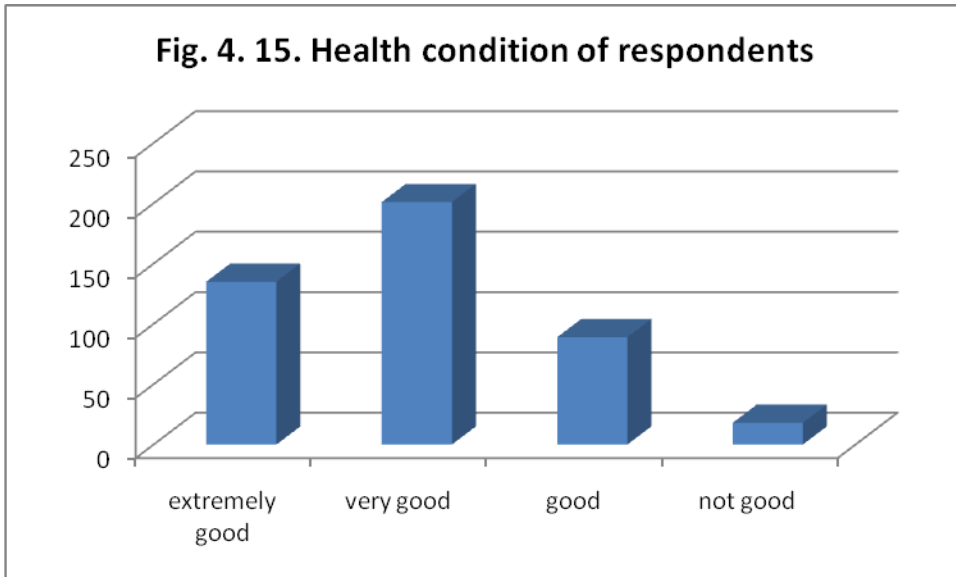


Fig. 4.13. Marital status of respondents**Fig. 4.14. Education level of respondents**



4.4 Methodology

Safer food would reduce the occurrence of foodborne illness risks. An empirical method designed by Shin [1992] measured consumers' willingness-to-pay in a higher education setting. Research results showed that the students at Iowa State University would be willing to pay an extra 22 cents to purchase a safer food compared with foods tainted with salmonella [Shin, 1992].

A means-end-chain laddering technique was used to analyze consumer perceptions of traceability which is an attribute often related to food safety [Van Rijswijk, 2008]. In this study, consumers were asked to rank some attributes such as food quality, food safety, and preference according to perceived importance. Van Rijswijk [2008] confirmed previous research results—consumers link food safety to food quality. The means-end-chain laddering technique is also utilized in the Total Food Quality Model by Grunert [2005]. The Total Food Quality Model includes both horizontal and vertical elements and is used to analyze the attributes that affect food safety. Wang [2008] investigated information about consumers' awareness, willingness to pay, and price premiums for milk products through HACCP management used to reduce food safety risks. Hedonic regression analysis was used. Tonsor et al. [2007] examined consumer preference for various beef food safety assurances. Survey data were from over 4,000 U.S., Canada, Japan, and Mexican consumers. Mixed logit models were utilized to estimate whether the WTP preferences of Japanese and Mexican consumers were nonlinear with respect to the level of food safety risk. They found that consumers had different marginal WTP for food

safety as well as different strategies for enhancing beef steak demand according to country. Schroeder [2007] also found that food safety management strategies varied across countries due to identified differences in food safety risk perceptions and risk.

The main approaches used to elicit consumer WTP are contingent valuation, choice experiments, and experimental auctions.

4.4.1 Choice Experiments

Survey data have been used in several studies of choice. Choice experiments help researchers to identify the different impacts of certain attributes separately. The paper by Carlsson et al. [2005] employed a choice experiment to estimate consumer preferences and willingness to pay for food quality attributes in chicken, beef, pig, egg, milk, and flour production in Sweden. A random parameter logit model was used to estimate the influence of several attributes relating to choice along with levels of food quality.

Loureiro and Umberger [2006] utilized choice experiments to test the relative importance of food safety attributes, analyze consumers' relative preferences, and estimate willingness to pay for certain meat attributes relating to country-of-origin labeling and traceability in rib eye beef steak purchased in the United States. A choice modeling framework was used to elicit consumers' preferences. Results showed that three attributes, which verified the presence of country-of-origin, traceability and tenderness information, carried a higher mean premium than attributes related to food safety inspection.

Moreover, food safety related to traceability and country-of-origin labeling was a main

concern among U.S. consumers [Loureiro and Umberger, 2006]. Gao and Schroeder [2008] designed two choice experiments to value beef steak products and investigate consumers' different responses. Cluster analysis was used to classify consumers into two groups based on their demographic information and shopping experiences. They found that WTP and food product attribute information were affected by consumer characteristics and the accuracy with which WTP information was provided to consumers [Gao and Schroeder, 2008].

4.4.2 Experimental Auctions

An experimental action occurs when individuals exchange real money for real goods in an active market to elicit consumer WTP. Umberger et al. [2002] estimated consumers' WTP for beef flavor from domestic markets in Chicago and San Francisco, using experimental auction procedures. Consumers' preferences for country-of-origin labeling of beef products were quantitatively and qualitatively evaluated in the U.S. The results indicated that those who were willing to pay the most for country-of-origin labeling for beef products wished to see a significant increase in food safety and quality. Brown et al. [2005] used non-hypothetical experimental auctions to estimate the impact of risk tolerance on Canadian consumers' willingness-to-pay for food safety. Some additional information was given to consumers in terms of the risk of illness from a chicken sandwich and the sandwich on which they were bidding. When consumers overestimated the food safety risk, differences in bids and informed rounds of bidding became smaller [Brown et al., 2005].

4.4.3 Contingent Valuation

It is difficult to assess and measure some non-market goods whose true value cannot be obtained directly through market exchanges. With regard to food safety, much research has been conducted. The attributes of food safety are not easy to estimate directly.

Therefore, a fit method of estimating non market value has been used to estimate certain aspects that do not have a market price since they are not directly sold. Moreover, the method applied to determine food safety benefits could involve estimating consumers' willingness to pay for safer and better quality food [Goldberg and Rosen, 2005].

The contingent valuation method (CVM), as a survey-based economic technique, is used to estimate the demand for a wide variety of ecosystem and environmental services [Hanemann, 1994; Hanemann and Kanninen, 1999]. The contingent valuation method involves asking the respondent directly how much they would be willing to pay or spend for some specific environmental services.

There has already been significant research on the market demand for food safety. With regard to food characteristics in food safety which are unable to be priced in the market, an appropriate estimation method is necessary to measure the demand for food safety. Buzby et al. [1995] showed that the consumer would be willing to pay an extra premium of \$0.19-\$0.69 for a grapefruit with fewer pesticides. In another case, the public feared salmonella and thought that eggs might be contaminated in the 1990s. In April 1996,

Michael Foods Inc. of Minnesota conducted a telephone survey about this concern and on the basis of the survey results increased the price of eggs in-shell pasteurized per dozen from \$0.85 to \$1.39 [Caswell, 1998b]. In another study, the average regular market price of one kind of seafood was \$4 per dozen in 1998 [Caswell 2008a]. Through the contingent valuation method, Caswell obtained the result that consumers would be willing to pay \$0.72-\$0.80 more than the regular price for safer products [Caswell 2008a].

As a method of measuring the market value of a non-market good, CVM was first proposed by Ciriacy-Wantrup in 1947 [Hanemann, 1994]. In 1963, Davis made the first practical application in studies that estimated the value of hunting entertainment and tourist camping in a wilderness area in Maine [Knetsch and Davis, 1966]. After that, CVM was used in more and more applications in the U.S. In the 1980s, CVM was introduced into Britain, Norway and Sweden. After ten years, CVM was applied as an economic technique in the valuation of non-market resources in France and Denmark [Carson, 1989; Lipton, 1995]. In the past 40 years, more than fifty countries have done research with CVM and the number of published research papers using CVM totals more than 2,000 [Jin, 2003]. Rodriguez [2008] estimated consumers' willingness to pay for organic food products available in the Argentinean domestic market with the contingent valuation method.

There are several possible sources of bias in the contingent valuation method. One is that the nonmarket goods are not real and exist only hypothetically. Another is the possibility of strategic behavior by respondents, meaning that respondents may attempt to influence

policy-making through their answers [Nestor, 1998]. The main concern in using CVM is whether or not the stated preference and revealed preference of consumers are consistent [Fox et al., 1998]. There is the possibility that people will exaggerate the extent of their actual willingness to pay [Lusk, 2003] but some research has shown consistency between respondents' answers and their real willingness to pay [Adamowicz et. al., 1994].

Hanemann [1999] outlined the theory of contingent valuation. We assume that utility is a function of market goods, non-market goods, and individual preferences. The price (p) of market goods, individual income level (y), individual preferences (s), and non-market goods (q) would then be the arguments of the indirect utility function. The indirect utility function might also depend on stochastic components such as measurement error and individual preference error. If ε stands for the stochastic components, the indirect utility function can be expressed by $V(p, q, y, s, \varepsilon)$. Assume that non-market goods consumption is changed from q_0 to q_1 . Assuming that utility increases, the change can be expressed as $V_I(p, q_1, y, s, \varepsilon) \geq V_0(p, q_0, y, s, \varepsilon)$. CVM is designed to reveal consumers' willingness to pay (w) for the improvement in utility, and is defined implicitly by the equation

$$V_I(p, q_1, y-w, s, \varepsilon) = V_0(p, q_0, y, s, \varepsilon).$$

In recent years, CVM has made widespread progress in estimating the economic value of ecological and environmental assessment. In the survey conducted for this thesis, open-ended questions were asked to obtain information on respondent's willingness to pay. A sample question was: "how much would you be willing to pay for a moon cake preserved with sorbic acid". To avoid some shortcomings such as protest answers and strategic

behavior, the questionnaire specially designed some questions in a yes-or-no referendum format to protect specified resources, such as “if a moon cake with sorbic acid had a price premium of RMB 3.5 compared to a moon cake with benzoic acid, would you like to buy?”. In this thesis, the market value of the moon cake with sorbic acid as a preservative is estimated using the contingent valuation method. This method is used to determine willingness to pay for moon cakes with a safer preservative as well as to examine the factors that influence individual willingness to pay.

Chapter 5

ECONOMETRIC MODEL SPECIFICATION

This study utilizes SAS statistical software to process the data and estimate both the ordered probit model and tobit model. Based on initial model estimations, some explanatory variables that were statistically insignificant were removed from the models in order to reduce multicollinearity and obtain better results. For example, the explanatory variable “Content” has 9 levels. The p-value of the second dummy variable “Content 2” was much larger than 0.1 (more than 0.9) in all the models. After dropping this dummy variable from models, the p-values of the other variables changed and became more statistically significant. Because each category variables had different ranks, a series of dummy variables for these category variables were created and renamed. For example, the explanatory variable “Education” which includes 6 levels was represented by 5 dummy variables.

$$\begin{array}{l}
 \text{"Education"} = \left\{ \begin{array}{l}
 1 \quad \text{"Deduc1"} \text{ (level 1) } = 1, \text{ otherwise } = 0; \\
 2 \quad \text{"Deduc2"} \text{ (level 2) } = 1, \text{ otherwise } = 0; \\
 3 \quad \text{"Deduc3"} \text{ (level 3) } = 1, \text{ otherwise } = 0; \\
 4 \quad \text{"Deduc4"} \text{ (level 4) } = 1, \text{ otherwise } = 0; \\
 5 \quad \text{"Deduc5"} \text{ (level 5) } = 1, \text{ otherwise } = 0; \\
 6 \quad \text{"Deduc6"} \text{ (level 6) } = 1, \text{ otherwise } = 0;
 \end{array} \right.
 \end{array}$$

Because we can use the first 5 dummy variables to calculate the 6th dummy variable, "Deduc6" was ignored in the analysis.

Based on the data obtained from the survey, two models were applied to further analysis. Reporting of WTP is subject to the tobit model; we used the ordered probit model to estimate the determinants of consumers' "Worry" and "Concern" about purchasing and eating a moon cake with or without a safer preservative.

5.1 Ordered Probit Model

The ordered probit model recognizes the discrete indexed natural order of various independent variables and the fact that the differences between the ranks are not necessarily equivalent [Greene, 2003]. Mckelvey and Zavoina first introduced the ordered probit model approach in 1975 [Greene, 2003]. The probit model can be

generated formally as $Y_i^* = \beta_0 + \beta_1 X_{1i} + \varepsilon_i$ where ε_i is assumed to follow a standard normal distribution [Storchmann, 2005]. Let Y_i be a binary outcome variable. If the utility index is “high enough”, consumers would like to buy the moon cake with a safer preservative (if $Y_i^* \geq 0$, $Y_i = 1$). If the utility index is “not high enough”, consumers will not wish to purchase this kind of moon cake (if $Y_i^* < 0$, $Y_i = 0$) [Storchmann, 2005]. The ordered probit model is used with ordinal multinomial dependent variables as a generalization of the basic probit model.

In this thesis, the ordered probit model was used to estimate the relationship between ordinal multinomial dependent variables (concern and worry) and independent variables (gender, age, income, content, and other variables). For example, if “Concern” was considered an observed dependent variable, the following specification was used here [Storchmann, 2005]:

$$Y_i^* = \beta' X_i + \varepsilon_i \text{ with } \varepsilon_i \sim N(0, \sigma^2)$$

where Y_i^* is the latent and continuous measure of “Concern” expressed by individual i 's “Concern” under some condition,

β' = a vector of parameters to be estimated,

X_i = a vector of explanatory variables describing the respondent preference, the survey locations, and socio-demographic characteristics, and

ε_i = a random error term assumed to follow a standard normal distribution.

The observed, ordinal multinomial dependent variable “Concern”, Y_i , was determined in this model as follows:

$$Y_i = \begin{cases} 1 & -\infty < Y_i^* \leq \gamma_1 \quad \text{very concerned} = 1 \\ 2 & \gamma_1 < Y_i^* \leq \gamma_2 \quad \text{concerned} = 2 \\ 3 & \gamma_2 < Y_i^* \leq \gamma_3 \quad \text{neither concerned nor unconcerned} = 3 \\ 4 & \gamma_3 < Y_i^* \leq \gamma_4 \quad \text{unconcerned} = 4 \\ 5 & \gamma_4 < Y_i^* \leq +\infty \quad \text{very unconcerned} = 5 \end{cases}$$

Here, the γ_i 's represent thresholds to be estimated along with the parameter vector β .

If we assume that $\varepsilon_i \sim N(0, \sigma^2)$, the probability of Y_i with a particular rank can be estimated as:

$$\Pr(Y_i=1) = \Pr(-\infty < Y_i^* \leq \gamma_1) = \Pr(-\infty < \beta'X_i + \varepsilon_i \leq \gamma_1) = \Pr(\beta'X_i + \varepsilon_i \leq \gamma_1) - 0 = \Pr(\varepsilon_i \leq \gamma_1 - \beta'X_i) = \Phi(\gamma_1 - \beta'X_i)$$

$$\begin{aligned} \Pr(Y_i=2) &= \Pr(\gamma_1 < Y_i^* \leq \gamma_2) = \Pr(\gamma_1 < \beta'X_i + \varepsilon_i \leq \gamma_2) = \Pr(\beta'X_i + \varepsilon_i \leq \gamma_2) - \Pr(\beta'X_i + \varepsilon_i \leq \gamma_1) \\ &= \Pr(\varepsilon_i \leq \gamma_2 - \beta'X_i) - \Pr(\varepsilon_i \leq \gamma_1 - \beta'X_i) = \Phi(\gamma_2 - \beta'X_i) - \Phi(\gamma_1 - \beta'X_i) \end{aligned}$$

and so forth, up to

$$\Pr(Y_i=5) = \Pr(\gamma_4 < Y_i^* \leq +\infty) = \Pr(\gamma_4 < \beta'X_i + \varepsilon_i \leq +\infty) = 1 - \Pr(\beta'X_i + \varepsilon_i \leq \gamma_4) = 1 - \Pr(\varepsilon_i \leq \gamma_4 - \beta'X_i) = 1 - \Phi(\gamma_4 - \beta'X_i).$$

$\Phi(\cdot)$ denotes the cumulative normal distribution function [Storchmann, 2005].

The latent variable Y_i^* is modeled as follows:

$$Y_i^* = \beta_j(\text{Area})_i + \beta_k(\text{Size})_i + \beta_l(\text{Favoritism1})_i + \beta_m(\text{Favoritism2})_i + \beta_n(\text{Content})_i + \\ \beta_o(\text{Purchase place})_i + \beta_p(\text{Gender})_i + \beta_q(\text{Age})_i + \beta_r(\text{Marriage})_i + \beta_s(\text{Education})_i + \\ \beta_t(\text{Children})_i + \beta_u(\text{Elder})_i + \beta_v(\text{Health condition})_i + \beta_w(\text{Income})_i + \varepsilon_i$$

The ordered probit model indicates the type of consumer who is more concerned about food safety and more worried about the quality and safety of moon cake.

For the dependent variable “concern”, which is whether the respondents were concerned about food safety, the sign of parameters β_k (Size) are expected to be positive. This means that consumers who shop in bigger markets are expected to be more concerned about food safety. The sign of parameters β_q (Age) is expected to be positive insofar as older consumers are more concerned about food safety and their health than younger consumers. The sign of parameters β_s (Education) is expected to be positive. Consumers with greater education are expected to be more concerned about food safety and may be more aware of food safety issues. The sign of parameters β_t (Children) is expected to be positive because the parents would be concerned about the health of their children and therefore more concerned about food safety issues. The sign of parameters β_u (Elder) is expected to be positive insofar as consumers care more about the health of elderly people and therefore about food safety. The sign of parameters β_v (Health condition) is expected to be positive because consumers are more likely to be concerned about food safety if

they care about their own health status. The sign of the parameter β_w (Income) is expected to be positive because consumers with higher income are more likely to be concerned about food safety issues.

For the dependent variable “worry”, which indicates whether respondents were worried about the quality and safety of moon cake, the sign of parameters β_k (Size) is expected to be positive because consumers who purchase moon cake at a bigger store are signaling their concern about food quality and safety. The sign of parameters β_l (Favoritism1) is expected to be positive because consumers who like to eat moon cake should be more worried about its quality and safety. The sign of parameters β_m (Favoritism2) is expected to be positive because consumers worry about the quality and safety of moon cake if they like to eat moon cake at each moon festival. The sign of parameters β_s (Education) is expected to be negative because consumers with greater education are more likely to be informed and therefore less likely to worry about the quality and safety of moon cake. The signs of parameters β_t (Children) and β_u (Elder) are expected to be positive because consumers who live with an elderly person who is older than 65 or children under 12 at home tend to be careful about health issues and cautious about their families. The sign of parameters β_y (Health condition) is expected to be positive because consumers concerned about their health status are more likely to worry about the quality and safety of moon cake.

5.2 Tobit Model

Jams Tobin [1958] proposed the tobit model, which is a statistical model used to describe the relationship between a non-negative dependent variable y_i and independent variable x_i [Takeshi, 1973, 1984, 1985]. The tobit model assumes that the observed dependent variables y_i for observations $i = 1, 2, \dots, n$ satisfy $y_i = \max(0, y_i^*)$. That means: if $y_i^* \leq 0$, then $y_i = 0$; if $y_i^* > 0$, $y_i = y_i^*$. y_i^* is the latent variable generated by the classical linear regression model $y_i^* = \beta x_i + u_i$. Following standard practice, we assume that the error term in this model is normally distributed $u_i \sim N(0, \sigma^2)$. In this thesis, a tobit model is used to estimate the determinants of consumers' WTP for safer moon cake. The following specification is used here:

$$y_i^* = \beta_j(\text{Gender})_i + \beta_k(\text{Age})_i + \beta_m(\text{Education})_i + \dots + \beta_w(\text{Income})_i + \dots + u_i \text{ with } u_i \sim N(0, \sigma^2)$$

where y_i^* is the latent value of individual i 's WTP,

β = a vector of parameters to be estimated,

x_i = a vector of explanatory variables describing respondent preferences, survey locations, and socio-demographic characteristics, and

u_i = a random error term assumed to follow a normal distribution.

The full model is:

$$y_i^* = \beta_j(\text{Area})_i + \beta_k(\text{Size})_i + \beta_l(\text{Favoritism1})_i + \beta_m(\text{Favoritism2})_i + \beta_n(\text{Content})_i + \\ \beta_o(\text{Purchase place})_i + \beta_p(\text{Gender})_i + \beta_q(\text{Age})_i + \beta_r(\text{Marriage})_i + \beta_s(\text{Education})_i + \\ \beta_t(\text{Children})_i + \beta_u(\text{Elder})_i + \beta_v(\text{Health condition})_i + \beta_w(\text{Income})_i + u_i \text{ with } u_i \sim N(0, \sigma^2)$$

The sign of parameter β_k (Size) is expected to be positive in the tobit model because consumers who purchase a moon cake at a larger store are signaling their willingness to pay more to purchase a safer moon cake. The signs of parameters β_l (Favoritism1) and β_m (Favoritism2) are expected to be positive. If consumers like to eat moon cake and do so often at each moon festival, one would expect that they would be willing to pay more for a safer moon cake. The sign of parameter β_q (Age) is expected to be positive. Older consumers would be willing to pay for a safer moon cake because they would be more concerned about their health. However, Buzby et al. [1995] indicated that older consumers are more reluctant to pay higher prices than younger consumers for safer food because generally it is difficult to change older consumers' minds. The sign of parameters β_s (Education) is expected to be positive. Consumers with a higher level of education would be willing to pay more for a safer moon cake because they understand how important safe food is to human health. But this is not universal: in terms of organic vegetables in Italy, Boccaletti and Nardella [2002] indicated that the higher the education degrees of consumers, the less likely they are to pay for organic vegetables. The sign of parameters β_t (Children) and β_u (Elder) is expected to be positive. Households with a person who is older than 65 or children under 12 would be willing to pay for safer food because they are concerned about the health of their families. Fu et al. [1999] indicated

that the consumers purchasing vegetables grown under soilless cultivation would be willing to pay premium to reduce the risk of cancers caused by pesticide residues. Their research also showed that the respondents' health status and their concerns about the price and quality of vegetables were significant factors in WTP decisions. The parameter β_w (Income) is expected to show a positive relationship between WTP and consumer's income.

The dependent variable $y_i = \max(0, y_i^*)$ is the observed value of individual i 's WTP. To help deal with outliers in the sample and yield a model in which the variance of the error term u_i can be modeled as the same for all observations, WTP is taken as a logarithm. However, if $WTP = 0$, $\ln(WTP)$ is undefined. So we introduce a parameter $\delta = 0.1$ that is a very small positive number and use $\ln(WTP + \delta)$ as the dependent variable rather than $\ln(WTP)$. If $WTP = 0$, the censoring point is $\ln(\delta) \approx -2.30$.

Chapter 6

RESULTS AND DISCUSSION

6.1 MODEL 1.1- Results of ordered probit model for dependent variable “Concern”

As a qualitative dependent variable model, the ordered probit model is not easy to interpret. The estimated coefficients (β) affect the probability that a certain value of the dependent variable “Concern” occurs. A positive sign (+) means that higher values of the explanatory variable increase the probability of higher values of the dependent variable [Boccaletti and Michele, 2000]. A negative sign (-) indicated the converse.

The dummy variable Area 4 (Fengtai district) has a positive and statistically significant impact on the dependent variable “Concern” at the significance level 0.1. This means that respondents in Area 4 are more concerned about moon cake safety than respondents in other areas. Fengtai district may be different from the others because it is where many universities are located and therefore many of its inhabitants are college students. College students by definition have a relatively high education level and they may

acquire information about food safety, including negative news, through various channels. It would make sense that the respondents in Fengtai district would be more concerned about food safety.

Respondents who neither liked nor disliked eating moon cake (Favor13) were statistically less concerned about the food safety issues. Relatively speaking, these respondents have a negative attitude toward eating moon cake so it is easy to understand why they were not concerned about the food safety issues. Respondents who bought moon cake at a farm market (Purchase Place5) were statistically more concerned about food safety issues. The safety of food sold at a farm market is difficult to guarantee, but food prices are generally much lower than at other kinds of stores. Home-made stores (Purchase Place6) are specialty locations for cooking and making moon cakes. Although their sales are relatively small and their prices are lower than other kinds of stores, home-made stores generally see the quality and safety of food they sell as key to customer retention and survival in a competitive marketplace. The results for this variable indicate that respondents who buy moon cake in home-made stores are not as concerned about the food safety issue.

Production date and production place (Content1 and Content4) have a statistically significant and negative impact on the dependent variable "Concern". This means that respondents who care about the production date and production place were not concerned about food safety issues. The estimated coefficient for Gender is positive and statistically significant, indicating that female respondents are more concerned about food safety issues than males. Married respondents (Marriage) are more concerned about food safety

issues than single respondents. The reason may be that married respondents generally have greater family responsibilities than single respondents.

Table 6.1. Analysis of ordered probit model: dependent variable “Concern”

Model Information		
Data Set	WORK.ORDEREDPROBIT	
Response Variable	CONCERN	CONCERN
Number of Response Levels	3	
Model	cumulative probit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	443
Number of Observations Used	411

Note: 32 observations were deleted due to missing values for the response or explanatory variables.

Response Profile		
Ordered Value	CONCERN	Total Frequency
1	1	75
2	2	173
3	3	163

Probabilities modeled are cumulated over the lower Ordered Values.

Model Convergence Status
Convergence criterion (GCONV=1E-8) satisfied.

Score Test for the Equal Slopes Assumption		
Chi-Square	DF	Pr > ChiSq
19.4236	21	0.5580

Model Fit Statistics		
Criterion	Intercept Only	Intercept and Covariates
AIC	860.059	828.224
SC	868.096	920.652
-2 Log L	856.059	782.224

Testing Global Null Hypothesis: BETA=0			
Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	73.8350	21	<.0001
Score	67.1327	21	<.0001
Wald	66.1138	21	<.0001

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Area1	1	0.0112	0.1577	0.0051	0.9433
Area2	1	0.1370	0.1762	0.6047	0.4368
Area4	1	0.3649	0.2013	3.2853	*0.0699

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Size1	1	-0.0882	0.1686	0.2737	0.6009
Size2	1	0.00472	0.1689	0.0008	0.9777
Favor13	1	-0.2775	0.1311	4.4815	**0.0343
Favor14	1	0.2345	0.2430	0.9310	0.3346
Favor21	1	0.0512	0.1276	0.1608	0.6884
DPP1	1	-0.1312	0.1827	0.5163	0.4724
PP3	1	-0.0110	0.2122	0.0027	0.9585
PP5	1	1.7376	0.6298	7.6124	***0.0058
PP6	1	-0.8864	0.3495	6.4327	**0.0112
Content1	1	-0.3379	0.1337	6.3917	**0.0115
Content4	1	-0.3939	0.2145	3.3702	*0.0664
Content5	1	-0.2269	0.1431	2.5150	0.1128
Gender	1	0.3699	0.1223	9.1521	***0.0025
Marriage	1	-0.4647	0.1665	7.7886	***0.0053
Educ3	1	0.1540	0.1661	0.8590	0.3540
Educ4	1	0.0213	0.1379	0.0239	0.8771
AGE	1	-0.00725	0.00570	1.6185	0.2033
LnIncome	1	0.0217	0.0886	0.0597	0.8070

Note. * p < 0.10 ** p < 0.05 *** p < 0.01.

6.2 MODEL 1.2- Results of ordered probit model from dependent variable “Worry”

The independent dummy variables Area1 and Area2 have positive and statistically significant impacts on the dependent variable “Worry”. The respondents in Area1 (Haidian district) and Area2 (Chaoyang district) were worried about the quality and safety of moon cake. Area1 (Haidian district) is where many universities in Beijing are located and therefore many of its inhabitants are college students. The overall education level is quite high. These respondents may know more about the process of making moon cake and the importance of the safe food to people’s health. Haidian district is also known as "electronics avenue" because of its connection to information technology and the preponderance of stores along a central, crowded street. Its formal name is "Beijing high-technology industry development experimental zone." People working in this area have higher income and education levels. Area 2 (Chaoyang district) is often referred to as the “Financial District” by foreigners living in Beijing. Housing prices are relatively high. Someone working or living in this area generally has higher income and education levels, and can afford expensive moon cakes. Generally, the expensive moon cakes have a greater guarantee in terms of quality and safety.

Respondents who do not like to eat moon cake (Favor14) are statistically more likely to be worried about the quality and safety of moon cake. At the same time, respondents who like to eat moon cake very often at each moon festival (Favor21) are statistically more likely to be worried. It is the respondents in the middle in terms of their like or dislike for moon cake who are less worried.

There is a statistically significant and negative relationship between “Purchase Place1” (supermarket) and “Worry”. Supermarkets provide a better guarantee concerning quality and safety, so people who shop there are not as worried about the quality and safety of moon cake. “Content1” (Production date) has a statistically significant and negative relationship with “Worry”. Respondents who care about the production date are less worried about the quality and safety of moon cake. Married respondents (Marriage) are statistically more worried about the quality and safety of moon cake than single respondents. There is a statistically significant and positive relationship between “Educ4” (technical institute) and “Worry”. The higher levels of education the respondent has, the more the respondent worries about the quality and safety of moon cake.

Table 6.2. Analysis of ordered probit model: dependent variable “Worry”

Model Information		
Data Set	WORK.ORDEREDPROBIT	
Response Variable	WORRY	WORRY
Number of Response Levels	4	
Model	cumulative probit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	443
Number of Observations Used	410

Response Profile		
Ordered Value	WORRY	Total Frequency
1	1	140
2	2	92
3	3	127
4	4	51

Probabilities modeled are cumulated over the lower Ordered Values.

Note: 33 observations were deleted due to missing values for the response or explanatory variables.

Model Convergence Status
Convergence criterion (GCONV=1E-8) satisfied.

Score Test for the Equal Slopes Assumption		
Chi-Square	DF	Pr > ChiSq
58.5286	42	0.0464

Model Fit Statistics		
Criterion	Intercept Only	Intercept and Covariates
AIC	1092.110	1091.201
SC	1104.159	1187.589
-2 Log L	1086.110	1043.201

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	42.9091	21	0.0032
Score	40.6356	21	0.0062
Wald	42.3498	21	0.0038

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Area1	1	0.2700	0.1487	3.2991	*0.0693
Area2	1	0.3242	0.1713	3.5824	*0.0584
Area4	1	0.2838	0.1950	2.1191	0.1455
Size1	1	-0.2161	0.1600	1.8239	0.1768
Size2	1	0.0224	0.1609	0.0194	0.8893
Favor13	1	0.0648	0.1231	0.2770	0.5987
Favor14	1	0.6931	0.2443	8.0497	***0.0046
Favor21	1	0.4174	0.1217	11.7623	***0.0006
PP1	1	-0.3155	0.1776	3.1564	*0.0756
PP3	1	-0.1085	0.2063	0.2765	0.5990
PP5	1	-0.0914	0.4913	0.0346	0.8523
PP6	1	-0.2762	0.3180	0.7544	0.3851
Content1	1	-0.2398	0.1285	3.4801	*0.0621
Content4	1	-0.0202	0.1937	0.0109	0.9167
Content5	1	-0.0506	0.1346	0.1416	0.7067
Gender	1	0.0787	0.1159	0.4609	0.4972
Marriage	1	-0.2863	0.1584	3.2681	*0.0706
Educ3	1	0.00986	0.1564	0.0040	0.9497

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Educ4	1	0.2764	0.1317	4.4048	**0.0358
AGE	1	0.00746	0.00541	1.8995	0.1681
LnIncome	1	-0.0423	0.0839	0.2535	0.6146

Note. * p < 0.10 ** p < 0.05 *** p < 0.01.

6.3 MODEL 2-Tobit analysis from dependent variable “WTP”

“Size1” (large) and “Size2” (medium) have statistically significant and positive impacts on the respondents’ WTP, with the coefficient on Size1 (0.3973) being greater than the coefficient on Size2 (0.2749). Food products sold in large shopping stores have a better quality guarantee. As the size of a shopping store decreases, the guarantee and trust in this food product on the part of respondents is decreasing also.

“Favor13”, which indicates that the respondent neither likes nor dislikes eating moon cake, has a positive and statistically significant impact on WTP. “Favor14”, which means that the respondent does not like to eat moon cake, has a negative and statistically significant impact on WTP. These results indicate that willingness to pay for safer moon cakes declines as dislike for moon cakes increases.

Purchase Place1, 3, and 6 are respectively supermarket, bakery, and home-made store. These three variables have a positive and statistically significant impact on WTP. For “Content5” (preservative content), there is a negative and statistically significant impact with WTP. The cost of a safer preservative is greater than the usual preservative, which may help explain this result. Respondents with a high level of education (Educ4) are statistically willing to pay more for safer moon cakes. Income has positive and statistically significant impact on WTP. The results indicate that the elasticity of WTP with respect to income is approximately 0.2.

Table 6.3. Analysis of tobit model: dependent variable “WTP”

Model Information		
Data Set	WORK.TOBIT	
Dependent Variable	LnWTPopen	LnWTPopen
Censoring Variable	censor	
Censoring Value(s)	1	
Number of Observations	398	
Noncensored Values	349	
Right Censored Values	49	
Left Censored Values	0	
Interval Censored Values	0	
Name of Distribution	Normal	

Model Information		
Log Likelihood	-415.2593306	

Number of Observations Read	443
Number of Observations Used	398
Missing Values	45

Algorithm converged.

Type III Analysis of Effects			
Effect	DF	Wald Chi-Square	Pr > ChiSq
Darea1	1	0.8242	0.3640
Darea2	1	0.4158	0.5190
Darea4	1	0.1981	0.6563
Dsize1	1	9.5291	0.0020
Dsize2	1	4.4650	0.0346
Dfavor13	1	2.9870	0.0839
Dfavor14	1	0.5646	0.4524
Dfavor21	1	2.5228	0.1122
DPP1	1	4.6189	0.0316
DPP3	1	3.6387	0.0565
DPP5	1	0.8444	0.3582
DPP6	1	3.2733	0.0704
Dcontent1	1	1.2542	0.2628
Dcontent4	1	1.4624	0.2266

Type III Analysis of Effects			
Effect	DF	Wald Chi-Square	Pr > ChiSq
Dcontent5	1	4.7671	0.0290
Dgender	1	0.5611	0.4538
Dmarriage	1	1.3758	0.2408
Deduc3	1	2.3901	0.1221
Deduc4	1	4.0783	0.0434
AGE	1	0.1454	0.7030
LnIncome	1	10.9773	0.0009

Parameter	Estimate	Standard Error	95% Confidence Limits		Chi- Square	Pr > ChiSq
Area1	-0.1088	0.1199	-0.3437	0.1261	0.82	0.3640
Area2	-0.0844	0.1308	-0.3407	0.1720	0.42	0.5190
Area4	-0.0703	0.1579	-0.3797	0.2392	0.20	0.6563
Size1	0.3973	0.1287	0.1450	0.6496	9.53	0.0020
Size2	0.2749	0.1301	0.0199	0.5300	4.47	0.0346
Favor13	0.1685	0.0975	-0.0226	0.3596	2.99	0.0839
Favor14	-0.1353	0.1800	-0.4881	0.2176	0.56	0.4524
Favor21	-0.1537	0.0968	-0.3433	0.0360	2.52	0.1122
PP1	0.2978	0.1386	0.0262	0.5693	4.62	0.0316
PP3	0.3077	0.1613	-0.0085	0.6238	3.64	0.0565
PP5	-0.3525	0.3837	-1.1045	0.3994	0.84	0.3582
PP6	0.5152	0.2847	-0.0429	1.0732	3.27	0.0704

Parameter	Estimate	Standard Error	95% Confidence Limits		Chi-Square	Pr > ChiSq
Content1	-0.1145	0.1022	-0.3148	0.0859	1.25	0.2628
Content4	0.1935	0.1600	-0.1201	0.5070	1.46	0.2266
Content5	-0.2318	0.1062	-0.4399	-0.0237	4.77	0.0290
Gender	-0.0684	0.0914	-0.2475	0.1106	0.56	0.4538
Marriage	-0.1460	0.1245	-0.3901	0.0980	1.38	0.2408
Educ3	0.1969	0.1273	-0.0527	0.4464	2.39	0.1221
Educ4	0.2067	0.1024	0.0061	0.4074	4.08	0.0434
AGE	-0.0018	0.0047	-0.0111	0.0075	0.15	0.7030
LnIncome	0.2248	0.0679	0.0918	0.3578	10.98	0.0009

Note. * p < 0.10 ** p < 0.05 *** p < 0.01.

Table 6.4. Summary of results of ordered probit models and tobit model

Model Type	Ordered probit model		Tobit model
	Concern	Worry	WTP
Dependent Variable	Pr > ChiSq	Pr > ChiSq	Pr > ChiSq
Area1	0.9433	*0.0693	0.364
Area2	0.4368	*0.0584	0.519
Area4	*0.0699	0.1455	0.6563
Size1	0.6009	0.1768	***0.002

Size2	0.9777	0.8893	**0.0346
Favor13	**0.0343	0.5987	*0.0839
Favor14	0.3346	***0.0046	0.4524
Favor21	0.6884	***0.0006	0.1122
PP1	0.4724	*0.0756	**0.0316
PP3	0.9585	0.599	*0.0565
PP5	***0.0058	0.8523	0.3582
PP6	**0.0112	0.3851	*0.0704
Content1	**0.0115	*0.0621	0.2628
Content4	*0.0664	0.9167	0.2266
Content5	0.1128	0.7067	**0.029
Gender	***0.0025	0.4972	0.4538
Marriage	***0.0053	*0.0706	0.2408
Educ3	0.354	0.9497	0.1221
Educ4	0.8771	**0.0358	**0.0434
AGE	0.2033	0.1681	0.703
LnIncome	0.807	0.6146	***0.0009

Note. * p < 0.10 ** p < 0.05 *** p < 0.01.

6.4 Summary of The Results

The results for estimated WTP indicate that moon cakes with a safer preservative (sorbic acid) are positively valued in Beijing, since most of the consumers (84%) are willing to

pay a price premium for a moon cake with a safer preservative. The mean of WTP for purchasing a safer moon cake is 5.35 yuan (\$0.79).

The results from the ordered probit models indicate that the extent to which respondents worry about the quality and safety of moon cake is affected by their geographic area, degree of favoritism toward moon cake, purchase place, production date, production place, preservative content, gender, and marital status. Respondents' concern about food safety is affected by their geographic area, degree of favoritism toward moon cake, purchase place, production date, marital status, and education level. WTP is affected by the size of the market where respondents shop, degree of favoritism toward moon cake, purchase place, preservative content, education level, and income.

1. Regarding the dependent variable "Concern" (whether the respondents are concerned about the food safety), the three variables with the greatest level of statistical significance are purchase place, gender, and marital status. The results show that consumers, who are female, married, and who purchase moon cake in home-made stores, are all concerned more about food safety.

2. Regarding the dependent variable "Worry" (whether the respondents are worried about the quality and safety of moon cake), the variable indicating whether respondents like to eat moon cake very often during each moon festival is the variable with the highest level of statistical significance. Education, production date, and the respondent's district of residence are other statistically significant variables. Consumers with a higher level of education are more worried about the quality and safety of moon cake. Consumers are

also worried about the quality and safety of moon cake if they are concerned about its production date.

3. Income is the most statistically significant variable affecting WTP. There is a positive relationship between income and WTP, and the estimated elasticity of WTP with respect to income is approximately 0.2. Consumers who prefer to purchase moon cake in large- or medium-sized markets are willing to pay for safer moon cake relative to those who shop at smaller markets.. Preservative content and education are also statistically significant variables affecting WTP. Consumers who are concerned about preservative content in purchasing moon cake are willing to pay for safer moon cake. Consumers with a higher level of education are also willing to pay for safer moon cake.

6.5 Discussion

The perceptions, preferences, and awareness of consumers regarding food safety have profound impacts on optimal government policy and food manufacturing firm strategies.

The results in this study suggest the following:

1. Build up effective and authoritative channels to improve information availability on food safety in China. At present, different kinds of food safety information are managed by different government agencies in China. Coordinated information systems and management services are lacking. The public lacks an authoritative and effective source

for information on food safety. Information management regarding food safety needs to be strengthened, which would gradually enhance the public's confidence in food safety.

2. Better food safety and quality standards. The producer provides the quality information of the product following certain quality specifications. Enhancing food quality specifications gradually would also enhance the public's confidence in food safety.

3. Consumers showed a strong willingness to pay for safer food, so food manufacturers should improve food quality and make safer food even if safer food costs more. This study's findings suggest that consumers' positive attitudes toward safer moon cake would pave the way for many food manufacturers and retailers to use a safer preservative in moon cake. The mean WTP of 5.35 *yuan* (\$0.79) from the survey results may potentially be overstated because some consumers might express a willingness to pay a high price but not have sufficient income to allow it. However, it is very clear that most consumers would like to purchase safer moon cake and pay a premium for it.

4. Enhance the public's perception of a safe moon cake. All types of information, including public service announcements and commercial advertising, should be used, including free tastings and free samples.

5. Food manufacturers should set a reasonable price for safer moon cake. Some manufacturers or retailers might set the price of safer moon cake too high, negatively affecting the marketing of safer moon cake. It would be better to sell safer moon cake (sorbic acid as preservative) with a price in line with WTP.

Chapter 7

CONCLUSION

Moon cake is a traditional food eaten during the Mid-Autumn Festival in China. Most moon cakes have a very short period of quality guarantee. Appropriate preservatives could help inhibit the growth of bacteria and fungi, avoid the food constituents quickly oxidizing and becoming decayed, and prolong shelf life. One kind of preservative, benzoic acid, is widely used in many fields in China because of its low cost and availability. However, there is a hazards identification of benzoic acid—it can cause much irritation to the upper respiratory tract, eyes, and skin. Therefore, sorbic acid, a safer preservative, is a candidate to replace benzoic acid. The toxicity of sorbic acid is extremely low and its safety is higher than that of benzoic acid. However, the cost of sorbic acid is much higher than that of benzoic acid. Consequently, the cost of a safer moon cake with sorbic acid will be higher than that with benzoic acid. The goal of this thesis was to analyze and measure consumers' preferences, perceptions, and willingness to pay for moon cake with a safer preservative.

The data used in this thesis were from the “Survey of consumer's willingness-to-pay and perception in terms of preservatives safety of moon cakes”, conducted by the Food Safety

Research Center at Renmin University in China of consumers in Beijing. There were 464 respondents; after excluding incomplete surveys, the number of useable questionnaires was 443, for a very high retrieval rate of 95%. The main purpose of this survey was to measure respondents' preferences, perceptions, and willingness to pay for moon cake using a safer preservative. Factors believed to influence individual consumption behavior were also examined in this research. Survey results indicate that safer moon cake is positively valued in Beijing, since a clear majority of consumers (84%) are willing to pay premium prices to acquire a moon cake with a safer preservative. The mean WTP for purchasing a safer moon cake is 5.35 *yuan* (\$0.79).

This thesis used ordered probit models to analyze the determinants of the degree of respondents' concerns for, and worrying about, food safety. This thesis also used a tobit model to analyze the determinants of willingness to pay for moon cake with a safer preservative (sorbic acid).

Regarding the dependent variable "Concern" (whether the respondents are concerned about the food safety), the three variables with the greatest level of statistical significance are purchase place, gender, and marital status. The results show that consumers who are female, married, and who purchase moon cake in home-made stores, are all concerned more about food safety.

Regarding the dependent variable "Worry" (whether the respondents are worried about the quality and safety of moon cake), the variable indicating whether respondents like to eat moon cake very often during each moon festival, is the variable with the highest level of statistical significance. Education, production date, and the respondent's district of

residence are other statistically significant variables. Consumers with a higher level of education are more worried about the quality and safety of moon cake. Consumers are also worried about the quality and safety of moon cake if they are concerned about its production date.

Income is the most statistically significant variable affecting WTP. There is a positive relationship between income and WTP, and the estimated elasticity of WTP with respect to income is approximately 0.2. Consumers who prefer to purchase moon cake in large- or medium-sized markets are willing to pay for safer moon cake more relative to those who shop at smaller markets. Preservative content and education are also statistically significant variables affecting WTP. Consumers who are concerned about preservative content in purchasing moon cake are willing to pay for safer moon cake. Consumers with a higher level of education are also willing to pay for safer moon cake.

The results of this study suggest that the government should build up effective and authoritative channels to improve information availability on food safety in China. At present, different kinds of food safety information are managed by different government agencies in China. Coordinated information systems and management services are lacking. The public lacks an authoritative and effective source for information on food safety. Information management regarding food safety needs to be strengthened, which would gradually enhance the public's confidence in food safety.

The results of this study indicated that consumers have a strong willingness to pay for safer food, so food manufacturers should improve food quality and make safer food even if safer food costs more. This study's findings suggest that consumers' positive attitudes

toward safer moon cake would pave the way for many food manufacturers and retailers to use a safer preservative in moon cake. The mean WTP of 5.35 *yuan* (\$0.79) from the survey results may potentially be overstated because some consumers might express a willingness to pay a higher price but not have sufficient income to allow it. However, it is very clear that most consumers would like to purchase safer moon cake and pay a premium for it.

Although China is one of the largest producers and consumers of food products in the world, little is known about Chinese consumer preferences, perceptions, and willingness to pay for safer food. The results in this thesis have important implications for manufacturers of moon cake as they make decisions about producing a safer moon cake as well as providing a reference price for them. The results also provide policy-makers and food industry managers with new insights into the impacts of food safety issues on food consumption. More research is needed that incorporates food safety information on particular preservatives that may affect other food products. One of the goals of such research is to obtain a global picture of food consumption behavior in China.

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