CONSUMERS' PREFERENCES FOR DAIRY PRODUCTS IN ALTERNATIVE FOOD STORE FORMATS IN CHINA

By

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To the Faculty of Washington State University:

The members of the Committee appointed to examine the dissertation of JUNFEI BAI find it satisfactory and recommend that it be accepted.

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Abstract

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China's emergence as the world's fastest growing economy during the last two decades has created incredible demand and a flourishing market for various agricultural products. China was once believed to be a serious threat to the world agricultural product markets; however, most researchers today believe that China does not threaten the world, but rather plays an important role in the world market. This situation creates unprecedented market and trade opportunities for potential agricultural product exporters outside of China, including the U.S.

This dissertation consists of three manuscripts, focusing on two separate but related issues that affect China's agricultural product markets. The first study centers on the modern food retail formats, supermarkets and hypermarkets, which have entered China and are spreading there as fast as (or faster) than anywhere in the world. The explicit objective of this study is to understand how Chinese consumers are responding to the entry and extension of these modern food retail formats, and to identify the underlying factors affecting this response. Different from most previous studies, the effects of potential interrelationships among different food retail

formats on consumer choice for shopping termination are taken into account. The results of this study provided empirical evidence that encouraged us to start a long-term research plan to help develop and build markets in China for U.S. agricultural product exports.

The second and third manuscripts focus on another topic—dairy—which has been one of the fastest growing demands for agricultural products in China in recent years. In the second paper, fluid milk is assumed to be a homogenous product. The objective of the study is to understand current fluid milk consumption in urban China, and to identify the underlying determinants. A Tobit model was applied to estimate and test a series of hypotheses since the dataset involves zero-consumption observations. The homogenous product assumption in this paper was relaxed in the third study by designing a choice-based conjoint (CBC) experiment, in which fluid milk is defined by a bundle of attributes and corresponding levels. This study jointly measures the effects of milk-specific attributes and individual-specific characteristics on consumers' preferences and purchasing behavior for fluid milk.

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CHAPTER ONE

INTRODUCTION

China's emergence as the world's fastest growing economy during the last two decades has created incredible demand and a flourishing market for various agricultural products, which was once believed to be a serious threat to the world agricultural product markets (Brown, 1994). However, most researchers today believe that China does not threaten the world, but plays an important role in the world market and creates unprecedented market and trade opportunities for potential agricultural product exporters (Huang et al., 1999).

While developing and expanding the U.S. agricultural product exports to this potential market in China, which has the largest population in the world, has been setup as a long-term goal for researchers and many major agricultural exporters, there is *a lack of understanding* of this new market and the buyers involved in it. *Lack of such knowledge is an important problem* because until acquired, evidence-based development of marketing strategies, trade policy, and focus for agricultural commodities to the world's fastest growing economy will remain problematic.

The overall objective of this dissertation is to increase this knowledge, which will allow U.S. agricultural producers to better understand and meet Chinese consumer needs. To reach the objective, this dissertation focuses on two separate but related topics. The first one examines impacts of the entry of supermarkets and hypermarkets on Chinese consumer food shopping behavior. The second one considers dairy products as a case study, focusing on understanding current fluid milk consumption in urban China and factors affecting it. The *central hypothesis* for

this dissertation is that the entry and expansion of modern retail formats in China will significantly influence consumer preferences, and drive their purchasing behaviors for wider range of food products, including dairy products.

This dissertation consists of three manuscripts. The first study is discussed in Chapter 2, focusing on the topic of supermarkets and hypermarkets that have entered China and are spreading there as fast as or even faster than anywhere in the world (Reardon et al., 2003). A multivariate binary probit model with four categories of retail food store formats (wet markets, small grocery stores, supermarkets, and hypermarkets) is developed and estimated to analyze how Chinese consumers are responding to the entry and expansion of the modern food retail formats. Different from previous relevant studies, the effects of potential interrelationships among different food retail formats on consumers' choice for shopping termination are taken into account.

The results indicate that the entrance of supermarkets, particularly hypermarkets such as Wal-Mart (U.S.), Carrefour (French), and Metro (German), have significantly influenced Chinese urban consumer food shopping habits. Compared to conventional food retail formats such as wet markets and small grocery stores, consumers tend to be more willing to shop for food at supermarkets and hypermarkets. However, as a result of some particular socioeconomic and cultural factors, traditional wet markets and small grocery stores may fill an important niche for providing fresh produce and meat until the transportation infrastructure improve. Meanwhile, this study also suggests that current supermarkets, which are somewhat smaller than their counterparts in developed countries, and which mainly offer food products only, are facing

increasing competition from hypermarkets. These hypermarkets can be defined as offering a real "one-stop-service" format, and were introduced into China just a few years later than supermarkets. In the future, supermarkets may have the choice to grow into hypermarkets or contract into a convenience store format. Interestingly, hypermarkets may not bring significant competitive pressures on the traditional wet markets or small grocery stores and new convenience stores. The possible reasons are linked to store characteristics such as location and quality control and may also be related to potential substitutability and complementarity among various formats, as well as consumers' demographics and shopping habits.

The second and third manuscripts focus on consumption for fluid milk that has been one of the fastest growing demands for agricultural products in China in recent years. The second paper is in Chapter three, where fluid milk is assumed to be a homogenous product. The objective of this study is to understand current fluid milk consumption in urban China and to determine the effects of individual and household characteristics and other social-demographics of Chinese consumers on fluid milk purchasing behavior. Since the dataset involves zero-consumption, a standard Tobit model (Tobin, 1958) was applied to estimate and test a series of hypotheses observations. The results indicate that income, being the main food shopper, and visiting supermarkets or hypermarkets more frequently play positive roles in individual market participation and consumption decisions. However, the presence of children and/or students in a household will significantly reduce the amount of fluid milk other family members consume. Also, the rapid rise of modern food retailers has strengthened consumer confidence in fluid milk quality.

The homogenous product assumption imposed in the second manuscript is relaxed in the third paper (Chapter 4) by designing a choice-based conjoint (CBC) experiment. CBC analysis is a stated preference technique that allows consumers to make choice decisions from a set of experimentally designed products defined by a bundle of products' attributes and levels (Louviere, 1988). This technique allows one to jointly measure the impacts of milk-specific attributes and individual-specific characteristics on consumers' preferences and purchasing behaviors for fluid milk. The four selected choice attributes are milk production processing method, fat content level, taste, and price. Two methods, counting choice at the aggregate level and estimating multinomial logit models (MNL) at the individual level, were used to analyze the CBC experimental data. The results indicate that Chinese consumer's preferences for the fluid milk specified by bundle of its attributes and their probabilities of choosing the milk are significantly influenced by the attributes and consumers individual characteristics. Typically, they are willing to pay a premium for pasteurized, low fat, and natural taste milk, but need a discount for choosing ultra high temperature (UHT), high fat content, and flavored milk. The utility scores of attributes, the probability of a milk alternative to be chosen, and the trade-offs among attributes change as consumers' income changes.

The three studies in this dissertation contribute to a growing literature on food-purchasing behavior/preferences and consumption, providing insights into China's market development and potential trade opportunities for agricultural exporters. The methodologies used in these studies could be easily applied to other studies on consumer preferences and market research. The data used in these papers was collected in-person by the author for the purposes of this dissertation in

Qingdao, China during the summer of 2005. The results from these studies empirically support the central hypothesis. In addition, these results suggest that a long-term research plan is needed to study these issues and will be beneficial to U.S. agricultural product exporters.

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CHAPTER TWO

CONSUMER CHOICE OF RETAIL FOOD STORE FORMATS IN QINGDAO, CHINA

Summary

This study analyzes Chinese consumer behavior across different retail food store formats and how household demographics affect shopping behavior. A multivariate probit model with four categories of retail food store formats (wet markets, small grocery stores, supermarkets, and hypermarkets) in Qingdao, China is estimated. The results indicate that the new hypermarkets are substitutes for supermarkets, but they do not compete extensively with wet markets and small grocery stores. Further development of various categories of food shopping store formats is linked to store-owner characteristics, potential interrelations among existing retail formats, as well as consumers' demographics and shopping habits.

Key words: Food retail store format, consumer choice, multivariate probit, Qingdao, China

Introduction

Economic development is frequently characterized by greater use of large, multi-line food retail outlets including supermarkets and hypermarkets (Veeck & Veeck, 2000). However, this characterization may not apply fully to the case of China. It is true that in the recent period following the opening of China to foreign direct investment (FDI), its food retail system, which was dominated by state-owned (SOEs), collective-operated enterprises (COE), traditional outdoor or "wet" markets, and small shops, has changed dramatically with a more diverse range of food shopping formats (Wang, 2002). More specifically, this transformation has occurred through the introduction of self-service supermarkets in the mid-1990s and later the entry of one-stop-shopping hypermarkets or supercenters (e.g. Wal-Mart). Relatively modern food shopping formats, such as small grocery stores and supermarkets, may be complements to traditional wet markets, which may continue to thrive at least until the transportation infrastructure improves. Veeck and Veeck (2000) write, "Meats and produce are purchased from supermarkets when time is limited, but making such purchasing at an outdoor or a 'wet' market…remains the ideal" (page 457). They note that these outlets are perceived as providing fresher products compared with supermarkets by Chinese consumers, and Bean (2006) explains that Chinese consumers are highly sensitive to the freshness of food products. The downside to wet markets is that sanitary conditions often raise food safety concerns.

Our motivation for this study is to understand the new food shopping environment in Qingdao, China. Several possible research questions arise: What types of consumers are shopping at the new supermarkets and hypermarkets, and to what extent do they still also shop at

traditional outlets. As rural to urban movement continues in China, consumer preferences are likely to adjust simply due to the increased availability of foods in urban markets (Huang & Rozell, 1998), and one would expect these changes to affect food shopping behavior. Will the traditional food retailers disappear from Chinese cites? What are the potential competitive relationships among the different food shopping formats? How does China differ from other developing and developed countries? China is an extremely complicated case because of its immense size, dense population and diverse cultures, its unbalanced economic development, less-developed infrastructure, and the current market situation.

As a first step in this line of research, we estimate consumer choice from among food shopping formats with a multivariate probit model. Our objectives are to identify factors that affect choice of food retail formats and the potential interrelationships among them, and to explore their implications for policies and marketing strategies.

Food retail in China

Before 1978, most urban consumers could only shop at state-run stores, which were known for their lack of variety (Veeck & Veeck, 2000). During the 1980s, other alternatives became available, especially small grocery stores. Self-service supermarkets entered the Chinese market in the mid-1990s. In recent years, hypermarkets have grown the fastest with their consistent quality, competitive prices, friendly shopping environment, and an attractive one-stop-shopping format (Bean, 2006). The further diffusion and expansion of hypermarkets in China, however, may be slowed by supply-side restrictions which include small-sized and unorganized farmers, as well as less-developed distribution channels (Hu et al., 2004).

However, the rapid development of modern retailers has not forced traditional retail formats to disappear. Some SOEs and COEs simply transformed into self-service supermarkets. Others repositioned themselves as department stores with a particular section selling food in direct competition with both supermarkets and hypermarkets, and still others have targeted particular customers competing with the emerging convenience stores. As an important part of China's traditional food markets, wet markets, despite in some cases being forced to close due to poor sanitary conditions and unregulated marketing behavior, still function well in most cities, particularly in rural areas. In cities, many of these outdoor wet markets have moved to indoor operations. Future directions may be not only rooted in marketing strategies and related policies, but also closely linked to Chinese consumers' demographics and buying habits, as well as the potential interrelationships among formats.

Several studies have been conducted to address the development and current situation of the Chinese food retail system and discuss future trends (e.g. Mousteraski, 2001; Reardon, Timmer & Berdegue, 2003; Gale, 2003; Hu, Yu & Reardon, 2003; Hu et al., 2004; Regmi & Gehlhar, 2005; Veeck & Veeck, 2000; Wang & Zhang, 2005). Samuel, Li and McDonald (1998) examined the purchasing behavior of Shanghai buyers of processed food and beverage products. They suggested that the purchases were mainly influenced by distance traveled to the store and the shopper's gender and income. The authors faced data limitations in that the small quantities purchased on each shopping occasion reduced the variation of the dependent variable. Wong and Yu (2002) indicated the differences in shopping patterns between higher-income and lower-income households in China.

Related literature

This article contributes to a growing literature on food-shopping behavior. Our specific focus is on food-shopping choices in a rapidly developing country, China. Key factors that have been found in this literature to affect food-shopping behavior include store characteristics and shopper characteristics. Store characteristics include location, price level, product variety, quality of service, quality of produce, and store environment. Shopper characteristics include a wide variety of characteristics such as personal preferences, cultural characteristics, income, and various demographic variables.

Huddleston, Whipple, and VanAuken (2004) examined consumer loyalty to food stores and found that store loyalty is promoted by advertisement, a convenient store location, a large product assortment, friendly service, and conveniences such as 24-hour-a-day service and quick checkout. Low prices appear to be a factor that entice shoppers to a store, but are not a key factor for customer loyalty. Messinger and Narasimhan (1997) point out that larger assortments become more important as one's opportunity cost of time increases. This is an explanation for why supermarkets, which have larger product assortments, are gaining popularity compared to the traditional grocery stores.

Various articles examine the relationship between shopper demographic characteristics and shopping behavior. Kahn and Schmittlein (1989) found that about one-third of the households are quick shoppers who make frequent lower-expenditure trips, while others make relatively less-frequent, higher-expenditure trips. Bawa and Ghosh (1999) study how family expenditures and the number of shopping trips are related to household composition and

socioeconomic characteristics. They assumed that households seek to minimize the sum of travel cost and the cost of holding goods in inventory, and concluded that households headed by individuals 55 years and over, households without working adults, larger families, and/or higher income households tend to shop more frequently than their counterparts. Kim and Park (1997) classify shoppers into "routine" and "random" shoppers. Routine shoppers have higher opportunity costs of time, which is often correlated with higher incomes, so they tend to revisit familiar grocery stores, but they do so less frequently and spend more per trip. In contrast, random shoppers face low opportunity costs of time and search more widely across stores and within larger stores for the best price. Thiele and Weiss (2003) analyzed consumer demand for food variety in Germany. They found that increases in income and living in a larger city increase the demand for food diversity. Interestingly, they found that increases in the number of children aged between 7 and 17 years of age and the housekeeping person is not additionally working outside the home also increase the demand for variety in food. A single male household consumes a smaller number of different food products. Ackerman and Tellis (2001) studied cross-cultural differences between Chinese and Americans in terms of shopping behavior. They found that Chinese use multiple senses when examining unpackaged food, inspect more items, and take more time to shop than do Americans. They also found that prices at Chinese supermarkets are consistently lower than those at mainstream American supermarkets.

Kim and Jin (2001) compared the profiles of Korean shoppers of multinationals versus Korean discount stores. They found that a higher percentage of the shoppers who have full-time jobs tend to patronize the multinational discount stores. However, there are no

significant differences between the two groups with respect to age, family size, education level, and income.

The above studies are generally restricted to comparisons of behavior within the same store format, i.e., they are limited to only supermarkets or to only discount stores. However, like our study, a small number of studies examine household choice across retail formats. Bhatnagar and Ratchford (2004) studied competition for non-durable goods sales among supermarkets, convenience stores, and food warehouses. They assumed that consumers choose the retail format that provides the most attractive combination of price, assortment of products, and travel cost. They concluded that convenience stores charge a higher price, but minimize travel time; supermarkets attract those shoppers who prefer larger product assortments; and food warehouses are preferred by heavy users, such as consumers with larger families. Fox, Montgomery, & Lodish (2004) studied consumer shopping choices among supermarket retailers, mass merchandisers, and drug stores, and found that consumers respond to variations in product assortments and promotions more than prices. Two studies, perhaps most similar to ours, looked at how changes in the availability of supermarkets and supercenters affect choice among retail format in general. D'Haese and van Huylenbroeck (2005) provide a case study of the shifting purchasing patterns of two villages in rural South Africa. The majority of households in their study now buy their main food items from supermarkets rather than from local shops and farmers. Seiders, Simonides, and Tigert (2000) studied the effects of supercenter market entry on local traditional food retailers. They found that consumers choose traditional supermarkets primarily for convenience, quality, and service, and choose supercenters primarily for price and

assortment.

Veeck and Veeck (2000) used data from a 1993 survey of 150 household primary shoppers in Nanjing, PRC to analyze food consumption patterns in China. Cluster analysis was used to group the respondents into convenience shoppers, frequent shoppers, and traditional shoppers. Basic demographic and household characteristics, as well as purchase patterns were examined. Study results show that convenience shoppers are younger single adults, primarily male, still living at home with above- average incomes. These consumers purchase more convenience foods than the other two groups, and they eat out of the house more often. Frequent shoppers include younger adults, primarily married, who still shop for food often and who eat out and purchase food at grocery stores moderately.

This present paper contributes to the literature summarized above by providing an analysis of consumer choice from among traditional and newly available shopping formats in Qingdao, China. It differs from other papers discussed above on shopper selection among food shopping formats in that we focus on a set of four different formats and examine the effects of personal demographic characteristics on format choice.

In the next section, we review the multivariate probit model. In the third section the data are presented. The estimation results are presented in section four. The last section summarizes the main findings and concludes with a brief discussion of implications.

Methodology

We characterize the choice from among shopping formats by a multivariate binary choice model, which can be depicted mathematically as follows:

$$\mathbf{y}^*_{ik} = \mathbf{X}\boldsymbol{\beta}_{ik} + \boldsymbol{\varepsilon}_{ik}$$

(1)

$$y_{ik} = \begin{cases} 1 & \text{if } y^*_{ik} > 0 \\ 0 & \text{otherwise} \end{cases}, \; k = 1,2,3,4; \;\; i = 1,2,...,N$$

where $\mathbf{y}^*_k$ is a N by 1 vector in which the i^{th} element y^*_{ik} represents the net benefit to the i^{th} shopper from the k^{th} shopping format. Since y^*_{ik} is actually unobservable, it can be empirically specified to be one when consumer i shops at least once a month or once a week in the k^{th} shopping format. The matrix $\mathbf{X}$ includes a set of explanatory variables representing shopper characteristics, $\boldsymbol{\beta}_{ik}$ denote the parameters to be estimated, and $\boldsymbol{\varepsilon}_{ik}$ are error terms distributed as multivariate normal, $N(\mathbf{0},\boldsymbol{\Sigma})$, where $\boldsymbol{\Sigma}$ has values of 1 on the leading diagonal and correlations $\rho_{jk} = \rho_{kj}$ as off-diagonal elements.

The model has a structure similar to that of a seemingly unrelated regression (SUR) model except that the dependent variables are binary indicators. As for the SUR case, the set of explanatory variables included in the equations are not necessarily expected to be exactly the same (Cappellarri and Jenkins, 2003). Following the form used by Cappellarri and Jenkins, the log-likelihood function associated with a sample outcome $(y_{1k},...,y_{nk})$ is then given by

$$\ln L = \sum_{i=1}^{N} \omega_i \ln \Phi(\mu_i;\Omega)$$

(2)

where ω_i is an optional weight for observation i, and Φ is the multivariate standard normal distribution with arguments μ_i and Ω, where μ_i can be denoted as

$\mu_i = (K_{i1}\beta_1 X_{i1}, K_{i2}\beta_2 X_{i2}, K_{i3}\beta_3 X_{i3}, K_{i4}\beta_4 X_{i4})$, while Ω has a matrix form with elements

$\Omega_{jk} = 1$ for $j = k$ and $\Omega_{jk} = \Omega_{kj} = K_{ij} K_{ik} \rho_{jk}$ for $j \neq k$, $j, k = 1, 2, 3, 4$, with $K_{ik} = 2y_{ik} - 1$.

Several simulation methods have been developed to overcome the computational difficulty in estimating the multivariate binary model, including the frequency method by Lerman and Manski (1981) and the sampling method by McFadden (1989). Recently, the most popular method is the Geweke-Hajivassiliou-Keane (GHK) smooth recursive conditioning simulator (Borsch-Supan et al., 1992; Borsch-Supan and Hajivassiliou, 1993; Keane, 1994). A brief review can be found in Greene (2003). The GHK simulator exploits the fact that a multivariate normal distribution function can be expressed as the product of sequentially conditioned univariate normal distribution functions, which can be easily and accurately evaluated. The GHK simulator is unbiased for any given number of replications, and hence generates substantially smaller variances than the alternatives (Borsch-Supan and Hajivassiliou, 1993).

As is usual for discrete choice models, the estimated marginal effect of an explanatory variable on the probability of shopping in a given store format is a function of the estimated parameters and the data. Since the marginal effects in a multivariate probit model are complicated and because most of our explanatory variables are indicator variables, we generate estimated marginal effects numerically as follows: First, we calculate the predicted probability for each store format for a benchmark set of characteristics. This benchmark is set for convenience such that all indicator variables are set to zero. Second, an individual indicator variable is set to equal to 1 (all others set at zero) and the predicted probability for each store format is again calculated. This process is repeated for each indicator variable in each equation.

The estimated effect of a change in the dummy variable in the predicted probability of shopping in store format *k* is equal to

$$\frac{\Delta \hat{p}_k}{\Delta x_j} = (\hat{p}_k \mid_{x_j=1} - \hat{p}_k \mid_{x_j=0}) \tag{3}$$

where $\hat{p}_i$ denotes the predicted probability for the i^{th} store format, x_j is the j^{th} dummy variable in **X**, and all other dummy variables ($i \neq j$) are set to zero for both cases. Thus, the estimated marginal effect is the discrete change in the predicted probability with respect to a discrete one-unit change in one dummy variable, *ceteris paribus*, where the predicted probabilities in both the base case and the alternative case are based on the multivariate normal distribution.

The joint and conditional probabilities can be calculated based on estimated parameters and correlation coefficients. The joint probability of all four selected formats occurring can be calculated by

$$\Pr(y_k = 1, \text{ all } k = 1,...,4) = \Phi_4(\mathbf{X}'\hat{\boldsymbol{\beta}}_k, \text{ all } k \mid \hat{\boldsymbol{\Sigma}}; X = \bar{X}) \tag{4}$$

and the probability of format *k* is chosen conditional on the other three formats occurring can be expressed as

$$\Pr(y_k = 1 \mid y_j = 1, \text{ all } j = 2,3,4) = \frac{\Phi_4(\mathbf{X}'\hat{\boldsymbol{\beta}}_k, \text{ all } k = 1,...,4 \mid \hat{\boldsymbol{\Sigma}}_4; X = \bar{X})}{\Phi_3(\mathbf{X}'\hat{\boldsymbol{\beta}}_j, \text{ all } j = 2,3,4 \mid \hat{\boldsymbol{\Sigma}}_3; X = \bar{X})} \tag{5}$$

where $\hat{\boldsymbol{\beta}}_{\mathbf{k}}$ and $\hat{\boldsymbol{\Sigma}}$ are estimated parameters and covariance matrices, respectively, from multivariate probit model regressions. Owing to space limitations we will not report all joint and conditional probabilities since a four-equation multivariate probit model will generate

hundreds of probability combinations.

Survey and Data Description

The data set used in this study was collected from in-person interviews (conducted in Chinese) of 838 urban residents in Qingdao, China in the summer of 2005. The survey used in this study was pre-tested both with Chinese-speaking students in the United States and with subjects in Qingdao, China. Qingdao is one of 14 coastal cities first opened to foreign markets in 1984. This city is on the southern tip of the Shangdong Peninsula along the Yellow Sea and is currently divided into seven urban districts. In 2003, the total population was 2.65 million. Over the past five years, city gross domestic product (GDP) growth averaged about 17 percent, reaching $26 billion in 2004. Annual per capita disposable income in 2005 was 12,920 yuan, which was about 2,000 yuan higher than the national level (10,493 yuan) and the Shandong province level (10,744 yuan), but lower than that of main metropolitan cities such as Beijing (17,653 yuan) and Shanghai (18,645 yuan) in the same period.

As in many other larger cities in China, the revolution in the food retail sector in Qingdao started in the mid-1990s and accelerated at the end of the 1990s. The entry of outside players and the ensuring competition brought to the domestic counterparts played important roles in the transformation. Following Japanese-funded Jusco and Malaysian-funded Parkson, which opened their first stores in Qingdao in 1998, Carrefour (French), Wal-Mart (U.S.), Metro (German), RT Mart (Taiwanese), and Dafuyuan (Taiwanese) sequentially made inroads into this city. The lucrative market even attracted a number of domestic retailers from other provinces. For example, Shanghai Hualian has six stores, and the Beijing Jian Hypermarket (Huapu in

Chinese) has opened stores in Qingdao. Facing the fierce competition, some traditional food retailers have chosen to expand to compete. For example, Qingdao Liqun opened its first supermarket with 5,000 square meters in size in April 1999, and over the next few years opened more than 10 stores of various sizes. The Beifang Guomao Group opened a 4,000 square meter supermarket in the first floor in its shopping mall building. Others, however, repositioned themselves to particular customer groups, or simply went out of business. Meanwhile, other traditional retail formats (mainly wet markets, "mom and pop" stores and fruit stands) still play their traditional roles, although they are no longer the dominant factor. As a consequence, there is now a diversity of retail formats in Qingdao -- from big department stores to convenience stores and "mom and pop" shops, from indoor supermarkets to outdoor market bazaars, and from domestic stores to foreign owned supercenters.

Our survey was performed in four food shopping locations in four of the seven urban districts: Shinan, Shibei, Sifang, and Licang. Geographically, Shinan is viewed as the old downtown, located south of Qingdao city, while Sifang and Shibei are located in the center of the city, with Shibei as the new downtown, and Licang located further up the peninsula and in the outskirts of the city. In 2003, the percentage of Qingdao's population in these four districts was 21.0 percent, 20.8 percent, 16.8 percent, and 12.5 percent, respectively. These locations were chosen to ensure a cross section of the Qingdao population.

Four university graduate students were hired and trained to conduct this survey. The training included two days of indoor training and one day of field training. In the first two days, we explained the objectives of the study and the survey methods, focusing particularly on the

way to ask each question. The four interviewers were also asked to interview each other to familiarize themselves with the questionnaire. In the field training, we focused attention to the selection of sample individuals, and provided helpful tips to asking survey questions. Each interviewer was asked to finish at least 10 respondent interviews during this training.

To avoid potential selection bias from individual sampling, respondents were selected with the criterion that the interviewer was to solicit every third consumer that came into the survey area following the completion of the last interview. To improve the data quality, we signed contracts with the selected food stores and paid 200 to 400 Yuan per day to each store for the survey area reservations. As a reward for participating in the survey, each survey respondent was given a gift card redeemable at the food shopping stores. Using this card, respondents could purchase products worth less than 15 Yuan (equivalent to about U.S. $1.80) in the store, without a cash refund.

Four main sample statistics were used to test the sample's representatives of the population. The results indicate that our selected sample is representative of the adult population in the study area (see last two columns in Table 2.1). The average family size in sampled households is 3.248, which is not significantly different from the general population. The monthly per capita disposable income in sampled respondents is 1,078 Yuan, which is only one Yuan higher than the reported level by the Qingdao Statistics Bureau. Two test results show that the share of females (66.3 percent) and the unemployment rate (6.1% percent) are higher than the corresponding population levels -- we believe that these biases are expected and acceptable. The higher share of female respondents was expected, since the survey was

conducted in food shopping stores and may be more representative of food shoppers because women normally play a larger role in family food shopping in China. The higher unemployment rate in the sample is also expected, because the population level used as the baseline is the registered unemployment rate, which currently is self-reported. It is widely recognized that not all unemployed people reported their status to the office (Asian Development Bank, 2002).

Table 2.1 also shows that the surveyed sample is distributed widely across various consumers. The majority of the total surveyed respondents were in their late 30's or early 40's, with an average age of 38 years. Among the 838 surveyed Qingdao respondents, nearly three-fourths had a high school education level or higher, and almost the same percentage reported being the main food shopper in their household. The monthly household disposable income for half of the sample ranged between 2,000 and 4,000 Yuan, or $250 and $500.

The statistics for Qingdao consumers' food shopping frequency and food shopping store visit frequency are presented in Table 2.2. Four categories of food shopping formats were contained in our official questionnaire. They are wet market, small grocery store which includes convenience stores, supermarket, and hypermarket.[1] Qingdao urban consumers shop frequently for food, as shown by the fact that 90 percent of the sampled individuals reported that

[1]Complicating our analysis of Qingdao's retail food sector are the different Chinese words used for each shopping format. The word for convenience store is translated into Chinese as "*bianmingdian*" or "*bianlidian*," but this word was widely used for "mom and pop" stores and variety stores, which in Chinese should be more properly called "*xiaomaibu*" and "*menshibu*," respectively. The term for supermarket (in Chinese "*chaoshi*") is another case that is widely misused in China. We address this problem by asking consumers to describe the main characteristics that they thought of for a number of descriptions of the various store formats in the field pre-test.

they did food shopping at least two to three times a week. The possible reasons frequency of shopping are rooted in small refrigerators, relatively low rates of car ownership, as well as Chinese consumers' extreme sensitivity to the freshness and quality of the food they buy (Bean, 2006). At the time of the survey, wet markets were still playing an important role in Chinese consumers' grocery choices for food shopping. In the same year, more than 80 percent and 50 percent of respondents visited supermarkets and hypermarkets at least once within two weeks for food shopping, respectively, while less than 20 percent of them reported they bought food products from small and independent stores with the same frequency.

The most frequently used forms of transportation used by shoppers included walking and taking the bus, accounting for 63 percent and 27 percent, respectively. Unlike the case in developed countries such as the U.S. and the E.U., only a minority of shoppers (4 percent) are able to drive a car for food shopping in Qingdao (Figure 2.1). In terms of the most important factor in choice of where to shop for food, 62 percent of samples reported quality, followed by store location (15 percent), price (8.9 percent) and food variety (8.6 percent). In addition, more than 5 percent of respondents thought that the shopping environment and service was the most decisive factor for their choice (Figure 2.2).

Empirical Analysis

The log-likelihood function in (2) is used to obtain parameter estimates for Qingdao urban consumers' food shopping format choices. The definition, unit and coding of the involved explanatory variables are provided in Table 2.3. The estimates of the simulated

multivariate probit model with 30 replications are reported in Table 2.4. The statistical significance of the model is examined by using a likelihood ratio test of the null hypothesis that all slope estimates are zero. The Chi square statistic with 51 degree of freedom is 411.74, indicating rejection of the null hypothesis.

As our primary interest is with respect to interrelationship of the four categories of shopping store format in term of consumers' choice, the estimated correlation coefficients and standard errors are presented at the bottom of Table 2.4. A likelihood ratio test rejects the null hypothesis of that off-diagonal elements in covariance matrix of errors are zeros. That is, by applying a univariate probit model for each format, one obtains significantly different results compared to those obtained by applying a multivariable probit model to all formats.

The positive correlation coefficient between wet markets and small grocery stores is statistically significant at the 1% level. This was expected, given that wet markets specialize in fresh fruit and vegetables, special crop products, livestock and poultry products, while small grocery stores in China normally concentrate on dried and packaged food items, and bottled or canned seasonings. This result indicates a complementary relationship between traditional wet markets and small grocery stores in Qingdao.

The correlation coefficient between supermarkets and hypermarkets is significantly negative, indicating a strong competitive relationship between these two so-called modern retail formats. The other correlation coefficients are not statistically significant. It is surprising that the modern retail formats (e.g. supermarkets and hypermarkets) do not bring significant pressure on the wet market and small grocery stores. Bean (2006) explains that Chinese consumers are

highly sensitive to the freshness of food products. Traditional wet markets satisfy this demand although the sanitary standards in these markets still need to be improved. At the same time, however, the selection and quality of vegetables in most supermarkets are often lacking, and hypermarkets are not convenient (close by) for daily and immediate shopping demand.

Applying expressions (3)-(5), the unconditional marginal effects and several joint and conditional probabilities are calculated and presented in Table 2.5. The predicted choice probabilities for each format show that supermarkets (87.3 percent) were most likely to be visited for food shopping in Qingdao, followed by wet markets (70.5 percent), hypermarkets (55.9 percent) and small grocery stores (29.5 percent). Given that the consumer frequents a hypermarket, the predicted conditional choice probability for also visiting a supermarket for food shopping is 73 percent. This is lower than its counterpart (94.1 percent), the predicted conditional choice probability that the consumer will visit a supermarket given that the consumer does not frequent a hypermarket. There are no significant differences for visiting wet markets or small grocery store formats when the condition of visiting a hypermarket changes. These results support our above findings that the growth of hypermarkets in Qingdao raises the level of competition for supermarkets, which just emerged a couple of years earlier than hypermarkets, but does not challenge traditional wet markets and small grocery stores.

A number of socioeconomic and demographic variables significantly influence Qingdao urban consumers' choice of food retail store format (see Table 2.4). Females, as expected, are more likely to shop for food in supermarkets and hypermarkets than males. Middle-aged consumers (31-50 years) and seniors (51 years and up) are more likely to buy food products in

wet markets, supermarkets, and hypermarkets and less likely to buy food in small grocery stores. The fast pace and busy lifestyle of young people compared to older people may be the reason that young people (under 30 years) shop for food in small stores or convenience stores more frequently than others. Household income does not have a significant effect on the probabilities that consumers will buy food in small grocery stores or supermarkets. However, higher income consumers are more likely to buy food in hypermarkets and less likely to buy from wet markets than the lower income consumers.

Consumers who prefer frequent shopping (*DAILYSHOP*) are more likely to shop at all formats except convenience stores. This may be due to the lower opportunity cost of time for the frequent shopper. The significant estimated coefficients for district dummies suggest that the development of various formats of food retail stores is unbalanced across regions, especially between the city center and the outskirts in Qingdao. In addition, as expected, those who most often walk to go food shopping significantly prefer wet markets, small stores, and supermarkets because these stores are in their neighborhood. However, those who mostly travel by car, take a bus or a free shuttle for food shopping are more likely to choose hypermarkets as a destination. Given the high population density and limited space to improve city transportation infrastructure, the traditional wet markets and small grocery stores will likely play an important role in Qingdao for some time. In a sense, the compulsory policies in some cities to eliminate wet markets may not be consistent with a market-directed economy.

Finally, those consumers who ranked variety or quality of offered food products as the most important factor for their choice of food shopping place are more likely to shop in

hypermarkets. This preference reflects the great returns to the one-stop shopping format and consistent and trusted food quality offered in hypermarkets.

Conclusion

Using the survey data collected from individual consumers in Qingdao, China, this study empirically estimates a multivariate binary probit model for four categories of food shopping store formats. By doing so, this study not only sheds light on several extremely important competitive interrelationships among the food shopping formats, but also identifies factors that affect consumers' decisions about where to shop for food. Ultimately, where consumers shop for food affects diet composition.

The main findings of this study show that hypermarkets in Qingdao are a substitute for supermarkets, which emerged in this city only a couple of years earlier. Interestingly, hypermarkets may not bring significant competitive pressures on the traditional wet markets or small grocery stores and new convenience stores. Possible reasons for this are linked to store characteristics such as location and quality control, and may also be related to potential substitutability and complementarity among various formats, as well as consumers' demographics and shopping habits. Higher incomes and access to transportation increase the likelihood that a consumer will shop at a hypermarket. The hypermarkets offer comparable freshness to wet markets, and they meet high sanitary standards.

These results suggest that the traditional wet markets and small grocery stores may fill an important niche of providing fresh produce and meat until transportation infrastructures improve, implying that current compulsive policies to close wet markets and small grocery stores in some

cities might not be a sound strategy in the short run despite concerns over sanitary conditions. Meanwhile, this study also suggests that current supermarkets that offer mainly food products are facing increasing competition from hypermarkets. In the future, supermarkets may have the choice to grow into hypermarkets or contract into a convenience store format. Currently, supermarkets in China are somewhat smaller than their counterparts in developed countries.

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Table 2.1. Sample Statistics and Representative Tests

	Sample Mean	Std. Dev.	Population Mean	P-value[a]
Sample Distribution				
Shinan District	0.239	0.427		
Shibei District	0.236	0.425		
Sifang District	0.242	0.429		
Licang District	0.283	0.451		
Respondent's Individual Characteristics				
Age (year)	38.05	13.64		
Under 30	0.377	0.485		
31-50	0.401	0.490		
Older than 50	0.222	0.416		
Female of Total	0.663	0.473	0.495 b	Pr>t=0.0000
Unemployed	0.061	0.239	0.030 c	Pr>t=0.0001
Education Level (binary; yes=1)				
Primary school or illiteracy	0.039	0.195		
Middle school	0.230	0.421		
High school or equivalent	0.370	0.483		
2-year college or equivalent	0.228	0.420		
4-year college	0.126	0.333		
Advanced or professional degree	0.006	0.077		
Main Food Shopper in Household	0.754	0.431		
Household Characteristics				
Monthly Per Capita Disposable Income (1000 Yuan)	1.078	0.566	1.077 c	Pr>|t|=0.9483
Less than 2000	0.210	0.408		
2001-4000	0.498	0.500		
More than 4001	0.292	0.455		
Household Size (person)	3.248	1.092	3.191 b	Pr>|t|=0.1298
Total Observations	838			

a. Null Hypothesis, Ho: sample mean=population level.
b. 2003 data as population level since 2005 data are unavailable. The household size is from 2004 Qingdao Statistical Yearbook; The share of female is calculated based on the data from 2004 Shandong Statistical Yearbook. We believe there are no significant differences for these data between 2003 and 2005.
c. Data are from Qingdao 2005 Economic and Social Development Annual Report released by Qingdao Bureau of Statistics.

Table 2.2. Food Shopping and Shopping Store Frequencies in Qingdao

	Frequency for Food Shopping	Wet Market	Small Grocery Store	Super-market	Hyper-market
Never	0.000	0.074	0.364	0.001	0.047
Monthly	0.005	0.165	0.328	0.043	0.149
Once for two weeks	0.012	0.056	0.051	0.084	0.243
Weekly	0.075	0.185	0.085	0.217	0.340
2-3 times a week	0.420	0.267	0.122	0.446	0.191
Daily (>3 times a week)	0.488	0.253	0.050	0.209	0.030

Table 2.3. Variable Definition, Unit and Coding

Variable	Definition and Unit	Coding
FEMALE	Respondent gender	Female=1, male=0
YOUNG*	Respondent age is less than or equal to 30 years	Yes=1, No=0
MID_AGE	Respondent age is between 31 and 50 years	Yes=1, No=0
SENIOR	Respondent age is greater than 50 years	Yes=1, No=0
EDU	Respondent education level, years	Continuous
LOW_INC*	Household monthly disposable income less than 2,000RMB	Yes=1, No=0
MID_INC	Household monthly disposable income ranges from 2,001-4,000RMB	Yes=1, No=0
HIGH_INC	Household monthly disposable income greater than 4,000RMB	Yes=1, No=0
DAILYSHOP	At least three-time food shopping a week	Yes=1, No=0
SHIBEI	Shibei District dummy	Yes=1, No=0
SIFANG	Sifang District dummy	Yes=1, No=0
SHINAN	Shinan District dummy	Yes=1, No=0
LICANG*	Licang District dummy	Yes=1, No=0
FASTFOOD	At least once/week visit foreign fast food restaurant	Yes=1, No=0
WALK	Most often used transportation is walking	Yes=1, No=0
CAR	Most often used transportation is a car	Yes=1, No=0
BUS	Most often used transportation is a bus or shuttle	Yes=1, No=0
VARIETY	Most important factor is product variety	Yes=1, No=0
QUALITY	Most important factor is quality of offered products	Yes=1, No=0
OTHER*	Most important factor is other (not variety or quality)	Yes=1, No=0

*Baseline category in regression.

Table 2.4. Estimates from the Multivariate Binary Probit Model

Variable	Wet Market			Small Store			Supermarket			Hypermarket		
	Coef.	S.E.		Coef.	S.E.		Coef.	S.E.		Coef.	S.E.	
CONSTANT	0.26	(0.25)		0.12	(0.25)		1.70	(0.31)	***	-1.58	(0.26)	***
FEMALE	0.19	(0.11)	*	0.34	(0.11)	***	0.01	(0.13)		0.09	(0.11)	
MID_AGE	0.36	(0.11)	***	-0.48	(0.12)	***	0.18	(0.14)		-0.21	(0.12)	*
SENIOR	0.51	(0.15)	***	-0.90	(0.15)	***	0.34	(0.18)	*	-0.30	(0.14)	**
EDU	-0.06	(0.05)		-0.11	(0.05)	**	-0.03	(0.06)		0.08	(0.05)	
MID_INC	-0.32	(0.13)	**	-0.08	(0.13)		-0.18	(0.17)		-0.01	(0.13)	
HIGH_INC	-0.31	(0.15)	**	-0.23	(0.15)		-0.22	(0.18)		0.28	(0.15)	**
DAILYSHOP	0.35	(0.11)	***	-0.15	(0.12)		0.31	(0.13)	**	0.24	(0.12)	**
SHIBEI	-0.08	(0.13)		-0.30	(0.14)	**	-0.56	(0.17)	***	0.89	(0.14)	***
SIFANG	0.09	(0.14)		-0.36	(0.15)	***	-0.27	(0.19)		0.90	(0.14)	***
SHINAN	0.43	(0.14)	***	0.15	(0.13)		-0.59	(0.18)	***	0.76	(0.14)	***
FASTFOOD	-0.14	(0.10)		0.03	(0.10)		-0.63	(0.14)	***	0.85	(0.10)	***
WALK	0.27	(0.10)	***	0.17	(0.11)	*	0.24	(0.12)	**			
CAR										0.40	(0.27)	
BUS										0.43	(0.11)	***
VARIETY										0.36	(0.19)	*
QUALITY										0.24	(0.11)	**

Number of Replications:	30
Log-Likelihood Function:	-1633.82
LR Chi2(51) test:	411.74
Prob>Chi2(51):	0.0000
Number of Observations:	838

(*next*)

Table 2.4. Results from the Multivariate Binary Probit Model (*cont.)*

Variable	Wet Market	Small Store	Supermarket	Hypermarket
Correlation Matrix				
Wet Market	1.00			
Small Store	0.19 (0.07) ***	1.00		
Supermarket	-0.05 (0.08)	-0.00 (0.08)	1.00	
Hypermarket	-0.02 (0.07)	0.10 (0.06)	-0.21 (0.08) ***	1.00
Likelihood ratio test of rho21 = rho31 = rho41 = rho32 = rho42 = rho43 = 0:				
LR Chi2(6) test:	18.3377			
Prob>Chi2(6):	0.0054			

Notes: *** means significant at 1% level, ** means significant at 5% level, * means significant at 10% level.

Table 2.5. Marginal Effects and Predicted Probabilities of Multivariate Probit Model

Variable	Wet Market		Small Grocery Store		Supermarket		Hypermarket	
	M.E.	S.E.	M.E.	S.E.	M.E.	S.E.	M.E.	S.E.
FEMALE	0.06	(0.03)	0.11	(0.04)	0.00	(0.02)	0.04	(0.04)
MID_AGE	0.12	(0.04)	-0.14	(0.03)	0.03	(0.02)	-0.08	(0.05)
SENIOR	0.15	(0.04)	-0.23	(0.03)	0.05	(0.02)	-0.12	(0.06)
EDU*	-0.02	(0.02)	-0.03	(0.02)	-0.01	(0.01)	0.03	(0.02)
MID_INC	-0.11	(0.04)	-0.02	(0.04)	-0.03	(0.03)	0.00	(0.05)
HIGH_INC	-0.11	(0.05)	-0.06	(0.04)	-0.04	(0.04)	0.11	(0.06)
DAILYSHOP	0.12	(0.04)	-0.05	(0.04)	0.06	(0.03)	0.09	(0.05)
SHIBEI	-0.03	(0.04)	-0.09	(0.04)	-0.11	(0.04)	0.32	(0.04)
SIFANG	0.03	(0.04)	-0.10	(0.04)	-0.05	(0.04)	0.32	(0.04)
SHINAN	0.13	(0.04)	0.05	(0.04)	-0.12	(0.04)	0.28	(0.04)
FASTFOOD	-0.05	(0.03)	0.01	(0.03)	-0.11	(0.02)	0.32	(0.04)
WALK	0.09	(0.03)	0.05	(0.03)	0.04	(0.02)		
CAR							0.14	(0.09)
BUS							0.17	(0.04)
VARIETY							0.13	(0.07)
QUALITY							0.09	(0.04)
Predicted Probability To Be Chosen:								
$Pr(Y_k=1, \text{all k})$			0.091					
$Pr(Y_k=0, \text{all k})$			0.006					
$Pr(Y_k=1)$	0.705		0.295		0.873		0.559	
$Pr(Y_k=1\|Y_4=0)$	0.729		0.257		0.941		0.000	
$Pr(Y_k=1\|Y_4=1)$	0.681		0.344		0.730		1.000	

*: Marginal effect for education is calculated at mean, but denotes discrete change from 0 to 1 for other dummy variables.

Figure 2.1. Most often used transportation for food shopping

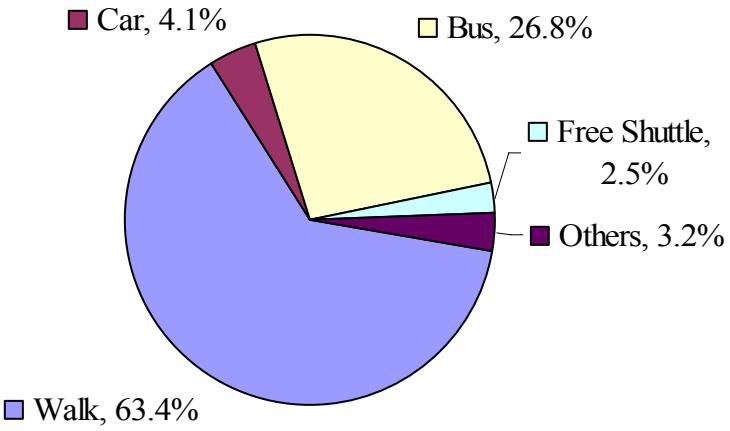
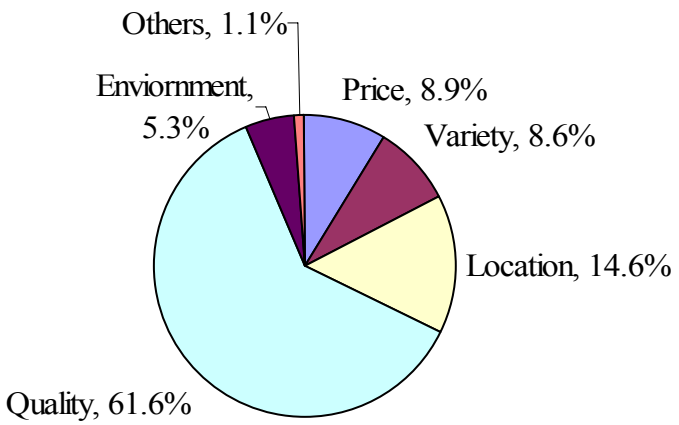


Figure 2.2. Most important factor for food shopping store choice



CHAPTER THREE

FLUID MILK CONSUMPTION IN CHINA: AN EMPIRICAL ANALYSIS FROM SURVEY DATA

Summary

This study analyzes the effects of social-demographic characteristics on Chinese urban consumers' consumption of fluid milk. A Tobit model with censoring at zero consumption is estimated based on individual-level survey data. Individual characteristics such as being a student, being male, the household's primary food shopper, higher income, owning a refrigerator, and frequently visiting modern retailers such as supermarkets and hypermarkets, are positively related to an individual's fluid milk consumption. Milk price and distance between home and the food shopping place have significant negative influences on consumers' consumption of fluid milk. The presence of children in one's household decreases the respondent's consumption, which supports that hypothesis that children are the top priority for family nutrition expenditures. The argument is that consumption is shifted from the adult respondents to their children. Predictions of unconditional and conditional expected values of per capita daily consumption for fluid milk are higher than previously reported levels, supporting the hypothesis that Chinese consumers' diets are changing to include more western foods, such as fluid milk. Income and own-price elasticity estimates are reported and imply that fluid milk consumption in Qingdao is a normal good and is inelastic.

Key words: China, consumption, fluid milk, market participation, survey data, Tobit regression

Introduction

With its vast population and rapid and sustained economic growth, China is a target for western companies in search of new customers. The entrance of China into the World Trade Organization (WTO) is another convincing argument for western companies to develop business strategies tailored to Chinese markets. To be successful in China, western companies must understand Chinese consumer preferences toward western products and how Chinese consumers will react as China integrates into the global economy and faces increased exposure to industrialized countries, cultures, and products.

Consumption of dairy products, particularly fluid milk, has experienced record growth over the last decade in China, especially in urban areas (Fuller et al., 2006). The National Bureau of Statistics of China (NBSC) reports that per capita annual consumption of fluid milk in urban households in China in 2004 increased to 18.8 kilograms from 6 kilograms in 1995. Furthermore, in 2002, annual milk consumption in Beijing, Shanghai, and Guangzhou reached 56, 51, and 27 kilograms, respectively (Fuller et al, 2004). Total sales of milk products in China in 2005 were $9.5 billion (U.S. dollars), of which, $4.1 billion (U.S. dollars) are from selling fluid milk (USDA, 2006). This is in sharp contrast to twenty years ago when consumption of milk products was essentially non-existent.

This increase in fluid milk consumption exemplifies the western influences and changes that have taken place in Chinese food consumption patterns and tastes over the last two decades. Other noteworthy shifts include the increased consumption of dietary fat, including meat and dairy products, the decreased consumption of grains, including rice, flour, and course grains, and

increased consumption of fruit and vegetables (Gould, 2002; Guo et al., 2000; Ma et al, 2004).

Understanding the factors driving this increase in milk consumption is important for forecasting market development, domestic production, and potential trade opportunities. Based on NBSC data, Wang et al (2004) and Ma and Rae (2004) estimated elasticities of income, expenditure, and price for milk products. However, the effects of consumers' characteristics on their milk consumption, and the zero-consumption problem were not considered in most cases because of either data limitation or estimating difficulties. Wang and Fan (1999) and Zhou et al (2002) discussed dairy product consumption in China, but their studies differ from this article because they are at the aggregate rather than individual level. In 2001, Fuller et al (2004) conducted a survey of 314 households in three metropolitan cities, Beijing, Shanghai and Guangzhou, with about 100 observations in each. The authors analyzed the factors influencing Chinese consumers' purchasing behavior. The current article adds to this literature with an analysis of a larger and more recent data set, while accounting for zero-consumption observations. The levels of consumption are greater than those previously reported, providing support of a continued trend of increasing milk consumption in China. In addition, hypotheses on the effect of children in the household and post-incident food safety risk are tested.

The primary objective of this study is to understand Chinese urban consumers' consumption behavior for fluid milk[2] and the factors that affect consumption. Since milk traditionally has not been part of the Chinese diet, we expect that a proportion of the population will be zero-consumption observations. Therefore, the standard Tobit model left censored at

[2] Cow milk is only considered in this study.

zero will be applied in this study to deal with the zero-consumption problem. This approach makes it feasible to simultaneously examine the marginal change in demand for fluid milk and the change in the probability of consumers switching between zero and non-zero consumption, as well as the effects of consumers' characteristics on both.

To accomplish these objectives, this paper is structured as follows. In section two, the empirical methodology, data, and variables used in the analysis will be presented. Estimation results will be discussed in section three. In the last section, we summarize the main findings of this study and conclude with a brief discussion of further research.

Methodology, Data, and Variables

Tobit model, marginal effects, and elasticities

The Tobit model has been widely applied to estimate demand equations for data with censored observations (Adesina and Zinnah, 1993; Showers and Shotick, 1994; Cornick et al., 1994; Howard, 1995; Castronova and Hagstrom, 2004; Fuller et al., 2004). The approach makes it possible to measure the decision of participation and to examine the levels of consumption in one model. Following the Mittelhammer et al. (2000) notation in this study the observed consumption of fluid milk by individual *i* can be specified as

$$(1) \qquad y_i = \begin{Bmatrix} y_i^* = \mathbf{x}_i\boldsymbol{\beta} + \varepsilon_i^* \\ 0 \end{Bmatrix} \text{ if } \begin{cases} y_i^* > 0 \\ y_i^* \le 0 \end{cases}$$

where y_i^* is an unobservable latent variable that can be modeled as a linear function of a vector of explanatory variables $\mathbf{x}_i$ and error term ε_i^*, which is usually assumed to have a normal

distribution $\varepsilon_i^* \sim$ iid $N(0,\sigma^2)$. The likelihood function associated with a sample outcome $(y_1,...,y_n)$ is then given by

$$L(\boldsymbol{\beta},\sigma;\mathbf{y}) = \prod_{(i:y_i=0)} F(\frac{-\mathbf{x}_i\boldsymbol{\beta}}{\sigma}) \prod_{(i:y_i>0)} \sigma^{-1} f(\frac{y_i - \mathbf{x}_i\boldsymbol{\beta}}{\sigma}) \tag{2}$$

where F and f are the distribution and density function respectively of the standard normal variable, $\prod_{(i:y_i=0)}$ represents the product over those i for which $y_i^* \le 0$, and $\prod_{(i:y_i>0)}$ represents the product over those i for which $y_i^* > 0$. The maximum likelihood (ML) estimates of parameters β and σ can be obtained by maximizing equation (2) or equivalently, maximizing its log version $\ln(L(\beta,\sigma;\mathbf{y}))$. Amemiya (1973, 1984) demonstrated that the usual consistency and asymptotic normality properties of ML estimators hold for this model.

From (1), the expected value of the unconditional purchases can be given by $E(y) = \mathbf{x}\beta F(z) + \sigma f(z)$ where $z = \mathbf{x}\beta/\sigma$, and the expected value of purchases conditional on having positive consumption $E(y \mid y^* > 0) = \mathbf{x}\beta + \sigma \frac{f(z)}{F(z)}$. Therefore, the relationship between the unconditional case and the conditional case can be derived as $E(y) = F(z)E(y \mid y^* > 0)$. By taking the derivative of this equation with respect to x_k, McDonald and Moffitt (1980) and Maddala (1983) showed how the total change in the unconditional purchases in term of a special independent variable x_k can be disaggregated into two parts: the change in conditional purchases weighted by the probability of purchasing, and the change in the probability of purchasing weighted by the conditional expected value of purchases, i.e.

(3) $$\frac{\partial E(y)}{\partial x_k} = F(z)\left(\frac{\partial E(y \mid y^* > 0)}{\partial x_k}\right) + E(y \mid y^* > 0)\left(\frac{\partial F(z)}{\partial x_k}\right)$$

where $\frac{\partial E(y \mid y^* > 0)}{\partial x_k}$ is the change in conditional purchases (or conditional marginal effect), identifying how the daily consumption for fluid milk changes due to a specific independent variable x_k for those with non-zero consumption; $\frac{\partial F(z)}{\partial x_k}$ is the change in the probability of purchasing (or marginal effect of probability of purchasing), explaining how those consumers with zero-consumption start consuming fluid milk due to x_k; $F(z)$ and $E(y \mid y^* > 0)$ represent the probability of purchasing and the conditional expected value of purchases, respectively.

Multiplying both sides of equation (3) by $\frac{x_k}{E(y)}$ and simplifying, the elasticities can be expressed as,

(4) $$\frac{\partial E(y)}{\partial x_k}\frac{x_k}{E(y)} = \frac{\partial E(y \mid y^* > 0)}{\partial x_k}\frac{x_k}{E(y \mid y^* > 0)} + \frac{\partial F(z)}{\partial x_k}\frac{x_k}{F(z)}$$
$$i.e. \quad \xi_{uncon} = \xi_{cond} + \delta_{pp}$$

where $\xi_{uncon} = \frac{\partial E(y)}{\partial x_k}\frac{x_k}{E(y)}$, $\xi_{cond} = \frac{\partial E(y \mid y^* > 0)}{\partial x_k}\frac{x_k}{E(y \mid y^* > 0)}$, and $\delta_{pp} = \frac{\partial F(z)}{\partial x_k}\frac{x_k}{F(z)}$ are unconditional elasticity, conditional elasticity, and elasticity of probability of purchasing in terms of x_k, respectively.

Data and survey description

In-person interviews were conducted for the purpose of this study with 638 participants

in the summer of 2005 in Qingdao, China. The City of Qingdao is one of 14 coastal cities that were first opened to foreign markets in 1984. It is on the southern tip of the Shangdong Peninsula along the Yellow Sea and is currently divided into seven urban districts. In 2003, the total population was 2.24 million. Annual per capita disposable income in 2005 was 12,920 Yuan, about 2,000 Yuan higher than the national level (10,493 Yuan) and the Shandong provincial level (10,744 Yuan) but lower than that of main metropolitan cities such as Beijing (17,653 Yuan) and Shanghai (18,645 Yuan) in the same period.

The surveys were conducted in three food shopping stores, located in three of the seven urban districts (one store in each district). These locations were chosen to ensure a sample that is representative of a cross section of the Qingdao population and to survey consumers at the same time and place where actual purchasing decisions were made in an effort to better elicit their true preferences. Four graduate students were hired and trained to conduct this survey in Chinese.

To avoid potential selection bias from individual sampling, respondents were selected with the criterion that the interviewer was to solicit every third adult consumer (18 years and older) who came into the survey area, following completion of the previous interview. To improve data quality, contracts were signed with the selected food stores, and 200-400 Yuan per day was paid to each store for use of the survey area. As a reward for participating in the survey, every respondent was given a gift card (worth U.S. $1.80) redeemable at the participating store.

The sample statistics indicate that our selected sample is representative of most of the

characteristics of the population in the study area (see the last two columns in Table 3.1). The average family size and monthly per capita disposable income in the sample have no significant differences from their corresponding population levels. Although women (66.9 percent) and unemployed respondents (6.7 percent) are over-represented in the sample, we believe that these sample characteristics are expected and acceptable. The higher share of female respondents is expected since women typically play a larger role in family food shopping in China. The unemployment rate in the sample is lower than the official registered unemployment rate. However, the sample may be representative of the true unemployment rate because there is "unregistered" urban unemployment (Wolf, 2004).

Table 3.1 also shows that the surveyed sample was distributed widely among various consumers. The monthly household disposable income for more than 60 percent of the sample ranged between 2,000 and 5,000 Yuan ($250 and $625). Forty-three percent had children under 18 years old. More than 90 percent of households owned a refrigerator. The majority of surveyed respondents were in their late 30's or early 40's, with an average age of 38 years. Nearly three fourths of respondents had a high school education level or higher and were the primary food shoppers in their households. Fifty percent were employed full-time.

The statistics for fluid milk consumption in the surveyed sample are summarized in Table 3.2. About 90 percent of respondent consumed fluid milk in 2005, with an average daily consumption of 185ml/person. This is equivalent to an annual consumption rate of 65.7 kilograms/person, which is significantly higher than the levels reported by Fuller et al. (2004) in Beijing (50 kg), Shanghai (51 kg), and Guangzhou (27 kg) in 2002. If respondents with zero

consumption are excluded from the sample, average daily consumption increases to 207ml/person (equivalent to 73 kg). The average price for fluid milk self-reported by consumers was 1.52 Yuan/250ml. Within the group of non-zero consumption respondents, 70 percent said that they had increased expenditures on fluid milk consumption over the past 3 years, while 27 percent reported no significant change, and 3 percent reduced in the same period. The most common explanations for zero consumption are unpleasant taste (75 percent) and milk allergies (12 percent).

Variables in the regression

The dependent variable is the respondents' individual daily consumption of fluid milk. As illustrated in the data description section, 10.5 percent of surveyed respondents did not consume fluid milk during the year of the survey. Consequently, the recorded outcomes for the respondent variable can be viewed as a mixed, discrete-continuous random variable. In other words, the per capita daily consumption of fluid milk is censored at the lower bound of zero.

The individual daily consumption of fluid milk in this study can be explained by three categories of explanatory variables: individual characteristics, household demographics, and other social-demographics. The detail definitions, coding, and expected signs of these variables are given in Table 3.3. The respondent's gender (GENDER) is an indicator variable, taking on the value of 1 if the respondent is a male. The respondent's age (AGE) is a continuous variable for which an ambiguous relationship is expected, since there are two opposing effects from age. The first effect is that consumers generally become more health conscious as they age and become more susceptible to illness. This suggests a positive effect because most respondents in

our survey believed that drinking fluid milk can strengthen their bones. The second effect associated with age is that younger consumers are generally more open to new or different food products. This suggests a negative relationship to age. The respondent's education level (EDU) in years is also a continuous variable in the model. Six indicator variables representing the respondents' employment status are also included in the model, with student (EM_STUD) as the comparative category. Our reasoning behind comparing all other categories to students is to test a hypothesis of that students' health and nutrition expenditure in a family has the most important role.

The last individual characteristic, SHOPPER, is a dummy variable which takes on the value of one if the respondent is the main food shopper in the household. According to Fuller et al. (2004), the point-of-purchase milk advertisements have a significantly positive effect on milk product sales in China. Thus, the estimate for SHOPPER is expected to be positive because they encounter more in-store milk advertisements than other members of the family.

Household-related characteristics consist of four variables, INCOME, INCOME2, CHILD, and REFR. All previous studies, either descriptively or empirically have found that income has a positive influence on consumers' fluid milk consumption (e.g. Zhou et al., 2002; Fuller et al., 2004). Bai and Wahl (2005) demonstrated that the consumption of fluid milk increases as income increases, but at a decreasing rate. A quadratic term of income, INCOME2, is thus included in the model. A negative sign is expected for this term owing to diminishing marginal utility. In addition, a dummy variable (CHILD) is imposed in the model to examine how the presence of child influences other family members' demand for fluid milk. The

expected sign for the estimate of CHILD is negative because it is hypothesized that the child is the nutritional priority in the household. REFR represents whether a refrigerator is available in the household. A refrigerator should have a positive effect on milk consumption for obvious reason of that a refrigerator can lengthen the relatively short storage time for fluid milk.

In the last explanatory category, four variables are included. The first one is PRICE, which is individual self-reported purchasing price for the milk which was often purchased[3]. The second one is RISK, which is a dummy variable that equals one if the respondent previously bought spoiled or adulterated milk or heard of any event involving spoiled or adulterated milk. According to media reports, some well-publicized cases of dairy quality problems have shaken consumers' confidence in milk consumption. This was used as important evidence in the USDA GAIN Annual Report (2005) on China dairy products in 2005 to explain their lowered forecasted growth rate for fluid milk use in China in 2006. By including this variable, we can statistically test the effect of these reported cases on consumers' confidence.

The rise of supermarkets in urban China is regarded as an important factor that has boosted milk sales since they have made milk readily available to urban consumers (Reardon et al., 2004). To confirm this qualitative result, the dummy variable SUPMKT, which equals one if the respondent visits a supermarket or hypermarket at least once a week, is included in the model and a positive sign expected. Finally, DISTANCE is a continuous variable, representing the distance between respondent's home and his or her food shopping place, such as an outdoor market or supermarket which is visited most often. The expected estimate sign is negative..

[3] For those who did not consume fluid milk, the self-reported prices are the prices they faced when they purchased for others. Four respondents who could not report milk prices were excluded from our dataset

Empirical Analysis

The log version of the likelihood function in (2) is used to obtain parameter estimates for fluid milk consumption. The square root of dependent variable is used to correct for heteroscedasticity since it provides the best fit. The estimated results from the maximum likelihood (ML) estimator are presented in Table 3.4. The statistical significance of the model is examined by using a likelihood ratio test of the null hypothesis that all slope estimates are zeros. The statistic, $LR\ chi2(17) = 84.35$, indicates that we can reject the null hypothesis. The skewness and kurtosis tests for normality in terms of the unconditional and the conditional errors produce $Prob_{uncond} > chi2 = .3057$ and $Prob_{cond} > chi2 = .2460$, respectively. Therefore, we fail to reject the null hypotheses of that the underlying distributions are normally distributed, implying that the ML estimator is consistent.

Estimated results show that all coefficients have the expected signs, and all but five are significant at $\alpha = 0.10$ level, implying that most of our hypotheses about the independent variables' influences on fluid milk consumption are empirically demonstrated. Characteristics such as being male, the family's primary food shopper, owning a refrigerator, and visiting modern retailers such as supermarkets and hypermarkets more frequently, are positively related to an individual's fluid milk consumption. As expected, income is positively related to fluid milk consumption, but the negative sign for the coefficient of its quadratic term (INCOME2) implies that the overall positive effect of income on milk consumption will be weakened as income increases. Also as expected, milk price and distance between home and the food shopping place have significant negative influences on consumers' demand for fluid milk. As expected

the effect of age is not statistically significant. This may reflect the two opposing effects of increasing health consciousness and decreasing openness to trying new foods cancel each other out.

The estimates for four out of five employment status dummy variables are significantly negative, representing that a student will consume more fluid milk compared to a non-student. In addition, the negative coefficient associated with the variable CHILD means that the respondent with child(ren) in the household will consume less fluid milk than those in a family without child(ren). Intuitively, the presence of a student and/or a child may significantly reduce the amount of fluid milk other members consume in a family. One explanation of this result is that children and students are given first priorities in family health and nutrition expenditures. A typical online advertisement for a milk product in China reads, "…pure and fresh milk, which can provide abundant nutrition for children's growth."[4]

The empirically estimated coefficient for RISK is negative but not statistically significant, implying that highly publicized incidents of poor milk quality did not significantly affect Qingdao consumers' confidence in milk safety. A possible reason may be related to the rapid development of modern food retailers such as supermarkets and hypermarkets, which have high consumer confidence for offering high quality food products. When these events happened, consumers simply buy their milk products from these modern stores rather than from traditional outdoor markets and small, independent stores.

Table 3.5 presents marginal effects, expected values for daily consumption and

[4] Downloaded from www.21 Food.com on November 10, 2006

probability of uncensored, and income and own-price elasiticities. The elasticities are evaluated at the mean of the independent variables. As we mentioned in methodology section, the total marginal effect (or unconditional marginal effect) in the Tobit model can be decomposed into two desired effects, conditional marginal effect and marginal effect on the probability of being uncensored. The former measures how the daily consumption for fluid milk changes due to a specific independent variable for current milk consumers, whereas the latter explains how those consumers who are at zero-consumption start consuming fluid milk due to the influence of the independent variable. For example, holding other variables constant, the average man is expected to consume 41 ml of fluid milk more than a woman in one day. This number falls slightly to 39.5 ml if only current milk consumers are considered. Meanwhile, compared to women, men have a 2.65 percent higher probability of being milk consumers. Another example, compared to the student milk consumer, an unemployed consumer drinks 78 ml less fluid milk, which is the largest reduction, followed by a retired consumer (71 ml), a part-time employed consumer (68 ml), a full-time employed consumer (46 ml), and a homemaker (33 ml).

Based on the estimates, the predictions of unconditional and conditional expected value of per capita daily consumption for fluid milk in Qingdao are 157 ml and 161 ml (or 55 kg and 59 kg a year), respectively. The estimated expected value for the probability of purchasing shows that there is 93% likelihood that urban consumers in Qingdao consume fluid milk. Table 3.5 also provides the 95% confidence intervals for the predictions.

It is very interesting that income increases and price decreases hardly convince of a zero-consumption consumer to become a milk consumer. From the estimated income and

own-price elasticities in Table 3.5, it is easy to see that as income increases 1 percent, the conditional dairy consumption for fluid milk will increase 0.50 percent. However, 0.04 percent increase in the probability of uncensored due to the 1 percent increase of income implies that the income increase has only minor effect on convincing of a zero-consumption consumer to start drinking fluid milk. Similarly, one percent decreases in own-price will lead to 0.67 percent grows in per capita dairy milk consumption for current milk consumers, but only have 0.05 percent increases in the probability of uncensored. In our survey, about 75 percent of zero-consumption respondents said that they don't like milk taste, and more abut 12 percent of them said that it's because of milk allergies. These reasons provide direct explanation for the minor income and price effects on zero-consumption customers. In addition, the estimated income and price elasticities imply that fluid milk in Qingdao was a normal good, but it is price inelastic, and thus reducing price might not be a good strategy for firms to expand market share.

Conclusion

Using the survey data collected from individual consumers in Qingdao, China, in 2005, we empirically analyzed consumers' fluid milk consumption behavior and factors affecting this behavior. Being male or one's household's main food shopper is positively related to an individual's fluid milk consumption, while the distance between home and food shopping place has a negative effect. Students and children are the highest priority in family health and are more important in purchasing milk products than other members in a family. Our empirical result also supports that the rise of modern food retailers such as supermarkets or hypermarkets has boosted consumers' demand for fluid milk.

The highlighted marginal effects and elasticities, with respect to household income, showed that milk is a normal good. However, among non-milk drinkers, the positive effect was minor, perhaps owing to a high level of dislike for the taste of milk or lactose intolerance among the remaining non-milk consumers. The price is inelastic, implying that price is not an efficient tool for firms to expand their market share in the Qingdao milk market.

Contrary to what we expected, the highly publicized incidents of poor quality milk did not significantly shake Qingdao consumers' confidence in milk consumption. The rapid development of modern food retailers such as supermarkets and hypermarkets (with their high cleanliness standards) is a likely cause for strong consumer confidence.

In conclusion, this study may shed light on globalization and its link to western-style food consumption behaviors world-wide. As more consumers buy their food from super and hypermarkets, often owned by multi-national corporations, and store their food in refrigerators, we observe changing consumption patterns. The implications are far-reaching from international trade opportunities to health.

Finally, we would like to point to several potential directions for further study. First, considering product characteristics and their effects on consumers' preferences for milk is important and useful for marketing and political strategy. Many varieties of flavored milks, including many fruit flavors are widely available in China. The availability of flavors, addresses the largest reason for zero consumption in our study: undesirable taste. Second, the expected annual per capita consumption levels (55 kg for unconditional and 59 kg for conditonal) for fluid milk in urban Qingdao were much higher than the national level (19 kilograms),

implying extreme regional differences in milk consumption. Analyzing regional differences and the factors behind them are obviously essential in any marketing strategy. Finally, a comprehensive understanding of the dairy economy in China needs to jointly consider current and potential domestic supply capacity, both in quantity and quality viewpoints, particularly in quality.

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Table 3.1. Sample Statistics and Representative Tests

	Sample Mean	Std. Dev.	Population Mean	P-value[a]
Respondent's Individual Characteristics				
Age (year)	37.95	13.51		
Female % of total (binary; female=1)	0.669	0.471	0.495 [b]	Pr>t=0.0000
Education level (binary; yes=1)				
Primary school or illiteracy	0.041	0.198		
Middle school	0.246	0.431		
High school or equivalent	0.370	0.483		
2-year college or equivalent	0.218	0.413		
4-year college	0.121	0.326		
Advanced or professional degree	0.005	0.068		
Employment status (binary; yes=1)				
Full time	0.495	0.500		
Part time	0.083	0.276		
Unemployed	0.067	0.251	0.030 [c]	Pr>t=0.0001
Homemaker	0.088	0.283		
Retired	0.190	0.392		
Student	0.077	0.266		
Main food shopper in household (binary; yes=1)	0.760	0.427		
Household Characteristics				
Monthly household disp. Income (binary; yes=1)				
Less than 1000	0.039	0.194		
1001-2000	0.177	0.382		
2001-3000	0.265	0.442		
3001-4000	0.218	0.413		
4001-5000	0.143	0.350		
5001-10000	0.132	0.338		
More than 10000	0.027	0.161		
Monthly per capita disp. income (1000 Yuan)	1.076	0.689	1.077 [c]	Pr>|t|=0.9711
Children under 18-years exist in household (binary; yes=1)	0.431	0.496		
Household size (persons)	3.237	1.074	3.191 [b]	Pr>|t|=0.2833
Refrigerator ownership (binary; yes=1)	0.915	0.279		
Total Observations	638			

a. Ho: sample mean=population mean.
b. 2003 data are used for population levels since 2005 data are unavailable. The household size is from 2004 *Qingdao Statistical Yearbook*, and the share of female is calculated based on the data from 2004 *Shandong Statistical Yearbook*. We assume that these data have no significant differences between 2003 and 2005.
c. Data are from *Qingdao 2005 Economic and Social Development Annual Report* released by Qingdao Bureau of Statistics.

Table 3.2. Fluid Milk Consumption in Surveyed Sample

	Mean	Std. Dev.
% of non-zero consumption observations (yes=1)	0.895	0.307
Per capita daily consumption (ml)		
In total sample (N=638)	185.3	110.2
In non-zero consumption sample (n=571)	207.0	95.2
Average purchasing price (yuan/250ml)		
In total sample (N=638)	1.515	0.315
In non-zero consumption sample (n=571)	1.500	0.306
Expenditure changed in last 3-years in non-zero consumption sample (binary; yes=1)		
Increased	0.699	0.459
Stay the same	0.271	0.445
Decreased	0.030	0.170
Reasons for zero-consumption (binary; yes=1)		
Don't like the taste	0.746	0.438
Allergic to milk	0.119	0.327
Others	0.134	0.344

Table 3.3 Variable Definition, Coding, and Expected Sign

Variable	Definition and Unit	Coding	Expected Sign
(1) Respondent Individual Characteristics:			
GENDER	Respondent gender	Male=1, female=0	+/-
AGE	Respondent age (years)	Continuous	+
EDU	Respondent education level	Continuous	+/-
EM_FULL	Full time employed	Yes=1, others=0	-
EM_PART	Part time employed	Yes=1, others=0	-
EM_UNEM	Unemployed	Yes=1, others=0	-
EM_HOME	Homemaker	Yes=1, others=0	-
EM_RETI	Retired	Yes=1, others=0	-
EM_STUD[a]	Student	Yes=1, others=0	
SHOPPER	Main food purchaser in household	Yes=1, No=0	+
(2) Household Characteristics:			
INCOME	Household monthly disposable income (1,000 yuan)	Continuous	+
INCOME2	Square of INCOME	Continuous	-
CHILD	Children under 18-year old exist in household	Yes=1, No=0	-
REFR	Refrigerator is available in household	Yes=1, No=0	+
(3) Other Characteristics:			
RISK	If the respondent previously bought spoiled or adulterated milk or heard of any event involving spoiled or adulterated milk.	Yes=1, No=0	-
PRICE	Self-reported price for fluid milk which was often purchased (yuan/250ml)	Continuous	-
SUPMKT	Visit supermarkets or hypermarkets at least once a week for food shopping	Yes=1, No=0	+
DISTANCE	Distance from home to the most often used food shopping place	Continuous	-

a. Reference category in regression.

Table 3.4. ML Parameter Estimates from Tobit Model for Fluid Milk Consumption

	Coef.		Std.Err.	Coef./S.E.
INTERCEPT	0.4739	***	0.0699	6.78
(1) Respondent's Individual Characteristics:				
GENDER	0.0531	**	0.0265	2.01
AGE	0.0008		0.0008	0.93
EDU	-0.0105		0.0078	-1.34
EM_FULL	-0.0627	**	0.0303	-2.07
EM_PART	-0.0963	**	0.0384	-2.51
EM_UNEM	-0.1109	***	0.0415	-2.67
EM_HOME	-0.0457		0.0395	-1.16
EM_RETI	-0.0986	**	0.0435	-2.27
SHOPPER	0.0435	*	0.0260	1.67
(2) Household's Characteristics:				
INCOME	0.0398	**	0.0179	2.22
INCOME2	-0.0038	*	0.0023	-1.65
CHILD	-0.0242	*	0.0148	-1.64
REFR	0.0257		0.0263	0.98
(3) Other Characteristics:				
RISK	-0.0145		0.0241	-0.60
PRICE	-0.0972	***	0.0224	-4.35
SUPMKT	0.0763	***	0.0141	5.41
DISTANCE	-0.0252	**	0.0106	-2.38

Log Likelihood Function:	103.8463
LR chi2(17) test:	84.35
Prob > chi2:	0.0000
McFadden R^2:	0.1134
Number of Observations:	638

Notes: *** means significant at 1% level, ** means significant at 5% level, * means significant at 10% level.

Table 3.5. Marginal Effects, Predictions and Elasticities

	Unconditional Expected Value of Dependent Variable	Conditional Expected Value of Dependent Variable	Probability of Uncensored
Marginal Effects:			
GENDER*	0.0410	0.0395	0.0265
AGE	0.0006	0.0006	0.0004
EDU	-0.0081	-0.0078	-0.0055
EM_FULL*	-0.0484	-0.0463	-0.0328
EM_PART*	-0.0736	-0.0683	-0.0622
EM_UNEM*	-0.0845	-0.0779	-0.0746
EM_HOME*	-0.0352	-0.0332	-0.0263
EM_RETI*	-0.0756	-0.0707	-0.0607
SHOPPER*	0.0336	0.0321	0.0230
INCOME	0.0308	0.0295	0.0207
INCOME2	-0.0029	-0.0028	-0.0020
CHILD*	-0.0187	-0.0179	-0.0127
REFR*	0.0198	0.0188	0.0141
RISK*	-0.0112	-0.0107	-0.0078
PRICE	-0.0751	-0.0719	-0.0505
SUPMKT*	0.0589	0.0563	0.0404
DISTANCE	-0.0195	-0.0186	-0.0131
Predictions of Expected Values:			
PREDICTIONS	0.157	0.161	0.930
95% CONF. INT.			
Lower	0.153	0.158	0.905
Upper	0.161	0.165	0.956
Income and Own-price Elasticities:			
INCOME	0.5419	0.5041	0.0378
PRICE	-0.7253	-0.6747	-0.0506

*: dF/dx is for discrete change of dummy variable from 0 to 1.

CHAPTER FOUR

CHINESE URBAN CONSUMERS' PREFERENCES FOR FLUID MILK: EMPIRICAL ANALYSIS FROM A CHOICE-BASED CONJOINT EXPERIMENT

Summary

A choice-based conjoint (CBC) technique was employed in this study to analyze Chinese consumers' preferences for fluid milks, which are defined by four choice attributes: production processing method, fat content level, taste, and price. Individual data were collected in Qingdao, China in the summer of 2005. Two methods, counting choice, and multinomial logit models, were used to analyze the CBC experimental data. The results indicated that Chinese consumer preferences for and probability of choosing an attributes-specified fluid milk were significantly influenced by the milk attributes and consumers' individual characteristics. Consumers are willing to pay a premium for pasteurized, low fat content, and natural tasting milk, but need a discount for choosing ultra high temperature (UHT), high fat content, and flavored milk. The utility of attributes, the probability of a milk alternative to be chosen, and the trade-offs among attributes change as consumers' income changes.

Key words: China, choice-based conjoint experiment, consumer preference, fluid milk consumption

Introduction

Consumption of dairy products, particularly fluid milk, has experienced record growth over the last decade in China, especially in urban areas (Fuller et al., 2006). Statistics from the National Bureau of Statistics of China (NBSC) show that per capita annual demand for fluid milk in urban households in 2004 reached 18.8 kilograms, up from 6 kilograms in 1995. In three metropolitan cities, Beijing, Shanghai and Guangzhou, annual per capita fluid milk consumption reached 56, 51, and 27 kilograms, respectively, in 2002, according to Fuller et al. (2004). Total sales of milk products in China in 2005 were $9.5 billion, of which $4.1 billion resulted from sales of fluid milk (USDA, 2006). This is in sharp contrast to twenty years ago when consumption of milk products was essentially non-existent.

Most researchers believe that China's increasing demand for milk will create unprecedented market and trade opportunities for potential exporters outside of China (e.g. Ma and Rae, 2004; Zhou et al., 2002; Yang et al., 2004), including the U.S. However, there is *a lack of understanding* of this newly emerging market and the buyers in it. *Lack of such knowledge* is an important problem because until we acquired, evidence-based development of marketing strategies, trade policy, and focus even R&D for new products to better fit the world's fastest growing economy will remain problematic. Hence, acquiring such knowledge is critical for potential milk exporters, including U.S. dairy producers, to be able to access China's market.

In the literature, some studies have estimated various demand elasticities for milk products. For example, based on survey data from Jilin, Inner Mongolia, Shangdong, Jiansu, Sichuan, and Guangdong, Wang et al. (2004) indicated that the income elasticity of milk was

0.32. Based on NBSC household income and expenditure data, Ma et al. (2004) estimated expenditure and own-price elasticities for seven animal products in urban China. Their results showed that the conditional expenditure elasticity for dairy products, including fresh milk and milk powder, were significantly decreased from 2.17 in the early of 1990s (1991-1993) to 1.07 in the late of 1990s (1999-2001). The estimated own-price elasticities for the two periods were -0.96 and -1.00, respectively. Zhou et al. (2002) and Yang et al. (2004) also discussed dairy product consumption, production and trade opportunity in China and influential factors. However, their studies are largely descriptive. Two studies analyzed milk consumption and influential factors in China by taking the zero-consumption problem into consideration. In 2002, Fuller and colleagues conducted a survey of 314 households in three metropolitan cities (Beijing, Shanghai and Guangzhou) in China. Using this data, the Tobit model and double hurdle model were estimated to help determine Chinese consumers' purchasing behavior and the influential factors behind those purchasing behaviors (Fuller et al., 2004). Using large-scale individual consumer survey data, Bai and Wahl (2006) also identified and analyzed individual and household determinants on fluid milk market participation and consumption level in Qingdao, China. However, a common point in the above studies is that milk was assumed to be a homogenous product. This assumption means that consumers' preferences and purchasing behavior for milk products is independent of milk attributes such as fat content level, taste, etc. The results from these studies are hence limited, especially for development of marketing strategies.

Different from previous studies, this study relaxes the homogenous product assumption,

treating both milk attributes and individual demographic characteristics together as potential determinants by designing a choice-based conjoint (CBC) experiment. The objective of this paper is to better understand Chinese consumers' preferences and purchasing behavior for fluid milk, and to increase knowledge of the new emerging market in China. The findings from this study can be critical in providing decision support information to milk producers, traders, and related policymakers.

This paper is organized as follows. First, the CBC method is reviewed. Second, experimental design, survey conduction, and sample summary are discussed. CBC data will then be analyzed in two approaches in the third section. The next section presents the probability of choosing the specified fluid milk, trade-offs among selected attributes, and simulation of income effects. We conclude this paper with a summary of our main findings.

Choice-based Conjoint Experiments

Choice-based conjoint analysis is sometimes referred to as a discrete-choice study. It is a stated preference technique that allows consumers to make choice decisions from a set of experimentally designed products defined by a bundle of a product's attributes (Louviere, 1988). Compared to the traditional ratings- or rankings-based conjoint analysis, the CBC approach has become an attractive alternative for measuring preference structures (e.g. Elrod, Louviere and Davey, 1992; Louviere and Gaeth, 1988; Louviere, 1991), particularly in the marketing research field. There are several reasons for its increasing popularity of this approach, according to the Sawtooth software technical paper series (1999). First, the task of choosing a preferred concept is similar to what buyers actually do in the marketplace. Choosing a preferred product from a group

of products is a simple and natural task that everyone can understand. Second, compared to most other conjoint analysis studies using "main effects only" assumptions, the CBC approach can generally quantify main effects and most interaction effects (depending on the experimental design) as well. Third, it is possible to measure alternative specific effects on consumers' preferences for the products in the CBC analysis. Finally, the analysis of CBC data is much simpler relative to ratings- or rankings-based conjoint data.

The basic problem is estimation of a utility function $U = f(X_1,...,X_k)$ where U denotes utility for the good in question and ($X_{1,...,}X_k$) represent the k attributes of the good. Consider an individual faced with a set of alternatives from which to choose, each of which consists of a different combination of levels of a set of multiple attributes. Suppose individual i faces J alternatives, indexed $j=1,...,J$ and described by vectors of attributes X_j. The individual i has a utility function that can be written in the linear form

(1) $$U_{ij} = X_j\beta + \alpha_i + \delta_{ij}$$

where X_j is the attribute vector of the j^{th} alternative, and β is coefficient vector representing the weight of attribute in the valuation of alternative j. The variable α_i is an individual specific component, and δ_{ij} is stochastic and reflects the idiosyncracies of individual i in tastes for the alternative j (McFadden 1974). As respondents are randomly chosen, the unknown individual specific component can be interpreted as a random disturbance term, that is, $\alpha_i + \delta_{ij} = \varepsilon_{ij}$. Then, the utility function for the individual i in (1) can be rewritten as

(2) $$U_{ij} = X_j\beta + \varepsilon_{ij}$$

Then, the probability of an individual choosing the m^{th} alternative is

$$P(m \mid C, \beta) = P(X_m\beta + \varepsilon_{im} > X_j\beta + \varepsilon_{ij} \quad \forall j \in C \ \& \ j \neq m) \tag{3}$$

where C denotes the choice set. In the case of independently and identically distributed extreme value disturbances, the probability of an individual choosing the m^{th} alternative can be expressed as follows:

$$P(m \mid C, \beta) = \frac{\exp(X_m\beta)}{\sum_{i \in C} \exp(X_i\beta)} \tag{4}$$

This equation can be estimated from the consumer choice data generally collected in surveys.

Questionnaire Design, Survey and Data Description

In this study, we used the CBC analysis method to isolate attributes from fluid milk. As is well known, experimental design is a fundamental component of choice-based conjoint analysis, and often it is the most challenging part of the entire study. In order to choose an appropriate experimental design, a series of factors need to be considered: for example, the main characteristics of the subject to be studied; the number of potential attributes and levels to be included; the estimated budget and sample size; whether it is necessary to measure the interaction effects; and so on. As might be expected, the greater complexity of the experiment allows the researcher to design and estimate more interesting effects than when using simple main effects and occasional interaction effects of traditional conjoint analysis (Louviere 1988; Anderson and Wiley, 1992; Lazari and Anderson, 1994). However, there is no single design approach that is clearly superior over others in all circumstance. The difference depends on which effects each approach can capture, and how efficiently they can do so (Chrzan and Orme,

2000).

The first design challenge is to decide which attributes and which corresponding levels are to be included in the CBC questionnaire. In our study, this process was separated into two stages. In the first stage, ten attributes of fluid milk were selected by focus group discussions, including milk production processes, brand, package category, production place, taste, protein, fat, calcium, vitamin content, and price. In the second stage, these attributes were sent by email to 50 friends, associates, and colleagues from primary school to university level educations located throughout China. Respondents were required to rank the ten pre-selected attributes from 1 to 10 by their importance for making a purchase decision. These questions could also be answered by their parents or friends. Meanwhile, the respondents were asked to tell us price and fat information of fluid milks that they often purchased. Based on statistical results from this pre-survey, four attributes and their corresponding levels were selected for the experiment (See Table 4.2).

Statistically, a full factorial design should have 2x3x2x3=36 unique milk combinations, and we acknowledge that it would be impossible to ask respondents to select their most preferred one from them (Louviere and Woodworth, 1983). Therefore, a fractional factorial design, which can significantly reduce potential profiles without sacrificing efficiency, can be used. This, however, is the second challenge of the design. In this study, an 18-run (or –profiles) fractional factorial design with six blocks was eventually chosen for the field survey based on comparing design efficiencies, balance, and operational ability. Obviously, this is a nearly orthogonal and nearly balanced design because a completely orthogonal and balanced design must have 36

profiles in this case. Table B.1 through B.5 in Appendix B provides a series of comparisons between the two designs. It is easy to see that a 36-run full factorial design has 100 percent D-efficiency, while an 18-run fractional factorial design provides a 99.84 percent D-efficiency, meaning almost no efficiency lost for an 18-run fractional factorial design.

How to use these selected runs to construct our questionnaire was the next challenge in the experimental design. As mentioned earlier, 18 profiles were blocked into 6 choice sets with 3 alternatives in each set. Technically, respondents should each see exactly one choice set. However, showing them more than one choice set is economical, and in practice, most researchers show more than one choice set to each respondent (Kuhfeld, 2005). Unfortunately, more choice sets shown to each respondent does not directly imply that more accurate results will be attained. In fact, too many choice sets might cause respondents to be fatigued of questions. Randomly assigning several choice sets to each respondent is preferred, and this approach has been adopted in most CBC applications. But this method is difficult to conduct in paper-administered interviewing. As an alternative, in this study 6 choice sets (See Table 4.3) were assigned to construct four versions of CBC experiments following the criteria of: Version I (Set 1, Set 2, and Set 3), Version II (Set 4, Set 5, and Set 6), Version III (Set 1, Set 3, and Set 5), and Version IV (Set 2, Set 4, Set 6). A questionnaire in English including Version I CBC experiment is attached in Appendix A. Table 4.4 presents an example of the selected choice set in our CBC experiment.

Survey and data description

The data in this study were collected from 838 in-person interviews in Qingdao, China in

the summer of 2005. Qingdao is one of 14 coastal cities first opened to the foreign market in 1984. This city is on the southern tip of the Shangdong Peninsula along the Yellow Sea, and is currently divided into 7 urban districts. In 2003, the total population was 2.24 million. Annual per capita disposable income in 2005 was 12,920 Yuan, about 2,000 Yuan higher than the national level (10,493 Yuan) and the Shandong provincial level (10,744 Yuan), but lower than that of main metropolitan cities such as Beijing (17,653 Yuan) and Shanghai (18,645 Yuan) in the same period.

The surveys were conducted in four food shopping stores located in four of the seven urban districts (one store in each district). These locations were chosen to ensure a sample representative of a cross section of the Qingdao population and to survey consumers at the same time and place where actual purchasing decisions were made, in an effort to better elicit their true preferences. Four graduate students from a university were hired and trained to conduct this survey.

To avoid potential selection bias from individual sampling, respondents were selected with the criterion that the interviewer was to solicit every third adult consumer (18 years and older) who came into the survey area following completion of the previous interview. To improve data quality, contracts were signed with the selected food stores, and 200-400 Yuan per day was paid to each store for use of the survey area. As a reward for participating in the survey, every respondent was given a gift card (worth U.S. $1.8) redeemable at the participating store.

The sample statistics indicate that our selected sample is relatively representative of the

characteristics of the population in the study area (see last two columns in Table 4.1). Average family size and monthly per capita disposable income in the sample have no significant differences from their corresponding population levels. Although female (66.3 percent) and unemployed respondents (6.1 percent) are over-represented in the sample, we believe that these sample characteristics are expected and acceptable. The higher share of female respondents is expected, since women typically play a larger role in family food shopping in China. The higher unemployment rate in the survey sample is less than the registered unemployment rate, which is currently self-reported to local unemployment registration offices in China.

Table 4.1 also shows that the surveyed sample was distributed widely among various consumers. The monthly household disposable income for more than 60 percent of the sample ranged between 2,000 and 5,000 Yuan ($250 and $625). Forty-three percent had children under 18 years old. More than 90 percent of households owned a refrigerator. The majority of the total surveyed respondents were in their late 30s or early 40s, with an average age of 38 years. Nearly three-fourths of respondents had a high school education level or higher and were the primary food shoppers in their households. Fifty percent were employed full-time.

CBC Data Analysis

In this section, the collected CBC experimental data will be analyzed by two methods: a counting choice approach and a multinomial logit model (MNL) approach. In the second approach, three MNL models are estimated. Model I takes only main effects into consideration. Model II adds interactions between attributes and respondent demographic characteristics to Model I. Model III further adds two-way attributes interactions to Model II.

Approach One: Counting Choice

The counting choice approach calculates a proportion for each level of each attribute based on how many times a milk profile including that level was chosen, divided by the number of times that level was presented in the entire CBC experimental survey. This approach can directly measure all main effects and most two-way interaction or higher-way interaction effects, which provides basic and intuitive knowledge for most effects for the survey data. We present an example to help understand how this method works. Suppose the choice set shown in Table 4.4 is the only set from which each respondent is asked to choose their preferred milk option, then we can see that the pasteurized level occurred twice (in product 1 and 2) for each respondent. Multiplying the total interviewed respondents N, we get $2N$, meaning that the pasteurized level occurred $2N$ times in our CBC experiment. Also suppose that there were m and n respondents who chose milk product 1 and 2, respectively, as their preferred milk product; then the main effect of pasteurized level can be expressed by $(m+n)/ 2N$. Similarly, we can count two-way and higher-way interaction effects. Table 4.5 reports only counted main effects and two-way interaction effects.

From Table 4.5, it is obvious that significant main effects can be observed. The rate for choosing pasteurized milk is 40 percent, which is about 15 percent higher than that for UHT milk. Free fat milk is the most popular, with a 54 percent rate, which is about double that for 1.5 percent fat content milk, and triple that of milk with 3.8 percent fat level. There is about 40 percent probability that milk with natural taste would be chosen as the preferred alternative, while 27 percent chose flavored milk in the experiment. Similar to fat content, the price of milk

obviously has a negative effect on the probability of choosing a milk alternative.

The counted two-way interaction effects vary differently across levels of attributes. For example, the probabilities of consumers choosing pasteurized milk were consistently higher than those of UHT, no matter what the fat content level was. Similarly, consumers were more likely to choose low fat content milk no matter what the price of the milk was. But, we also noticed that there was 43 percent of probability that flavored milk was chosen as the most preferred milk at 1.3 yuan/250ml price level, which was about 10 percent higher than that of natural taste milk. However, when the price level increased to 1.6 yuan/250ml and 1.9 yuan/250ml levels, natural taste milk was more likely to be chosen than the flavored one. This suggests a possible interaction between taste and price. Figures 4.1-4.4 provide visible and intuitive interaction effects. For example, there might be no interaction effects between taste and fat content level, and between fat level and processing method (see Figures 4.1 and 4.2). But interaction effects might exist between price and fat level, and between price and taste (see Figures 4.3 and 4.4). We will further test these potential interactions using the second analysis approach.

Approach Two: Multinomial Logit Models (MNL)

In the multinomial logit model, consumers' demographic characteristics will fall out of the probability of choosing an alternative, since they do not vary across milk alternatives (Greene, 2003). One method to modify the model is to create a set of dummy variables for the choices and multiply each of them by the individual specifics (Greene, 2003). As an analog, demographics can also be imposed into the MNL model by multiplying them by the product attributes (e.g. Morrison et al., 2002). The former method is widely applied in common CBC brand specified

studies, while the latter one has been mainly adopted in a purely generic choice model. In a purely generic choice experiment, the alternatives are not brand specified, but are defined by the bundles of a product's attributes, such as in this study.

Thus, the utility U for the individual i from consuming fluid milk j can be empirically expressed as a function of milk attributes, interactions between a pair of attributes, and interactions between attributes and demographics as follows:

$$\begin{aligned} U_{ij} &= \beta_1 process + \beta_2 fat + \beta_3 taste + \beta_4 price \\ &+ \gamma_1 processXfat + \gamma_2 processXtaste... + \gamma_5 tasteXprice \\ &+ \lambda_1 processXgender + ... + \lambda_k fatXincome + ... + \lambda_{k+l} priceXincome + ... + \varepsilon_{ij} \end{aligned} \tag{5}$$

where $\beta, \gamma, and \lambda$ are parameters to be estimated, ε is an error term with extreme value disturbances, and X indicates that variable is an interaction between the variable before it and after it. These interaction items show how other attributes and individual characteristics modify the effect of the multiplied attribute on the probability of choice.

The estimated results from three MNL models are presented in Table 4.6. In interaction terms, *young* is a dummy variable showing that a respondent is less than or equal to 30 years, *senior* is also a dummy showing that a respondent is older than or equal to 50 years, and *income* indicates monthly per capita disposable income. The statistical significance of the models is examined by using likelihood ratio tests of the null hypothesis that all slope estimates are zeros. The LR Chi-square values in models I through III are 1031.74, 1245.12, and 1461.18, respectively. The probability that the LR Chi-square is greater than the corresponding critical value is less than 0.01 in each model, meaning we can reject the null. The estimates for all but

two (*seniorXfat* and *processXfat*) variables are significant at the 1% level.

In model I, the estimated coefficients represent the main effects of four selected attributes of milk. Qingdao urban consumers are more likely to choose pasteurized milk than UHT. As expected, fat content level and price have negative effects on the probability of an alternative being chosen. Also, the probability of choosing natural taste milk is in general greater than that of choosing flavored milk. Obviously, estimated results in model I are consistent with the results from the counting approach.

Estimates for the four attributes in model II and model III do not exactly represent the effects of attributes on the response variable since they are modified by respondents' characteristics and other attributes. In order to capture the main effects, a simple mathematic computation is needed. For example, the effect of fat content on consumers' probability of choice in model II can be expressed as $\hat{\beta}_2 + \hat{\lambda}_3 senior + \hat{\lambda}_4 income$, which equals -0.444 at the means of *senior* and *income*. Similarly, we can recover the main effects of processing method (-0.6082), taste (0.6293), and price (-1.120). Compared to the corresponding main effects from model I estimation, they are nearly the same.

The estimates for the interaction items in model II and model III reflect how individual characteristics and other product attributes modify the effects of the studied attribute on the probability of choice. For example, in model II, as per capita income increases, consumers are more likely to choose lower fat milk and higher price milk. Male consumers are more likely to prefer natural tasting milk to flavored milk than females, but young buyers (less than or equal to 30 years) significantly prefer flavored to natural milk compared to others. Also, senior

consumers are more sensitive to fat content level than other consumers.

However, the estimates for interactions between a pair of attributes (or two-way interactions) in model III are difficult to explain. In fact, what we know from the estimates for the two-way interactions is that most of them have significant effects in the probability of an alternative being chosen. But the signs of these estimates themselves are not very meaningful. To illustrate, having a CD but no CD player for a music fan is bad (say utility is -20) and having a CD player but no CD is also bad (say utility is -30), but having CD and CD player could be altogether to have positive utility. Another example from Chrzan and Orme (2000) is more intuitive. Being naked is a modestly good thing (+3) and speaking at an academic conference is +10, but speaking naked at a conference is a -100. In fact, regarding the two-way interaction effects, the MNL approach may not provide more information than the counting approach does.

Implications

The parameter estimates in the previous section represent the utility of the corresponding attribute. In this section, they are used to calculate consumer's indirect utility from consuming alternative *j* defined by a bundle of attributes and levels and to construct the estimated probability that each alternative will be chosen in the choice set it belongs to. Given a particular market structure (i.e. we know how many milk options are available in the market and their attributes' levels), in fact, we can simply predict the probability of choice any available milk defined by the selected attributes and associated levels. As an illustration, a simulation for milk choice probability is implemented to examine the effects of per capita income. At the end of this section, the trade-offs among the attributes of milk will be presented.

Predictions for Utility and Probability of Choice

The predictions for the utility of consuming milk combination *j* and the probability of choosing it from the choice set it belongs to are calculated based on the predicted forms (i.e. eliminated error term and replace parameters into their estimates) of equation (2) and (4). Table 4.7 presents the predictions for 18-profile that were contained in the CBC experimental design (containing 17 unique milk products, since one of them is duplicated). In model I predictions, the alternative 1 in choice set 5 (with attributes of pasteurized, free fat, natural taste, and 1.3 yuan price) has the highest utility (-0.836) over the 18 profiles, followed by alternative 3 in choice set 3 (with attributes of pasteurized, free fat, natural taste, and 1.6 yuan price), and alternative 1 in choice set 1 (with attributes of pasteurized, free fat, flavored taste, and 1.3 yuan price). Within the choice set they belong to, the probabilities to be chosen for these three top alternatives are 87.6%, 67.4% and 60.9%, respectively (in **Bold** in Table 4.7). These utilities and probabilities of choice do not change in model II- and model III-based predictions.

So far, an apparent finding is that Qingdao consumers preferred pasteurized milk to UHT milk. One may be surprised to see that the milk found in the market is mostly UHT rather than pasteurized milk. It is worthwhile to emphasize that the probability of choice does not mean the market share, since there is no volume involved when we estimate probability of choice. Meanwhile, the larger market share of UHT does not imply that consumers have a greater preference for it, but is rather a result of trading off with other attributes, such as price or some other attribute that was not included in the CBC experiment, for example, shelf-time. Unfortunately, this touches upon one of the CBC approach's disadvantages. That is, only a few

attributes can be included in the design.

The three alternatives with the least utility are in sequentially alternative 2 in choice set 5 (UHT, 3.8% fat level, flavored, and 1.9 yuan price), alternative 1 in choice set 3 (pasteurized, 3.8% fat level, flavored, and 1.9 yuan price), and alternative 3 in choice set 1 (UHT, 3.8% fat level, flavored, and 1.6 yuan price). The corresponding probabilities to be chosen are 2.6%, 5.1%, and 8.8%, respectively in model I-based predictions (in *Italic* in Table 4.7). Again, they are same in model II- and model III-based predicted results.

The predicted utilities for the nineteen milk profiles that were not included in the CBC design are presented in Table 4.8. The presented alternatives in the table are sorted by their predicted utilities based on model I. Obviously, there is no difference in utility order between model I-based and model II-based results. The model III-based predications in general provide consistent results as the model I- and model II-based results, but slightly change some alternatives' ranking within 19-profile. Again, in Table 4.8, the numbers in **Bold** indicate the top three alternatives in utility and the numbers in *Italic* show the bottom three ones.

Simulation for Income Effects

The above discussion about probability of choosing an alternative from the choice set that it belongs to is based on assumption of that the per capita income is at its mean level (1,078 yuan a month, or 135 US$ a month in this study). However, we can simulate income effects on the probability of choice of any alternative in the choice set it belongs to. These simulations are only applied in the model II and model III, since there is no income involved in model I.

Figures 4.5- 4.10 show the simulated results for each designed choice set. For ease of

comparison, the figures based on model II are on the left side and the figures based on model III are on the right side. There is almost no difference between model II and model III results except choice set 4 where the probability of alternative 2 to be chosen in model II is less than that of alternative 3 no matter the income levels, but it is opposite in model III until the per capita monthly income is greater than 1,900 yuan or about 230 US$.

In addition, one may already see that within five choice sets (except set 5), one of three alternatives will sooner or later achieve near 100% of probability of choice, while another two will gradually lose their consumers' interests. Taking choice set 1 as an example, the probability of alternative 2 (pasteurized, 1.5% fat, natural taste, and 1.9 yuan price) to be chosen will gradually near to 100% as income increases, although it is obviously lower than that of alternative 1 (pasteurized, free fat, flavored, and 1.3 yuan price) at the mean of current incomes.

Notice that the above discussion on the simulations of income effects on probability of choice do not consider price changes. However, it is just different in magnitude only if price inflation is less than the growth rate of income. Similar logistics can be used for choice set 2 through 6.

Two points are worthwhile to emphasize. First, these simulations of income effects actually can be done for any set combined by any milk alternatives. Second, to better understand Figures 4.5-4.10, it is necessary to refer to Table 4.3.

Trade-offs within Attributes

Including a value variable into the CBC design has a particular advantage. That is, it can be used to measure the trade-offs for other attributes. Taking model II as an example, the

prediction form of the utility function in equation (5) can be written as

$$\hat{U}_{ij} = \hat{\beta}_1 process + \hat{\beta}_2 fat + \hat{\beta}_3 taste + \hat{\beta}_4 price + \hat{\lambda}_1 genderXtaste + \hat{\lambda}_2 youngXtaste + \hat{\lambda}_3 seniorXfat + \hat{\lambda}_4 incomeXfat + \hat{\lambda}_5 incomeXprice$$

Assuming that *gender*, *young*, *senior*, and *income* are at their means, we then take total differential to get,

$$d\hat{U}_{ij} = \hat{\beta}_1 dprocess + \hat{\beta}_2 dfat + \hat{\beta}_3 dtaste + \hat{\beta}_4 dprice + \hat{\lambda}_1 \overline{gender} * dtaste + \hat{\lambda}_2 \overline{young} * dtaste + \hat{\lambda}_3 \overline{senior} * dfat + \hat{\lambda}_4 \overline{income} * dfat + \hat{\lambda}_5 \overline{income} * dprice$$

Then, one attribute' trade-off can be calculated by assuming the utility and other attributes except price no change. For example, the trade-off of changing attribute processing method from pasteurization to UHT can be expressed as

$$dprice = -[\hat{\beta}_1 / (\hat{\beta}_4 + \hat{\lambda}_5 \overline{income})] * dprocess = -0.543$$

This means that the price of the alternative has to reduce 0.542 yuan per unit (250ml) to keep the utility unchanged if the processing method of this alternative switches from pasteurization to UHT. Table 4.9 presents all trade-offs based on model II. The same procedure can be used to obtain the trade-offs based on model III. The computation, however, becomes much more complicated, since there are two-way interaction effects involved. In this paper, we ignore the computations for the trade-offs within attributes in model III. Instead, we believe that there are no significant differences from those in model II, since the predicted utilities are so between model II- and model III-based estimations (recall the first part of this section).

Two points are worth mentioning. The first point is that the estimated trade-offs are identical with the marginal Willingness-To-Pay (WTP)[5]. The positive sign means that consumers are willing to pay a premium for gaining utility, while the negative means that consumers want a discount for compensating lost utility. The second point is that the trade-offs are functions of respondents' demographic characteristics, such as income. Thus, technically we also can simulate income effects on the trade-offs. However, we can intuitively know that the trade-offs will go up as income increases, since income increases weaken the price effects on probability of choice.

Conclusion

Fluid milk has been increasingly consumed in China's urban areas, which are commonly believed to be able to create potential and huge marketing and trade opportunities. In most literature, milk consumption in China has been widely studied on aggregate level, focusing on its growing trends and whether China's domestic milk production can meet the rapidly increasing demand. In consumers' preference studies, most attention has been paid to identifying consumer-related influences and market-related determinants, such as advertising promotion (Fuller et al., 2004). A common point of these studies is that they have ignored milk products' specific characteristics. In this study, a choice-based conjoint technique is applied to estimate

[5] For fat content, the marginal WTP is equal to the trade-off from adding fat content 1 percent. The WTP for fat content is -0.397 in RMB or about 5 cents in US currency. For continuous variables such as fat content, we may actually calculate price elasticity instead of the marginal WTP. In this case, the estimated price elasticity with respect to fat content is -0.438.

consumers' preferences for fluid milk in Qingdao, China. The suitability of conjoint techniques arises from their capacity to allow for different changes in milk-specific levels as well as differences in individual socioeconomic characteristics when consumers' preferences are estimated.

Production processing method, fat content level, and taste were used to define milk profiles in the CBC experimental design. To quantify the measurements of trade-offs, a value variable, price of alternative, was included in the design as well. Two approaches, counting on aggregated data and estimating multinomial logit model on individual data, were applied to analyze main effects, interaction effects between attributes and demographics, and interaction effects between a pair of attributes on consumers' preferences for designed milks and on probabilities of alternatives to be chosen.

The estimates from the MNL regressions show that all of four selected attributes have significant main effects on Qingdao urban consumers' preferences for fluid milks. So do most of their pair interactions, and the interactions with demographics. Since the detailed results were addressed in the last section, I would only highlight that Qingdao consumers are willing to pay a premium for pasteurized milk, low fat milk, and natural tasting milk. However, their probabilities to choose designed milks change as their income increases. Typically, they are willing to pay more to obtain their preferred milks.

Compared to contingent valuation methods (CVM), CBC design is more informative. However, in terms of biases of estimates of WTP and predictions, the literature could not provide consistent answers. More evidence, both theoretical and empirical, is still needed. In

conclusion, it should be pointed out that the disadvantage of the CBC technique is the limitation on the numbers of attributes to be contained in the design, and there exists a trade-off between selected number of attributes and the efficiency of estimation.

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Table 4.1. Sample Statistics and Representative Tests

	Sample Mean	Std. Dev.	Population Mean	P-value[a]
Sample Distribution				
Shinan District	0.239	0.427		
Shibei District	0.236	0.425		
Sifang District	0.242	0.429		
Licang District	0.283	0.451		
Respondent's Individual Characteristics				
Age (year)	38.05	13.64		
Under 30	0.377	0.485		
31-50	0.401	0.490		
Older than 50	0.222	0.416		
Female of Total	0.663	0.473	0.495 b	Pr>t=0.0000
Unemployed	0.061	0.239	0.030 c	Pr>t=0.0001
Education Level (binary; yes=1)				
Primary school or illiteracy	0.039	0.195		
Middle school	0.230	0.421		
High school or equivalent	0.370	0.483		
2-year college or equivalent	0.228	0.420		
4-year college	0.126	0.333		
Advanced or professional degree	0.006	0.077		
Main Food Shopper in Household	0.754	0.431		
Household Characteristics				
Monthly Per Capita Disposable Income (1000 Yuan)	1.078	0.566	1.077 c	Pr>|t|=0.9483
Less than 2000	0.210	0.408		
2001-4000	0.498	0.500		
More than 4001	0.292	0.455		
Household Size (person)	3.248	1.092	3.191 b	Pr>|t|=0.1298
Total Observations	838			

a. Null Hypothesis, Ho: sample mean=population level.
b. 2003 data as population level since 2005 data are unavailable. The household size is from 2004 Qingdao Statistical Yearbook; The share of female is calculated based on the data from 2004 Shandong Statistical Yearbook. We believe there are no significant differences for these data between 2003 and 2005.
c. Data are from Qingdao 2005 Economic and Social Development Annual Report released by Qingdao Bureau of Statistics.

Table 4.2. Selected Attributes and Levels Used in CBC Experiment

Attributes and Units	Levels
Processing Technology	Ultra-High Temperature (UHT), and Pasteurized
Fat Content (%)	Free fat, 1.5%, and 3.8%
Taste	Natural, and Flavored (like chocolate or fruit)
Prices (RMB yuan/250ml)	1.3, 1.6, and 1.9

Table 4.3. 18-Profile with Six Block (Choice Sets) in CBC Design

Choice Set	Alternative	Attribute			
		Process	Fat (%)	Taste	Price (yuan/250ml)
1	1	Pasteurized	0	Flavored	1.3
	2	Pasteurized	1.5	Natural	1.9
	3	UHT	3.8	Natural	1.6
2	1	Pasteurized	1.5	Natural	1.9
	2	UHT	3.8	Natural	1.3
	3	UHT	0	Flavored	1.6
3	1	Pasteurized	3.8	Flavored	1.9
	2	UHT	1.5	Natural	1.3
	3	Pasteurized	0	Natural	1.6
4	1	UHT	0	Natural	1.9
	2	Pasteurized	3.8	Flavored	1.3
	3	Pasteurized	1.5	Flavored	1.6
5	1	Pasteurized	0	Natural	1.3
	2	UHT	3.8	Flavored	1.9
	3	UHT	1.5	Flavored	1.6
6	1	UHT	0	Flavored	1.9
	2	UHT	1.5	Flavored	1.3
	3	Pasteurized	3.8	Natural	1.6

Table 4.4. An Example of Selected Choice Set in CBC Experiment

Q: If you are planning to buy milk today, and the following alternatives are available, please fill "√" in your most preferred product from each choice set.

Product Attributes	**Product 1 _____**	**Product 2 _____**	**Product 3 _____**
Processing Technology	Pasteurized	Pasteurized	UHT
Fat content	Free Fat	1.5%	3.8%
Taste	Flavored	Natural	Natural
Price (yuan/250ml)	1.3 yuan	1.9 yuan	1.6 yuan

Table 4.5. Counted Main and Two-way Interaction Effects

Attributes		Process		Fat			Taste		Price		
	Levels	UHT	Past.	0%	1.50%	3.80%	Natl	Flvd	1.3	1.6	1.9
Process	UHT	26.0	---								
	Past.	---	40.6								
Fat	0%	38.9	68.8	54.1	---	---					
	1.50%	27.9	27.8	---	27.8	---					
	3.80%	11.5	24.6	---	---	18.0					
Taste	Natural	25.7	50.9	66.4	28.5	24.3	39.7	---			
	Flavored	26.2	27.7	41.8	27.2	11.8	---	26.9			
Price	1.3	23.3	52.7	63.4	25.5	24.5	33.6	42.5	38.0	---	---
	1.6	27.6	46.0	58.9	23.9	27.0	44.8	28.5	---	36.7	---
	1.9	27.2	23.5	39.6	34.0	2.9	40.8	9.9	---	---	25.3

Table 4.6. Estimated Results from Multinomial Logit Models

	Model I		Model II		Model III	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Attributes:						
Processes (1=UHT)	-0.5923***	0.0507	-0.6082***	0.0515	-4.2936***	0.4455
Fat Content	-0.4280***	0.0178	-0.2267***	0.0408	0.6261***	0.1722
Taste (1=Natural)	0.6179***	0.0534	0.7863***	0.0773	-3.3896***	0.4217
Price	-1.1186***	0.1058	-2.7428***	0.2340	-5.7268***	0.4038
Interactions with demographics:						
GenderXtaste			0.3565***	0.1116	0.3569***	0.1126
YoungXtaste			-0.7343***	0.1083	-0.7769***	0.1100
SeniorXfat			-0.0985**	0.0423	-0.1030**	0.0419
IncomeXfat			-0.1791***	0.0343	-0.1552***	0.0342
IncomeXprice			1.5057***	0.1953	1.5170***	0.2000
Interactions with other attributes:						
ProcessXfat					0.0160	0.0507
ProcessXtaste					-1.5046***	0.1460
ProcessXprice					2.9527***	0.2984
FatXtaste					0.1414***	0.0417
FatXprice					-0.5365***	0.1170
TasteXprice					3.1246***	0.2753
Statistics:						
Observations	7542		7542		7542	
Log Likelihood	-3197.15		-3117.06		-2988.33	
LR chi2	1031.74		1191.93		1449.4	
Prob > chi2	0.0000		0.0000		0.0000	
McFadden Adj R2	0.1389		0.1605		0.1952	

*, **, and *** denotes statistically significant at the 10%, 5%, and l% levels, respectively.

Table 4.7. Predicted Utilities and Probabilities of Choice for 18-profile[a] with Six-block in the CBC Design

		Attributes[b]				Based On Model I			Based On Model II[c]			Based On Model III[c]		
Set	Alt	Process	Fat	Taste	Price	Uj	Exp(Uj)	Pr(cj|Set)	Uj	exp(Uj)	Pr(cj|Set)	Uj	exp(Uj)	Pr(cj|Set)
1	1	0	0	0	1.3	**-1.454**	**0.234**	**60.9%**	**-1.456**	**0.233**	**61.4%**	**-5.319**	**0.005**	**61.5%**
	2	0	1.5	1	1.9	-2.150	0.117	30.4%	-2.164	0.115	30.3%	-6.067	0.002	29.1%
	3	1	3.8	1	1.6	*-3.391*	*0.034*	*8.8%*	*-3.458*	*0.031*	*8.3%*	*-7.201*	*0.001*	*9.4%*
2	1	0	1.5	1	1.9	-2.150	0.117	45.5%	-2.164	0.115	46.0%	-6.067	0.002	43.9%
	2	1	3.8	1	1.3	-3.055	0.047	18.4%	-3.122	0.044	17.7%	-7.185	0.001	14.3%
	3	1	0	0	1.6	-2.382	0.092	36.1%	-2.400	0.091	36.3%	-6.116	0.002	41.8%
3	1	0	3.8	0	1.9	*-3.752*	*0.023*	*5.1%*	*-3.815*	*0.022*	*4.8%*	*-10.001*	*0.000*	*0.6%*
	2	1	1.5	1	1.3	-2.071	0.126	27.5%	-2.101	0.122	26.8%	-6.939	0.001	13.7%
	3	0	0	1	1.6	**-1.172**	**0.310**	**67.4%**	**-1.162**	**0.313**	**68.4%**	**-5.110**	**0.006**	**85.6%**
4	1	1	0	1	1.9	-2.100	0.122	47.8%	-2.106	0.122	48.6%	-5.588	0.004	59.5%
	2	0	3.8	0	1.3	-3.081	0.046	17.9%	-3.143	0.043	17.2%	-6.323	0.002	28.5%
	3	0	1.5	0	1.6	-2.432	0.088	34.3%	-2.458	0.086	34.2%	-7.184	0.001	12.0%
5	1	0	0	1	1.3	**-0.836**	**0.433**	**87.6%**	**-0.826**	**0.438**	**88.2%**	**-4.819**	**0.008**	**85.4%**
	2	1	3.8	0	1.9	*-4.344*	*0.013*	*2.6%*	*-4.423*	*0.012*	*2.4%*	*-8.624*	*0.000*	*1.9%*
	3	1	1.5	0	1.6	-3.024	0.049	9.8%	-3.066	0.047	9.4%	-6.729	0.001	12.7%
6	1	1	0	0	1.9	-2.718	0.066	33.9%	-2.736	0.065	34.5%	-6.457	0.002	27.2%
	2	1	1.5	0	1.3	-2.689	0.068	34.9%	-2.730	0.065	34.7%	-6.146	0.002	37.1%
	3	0	3.8	1	1.6	-2.798	0.061	31.2%	-2.850	0.058	30.8%	-6.187	0.002	35.6%

[a] : The 18-profile actually includes 17 unique products since there is duplicate profile in this design.
[b] : Coding and units: process (1=UHT; 0=Pasteurized); unit of fat: percent; taste (1=Natural; 0=Flavored); unit of price: RMB yuan/250ml.
[c] : Predicted values are calculated at means of the demographics.

Table 4.8. Predicted Utilities and Probabilities of Choice for 19 profiles[a] Out of the CBC Design

	Attributes[b]				Based On Model I			Based On Model II[c]			Based On Model III[c]		
Profile	Process	Fat	Taste	price	Uj	Exp(Uj)	Pr(cj|Set)	Uj	exp(Uj)	Pr(cj|Set)	Uj	exp(Uj)	Pr(cj|Set)
1	1	0	1	1.3	**-1.429**	**0.240**	---	**-1.435**	**0.238**	---	-6.779	0.001	---
2	0	1.5	1	1.3	**-1.478**	**0.228**	---	**-1.492**	**0.225**	---	**-5.003**	**0.007**	---
3	0	0	1	1.9	**-1.508**	**0.221**	---	**-1.498**	**0.224**	---	**-5.400**	**0.005**	---
4	1	0	1	1.6	-1.764	0.171	---	-1.770	0.170	---	-6.183	0.002	---
5	0	0	0	1.6	-1.790	0.167	---	-1.792	0.167	---	-6.547	0.001	---
6	0	1.5	1	1.6	-1.814	0.163	---	-1.828	0.161	---	-5.535	0.004	---
7	1	0	0	1.3	-2.047	0.129	---	-2.064	0.127	---	-5.774	0.003	---
8	0	1.5	0	1.3	-2.096	0.123	---	-2.122	0.120	---	-5.715	0.003	---
9	0	0	0	1.9	-2.125	0.119	---	-2.128	0.119	---	*-7.774*	*0.000*	---
10	1	1.5	1	1.6	-2.406	0.090	---	-2.437	0.087	---	-6.585	0.001	---
11	0	3.8	1	1.3	-2.463	0.085	---	-2.514	0.081	---	**-5.286**	**0.005**	---
12	1	1.5	1	1.9	-2.742	0.064	---	-2.772	0.063	---	-6.231	0.002	---
13	0	1.5	0	1.9	-2.767	0.063	---	-2.794	0.061	---	*-8.653*	*0.000*	---
14	0	3.8	1	1.9	-3.134	0.044	---	-3.186	0.041	---	-7.089	0.001	---
15	1	1.5	0	1.9	-3.360	0.035	---	-3.402	0.033	---	-7.313	0.001	---
16	0	3.8	0	1.6	-3.416	0.033	---	-3.479	0.031	---	*-8.162*	*0.000*	---
17	1	3.8	0	1.3	*-3.673*	*0.025*	---	*-3.751*	*0.023*	---	-6.717	0.001	---
18	1	3.8	1	1.9	*-3.726*	*0.024*	---	*-3.794*	*0.023*	---	-7.217	0.001	---
19	1	3.8	0	1.6	*-4.009*	*0.018*	---	*-4.087*	*0.017*	---	-7.670	0.000	---

[a] : There were actually 19 profiles out of this design since one of experimentally designed profile was duplicated in the design.
[b] : Coding and units: process (1=UHT; 0=Pasteurized); unit of fat: percent; taste (1=Natural; 0=Flavored); unit of price: RMB yuan/250ml.
[c] : Predicted values are calculated at means of the demographics.

Table 4.9. Estimated Trade-offs in CBC Design (based on model II)

Attributes	Trade-off Directions	Trade-offs	
		in RMB	in US$[a]
Process	Pasteurization→UHT	-0.543	-0.068
Fat content	0%→1.5%	-0.595	-0.074
	1.5%→3.8%	-0.912	-0.114
	0%→3.8%	-1.507	-0.188
Taste	Flavored→Natural	0.562	0.070

[a] : exchange rate used is 1 US$=8RMB.

Figure 4.1. Interaction Effects Between Tastes and Fat Levels

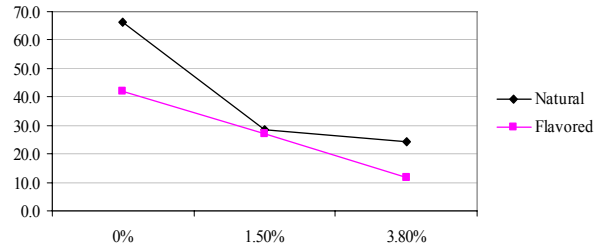


Figure 4.2. Interaction Effects Between Fat Levels and Processes

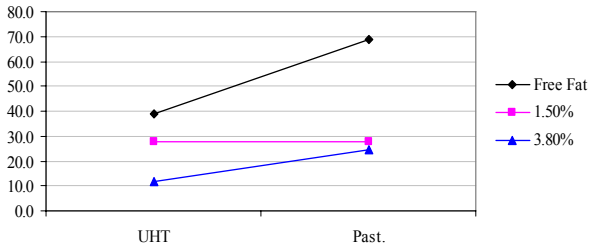


Figure 4.3. Interaction Effects Between Prices and Fat Levels

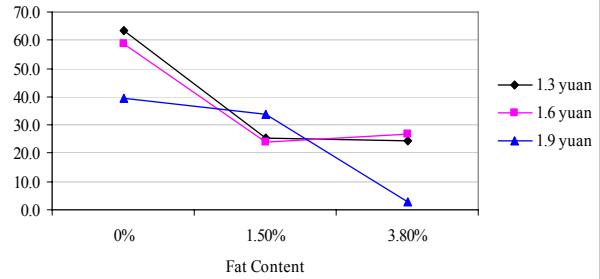
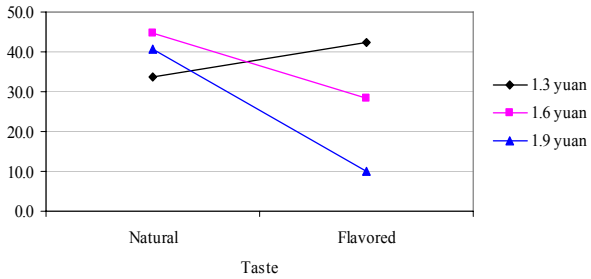


Figure 4.4. Interaction Effects Between Prices and Tastes



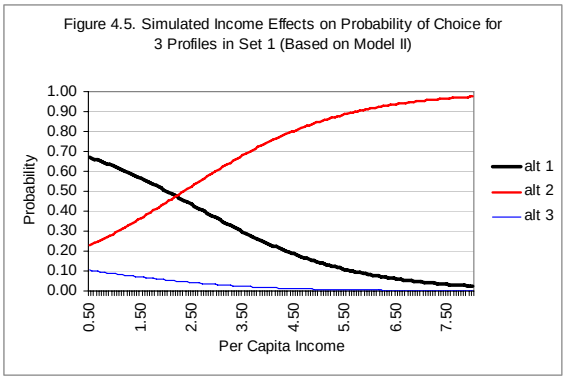


Figure 4.5. Simulated Income Effects on Probability of Choice for 3 Profiles in Set 1 (Based on Model II)
Probability
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.50
1.50
2.50
3.50
4.50
5.50
6.50
7.50
Per Capita Income
alt 1
alt 2
alt 3

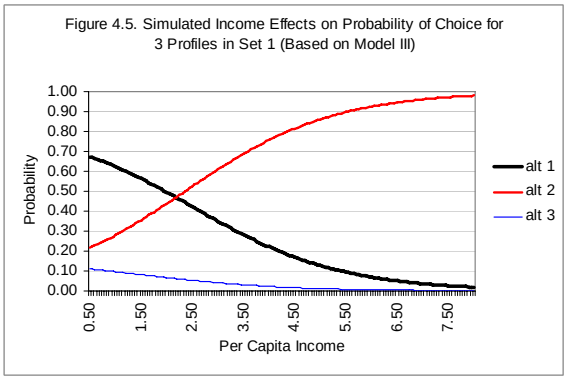


Figure 4.5. Simulated Income Effects on Probability of Choice for 3 Profiles in Set 1 (Based on Model III)
Probability
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.50
1.50
2.50
3.50
4.50
5.50
6.50
7.50
Per Capita Income
alt 1
alt 2
alt 3

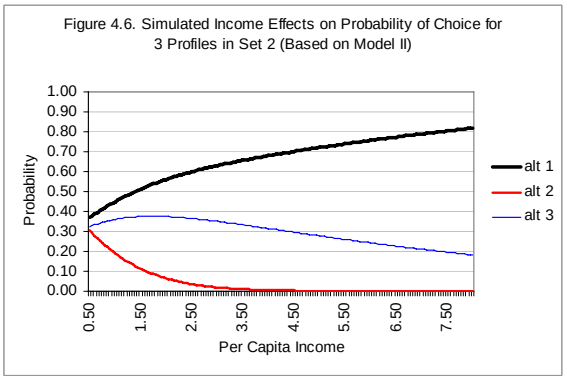


Figure 4.6. Simulated Income Effects on Probability of Choice for 3 Profiles in Set 2 (Based on Model II)
Probability
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.50
1.50
2.50
3.50
4.50
5.50
6.50
7.50
Per Capita Income
alt 1
alt 2
alt 3

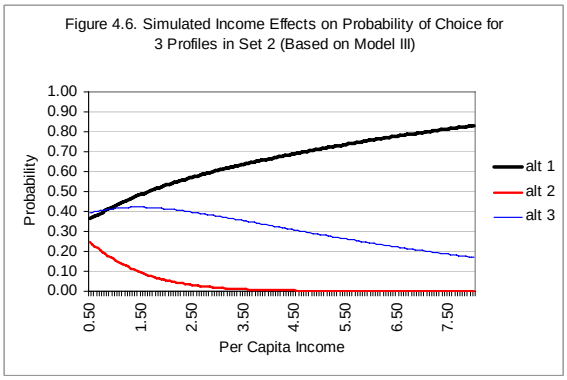


Figure 4.6. Simulated Income Effects on Probability of Choice for 3 Profiles in Set 2 (Based on Model III)
Probability
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.50
1.50
2.50
3.50
4.50
5.50
6.50
7.50
Per Capita Income
alt 1
alt 2
alt 3

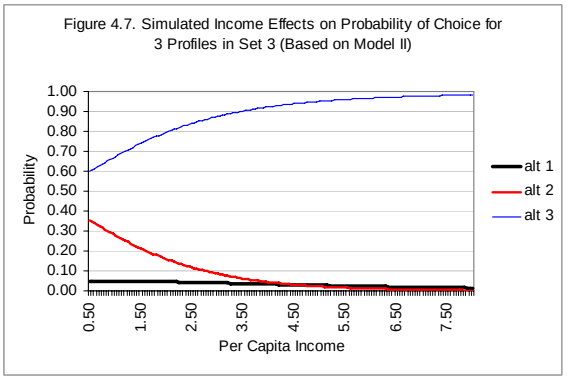


Figure 4.7. Simulated Income Effects on Probability of Choice for 3 Profiles in Set 3 (Based on Model II)
Probability
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.50
1.50
2.50
3.50
4.50
5.50
6.50
7.50
Per Capita Income
alt 1
alt 2
alt 3

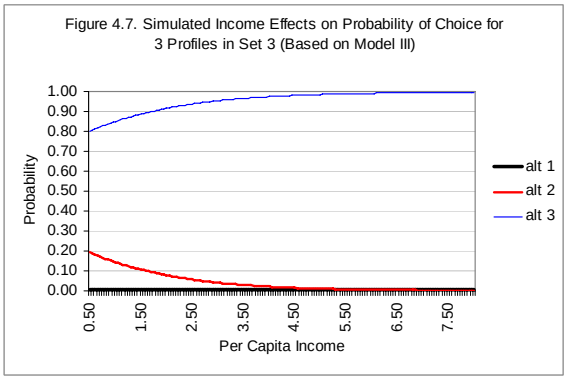


Figure 4.7. Simulated Income Effects on Probability of Choice for 3 Profiles in Set 3 (Based on Model III)
Probability
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.50
1.50
2.50
3.50
4.50
5.50
6.50
7.50
Per Capita Income
alt 1
alt 2
alt 3

Figure 4.8. Simulated Income Effects on Probability of Choice for 3 Profiles in Set 4 (Based on Model II)

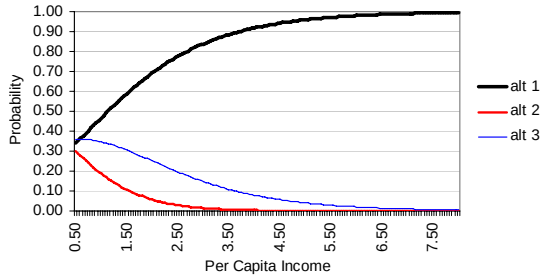


Figure 4.8. Simulated Income Effects on Probability of Choice for 3 Profiles in Set 4 (Based on Model III)

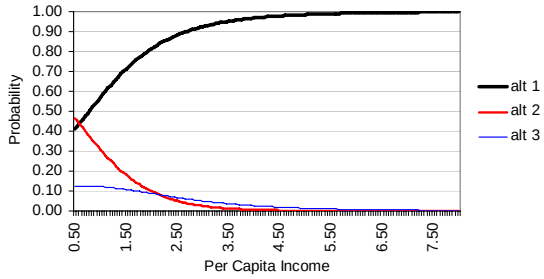


Figure 4.9. Simulated Income Effects on Probability of Choice for 3 Profiles in Set 5 (Based on Model II)

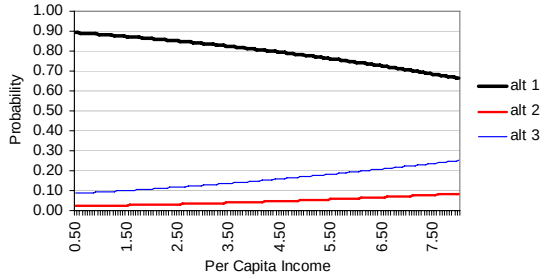


Figure 4.9. Simulated Income Effects on Probability of Choice for 3 Profiles in Set 5 (Based on Model III)

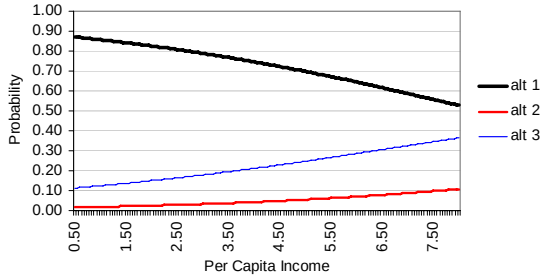


Figure 4.10. Simulated Income Effects on Probability of Choice for 3 Profiles in Set 6 (Based on Model II)

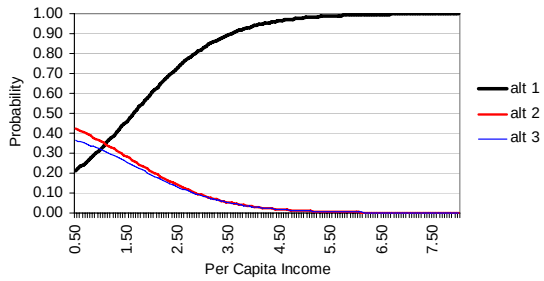
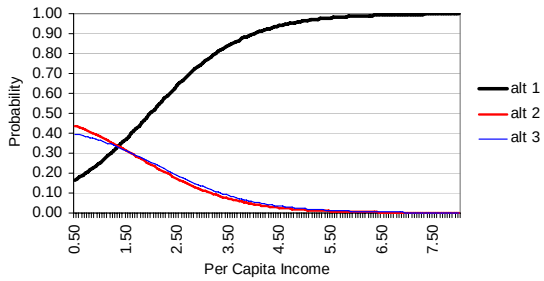


Figure 4.10. Simulated Income Effects on Probability of Choice for 3 Profiles in Set 6 (Based on Model III)



APPENDIX

A. QUESTIONNAIRE

(English Version)

Male / Female	City: Qingdao, China	Site: 1 2 3 4
Interviewer's Name:		Date: ____/___/2005

Instructions: *Please ask shopper the following questions. This is a face-to-face questionnaire. This questionnaire will be given to a random number of consumers entering the store. For example, an interviewer will approach every third customer who visits their section.*

Interviewer: *"Hi, my name is […] and I am working with a research team at Washington State University, School of Economic Science to evaluate consumers' food shopping choices. This research has been reviewed and approved by the Institutional Review Board at Washington State University. Would it be OK if I ask for your participation in a survey that we are conducting today? I will ask you some questions regarding your food shopping choices, and some questions related to yourself. It will take only about ten minutes, and in return for participating in the survey I will give you XXX. If you have any questions or concerns about this research project, you can contact the WSU IRB at (509)335-9661. Would you like to take part in this survey?"*

Section 1: *Consumers' choice of grocery shopping*

Q.1 Are you the person who buys most of the groceries for your household? (INTERVIEWER: IF THEY ASK WHAT HOUSEHOLD MEANS: YOUR HOUSEHOLD INCLUDES YOURSELF, YOUR DEPENDENTS, AND PERSONS WITH WHOM YOU SHARE INCOME AND LIVING EXPENSES)

1. Yes
2. No

Q.2 How often do you shop for food? (CIRCLE JUST ONE)

1. Daily
2. Between 2-5 times per week
3. Once a week
4. Once ever two weeks
5. Once a month

Q.3 Do you prefer domestic to imported food products?

1. Yes
2. No

Q.4 Do you prefer domestic to foreign grocery stores (for example: Wal-Mart and Carrefour) to purchase food products?

1. Yes
2. No

Q.5 What is the most important factor in your choice of where to shop for food?

1. Price
2. Variety
3. Quality
4. Location
5. What I want to cook or occasion

Q.6 How often do you shop at the following places for food?

	(1)	(2)	(3)	(4)
	Outdoor market/"farmer market"	Small, independent store	Supermarket	Major chain grocery store
Never				
Once a month				
Once half month				
Weekly				
2-3 times/week				
Daily				

Q.7 What transportation do you most often use to go food shopping?

1. Car
2. Bus
3. Bicycle
4. Walk
5. Supermarket free shuttle
6. Others. Please fill in_____

Q.8 Approximately, how many meters from your house to the shopping place where you often purchase food for your household? _____meters.

Q9 How often you frequent quick service restaurants?

1. Never
2. Seldom
3. Once a month
4. Weekly

5. 2-3 times/week
6. Daily

Section 2: ***Milk products consumption***

Q.10 Has the consumption of fluid milk products in your family increased, stayed the same, or decreased over the past years? Why?

1. Increased
2. Stayed the same
3. Decreased

Reasons: _____

Q.11 If you are planning to buy milk today, and the following alternatives are available, please fill "√" in your most preferred product from each choice set. [Version I]

Product Attributes	**Product 1 _____**	**Product 2 _____**	**Product 3 _____**
Processing Method	Pasteurized	Pasteurized	UHT
Fat content	Free Fat	1.5%	3.8%
Taste	Flavored	Natural	Natural
Price (yuan/250ml)	1.3 yuan	1.9 yuan	1.6 yuan

Product Attributes	**Product 1 _____**	**Product 2 _____**	**Product 3 _____**
Processing Method	Pasteurized	UHT	UHT
Fat content	1.5%	3.8%	Free Fat
Taste	Natural	Natural	Flavored
Price (yuan/250ml)	1.9 yuan	1.3 yuan	1.6 yuan

Product Attributes	**Product 1 _____**	**Product 2 _____**	**Product 3 _____**
Processing Method	Pasteurized	UHT	Pasteurized
Fat content	3.8%	1.5%	Free Fat
Taste	Flavored	Natural	Natural
Price (yuan/250ml)	1.9 yuan	1.3 yuan	1.6 yuan

Q.12 Have you ordered milk that was periodically delivered to your door?

1. Yes. Where did you order it from:_____
2. No

Q.13 Do you prefer soybean milk to cow milk?

1. Yes
2. No

Q.14 Where did you most often purchase liquid milk products in this year
1. Supermarket
2. Outdoor market/ “Farmer’s market”
3. Small, independent store
4. Order/Deliver to door
5. Others, please fill in _____

Q.15 What is the most important factor in your choice of where to shop for milk?
1. Price
2. Variety
3. Quality
4. Location
5. Others, please fill in_____

Q.16 What kinds of milk products have you consumed in this year? Please also rate them by average expenditure in following table.

Milk products	Consumed (fill in “√”)	Consumption Amount per day (ml)	Expenditure rate	How did it change? 1. Increased 2. same 3. Decreased
Liquid milk				
Milk powder				
Yoghourt				
Ice cream				
Cheese				

Q.17 Why didn’t you consume milk at all?
1. Expensive
2. Don’t like its taste
3. Not available
4. Allergic at milk
5. Other, please fill in _____

Q.18 What is the price of milk that you often purchased _____?

Q.19 Have you ever bought any false milk or the milk that was out of date?
1. Yes

2. No

Q.20 Have you heard about any milk poisoning event?
1. Yes
2. No

Q.21 Do you prefer imported to domestic milk powder?
1. Yes
2. No

Section 3: *Demographic information*
[Interviewer: "Now, I would like to finish this survey by asking you a few questions about yourself. If there are any specific questions you don't want to answer, please let me know."

Q.22 Do any children under 18 live in your household?
1. Yes
2. No

Q.23 Does any person older or equal to 60 live in your household?
1. Yes
2. No

Q.24 For how many people do you usually shop for groceries, including yourself? _____

Q.25 Does your household own a refrigerator?
1. Yes
2. No

Q.26 How much income did your household receive in per MONTH on average in 2005? I am going to read for you some income levels; please stop me when I reach the level that best describes your household income.
1. less than 1,000 yuan
2. 1,001-2,000yuan
3. 2,001-3,000yuan
4. 3,001-4,000yuan
5. 4,001-5,000yuan
6. 5,001-10,000yuan
7. greater than 10,000yuan

Q.27 What is the highest level of education that you (and your spouse) have completed?

Yourself	Your spouse
1. Compulsory education	1. Compulsory education
2. High school	2. High school
3. 2-year college	3. 2-year college
4. College	4. College
5. Advanced or professional degree	5. Advanced or professional degree
6. Refused	6. Refused

Q. 28 Which one of the following categories best represents your employment status:

1. Full time employed
2. Part time employed
3. Unemployed
4. Homemaker
5. Retired
6. Refused

Q. 29 May I ask you in what year were you born?

1. _____
2. Refused

Thank you very much for your participation.

APPENDIX

B. COMPARISONS OF TWO EXPERIMENTAL DESIGNS

Table B.1. 36-run full factorial design

Run	process	fat	taste	price
1	1	1	1	1
2	1	1	1	2
3	1	1	1	3
4	1	1	2	1
5	1	1	2	2
6	1	1	2	3
7	1	2	1	1
8	1	2	1	2
9	1	2	1	3
10	1	2	2	1
11	1	2	2	2
12	1	2	2	3
13	1	3	1	1
14	1	3	1	2
15	1	3	1	3
16	1	3	2	1
17	1	3	2	2
18	1	3	2	3
19	2	1	1	1
20	2	1	1	2
21	2	1	1	3
22	2	1	2	1
23	2	1	2	2
24	2	1	2	3
25	2	2	1	1
26	2	2	1	2
27	2	2	1	3
28	2	2	2	1
29	2	2	2	2
30	2	2	2	3
31	2	3	1	1
32	2	3	1	2
33	2	3	1	3
34	2	3	2	1
35	2	3	2	2
36	2	3	2	3

Table B.2. 18-run fractional factorial design

Run	process	fat	taste	price
1	1	1	1	1
2	1	1	1	2
3	1	1	2	3
4	1	2	1	1
5	1	2	2	1
6	1	2	2	2
7	1	3	1	3
8	1	3	1	3
9	1	3	2	2
10	2	1	1	2
11	2	1	2	1
12	2	1	2	3
13	2	2	1	2
14	2	2	1	3
15	2	2	2	3
16	2	3	1	1
17	2	3	2	1
18	2	3	2	2

Table B.3. Canonical Correlations between the Factors

	Process	Fat	Taste	Price
36-Run Full Factorial Design				
Process	1	0	0	0
Fat	0	1	0	0
Taste	0	0	1	0
Price	0	0	0	1
18-Run Fractional Factorial Design				
Process	1	0	0.11	0
Fat	0	1	0	0
Taste	0.11	0	1	0
Price	0	0	0	1

Table B.4. Summary of Frequencies in Both Designs

Main/Interaction		36-Run Full Factorial Design										18-Run Fractional Factorial Design									
Process		18	18									9	9								
Fat		12	12	12								6	6	6							
Taste		18	18									9	9								
Price		12	12	12								6	6	6							
Process	Fat	6	6	6	6	6	6					3	3	3	3	3	3				
Process	Taste	9	9	9	9						*	5	4	4	5						
Process	Price	6	6	6	6	6	6					3	3	3	3	3	3				
Fat	Taste	6	6	6	6	6	6					3	3	3	3	3	3				
Fat	Price	4	4	4	4	4	4	4	4	4		2	2	2	2	2	2	2	2	2	
Taste	Price	6	6	6	6	6	6					3	3	3	3	3	3				
N-Way		1	1	1	1	1	1	1	1	1	*	1	1	1	1	1	1	2	1	1	
		1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1		
		1	1	1	1	1	1	1	1	1											
		1	1	1	1	1	1	1	1	1											

* Indicates Unequal Frequencies

Table B.5. Comparison of Efficiencies between 36-run and 18-run Factorial Designs

	D-Efficiency	A-Efficiency	G-Efficiency	Average Prediction Standard Error
36-Run	100.00	100.00	100.00	0.4410
18-Run	99.82	99.64	98.26	0.6236