REGIONAL DIFFERENCES IN BEVERAGE AND FRUIT CONSUMPTION IN CHINA

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ABSTRACT

The purpose of this thesis was to examine the impact of regional and other demographic characteristics, such as age, education level, and household income, on food consumption in China. In total, data for 2342 households from 11 different Chinese cities were analyzed. Two separate studies on fruits and beverages were conducted, each with four 'home food' groups and four 'away from home food' groups. A two-step quadratic ideal demand system model was used to analyze the regional differences and the effects of the other demographic characteristics on food consumption in China. Regional differences in beverage and fruit consumption were identified in this study, due to the usage of the four away-from-home and four at-home food consumption groups. The relationship between food at-home and food away-from-home for the same food items were also evaluated.

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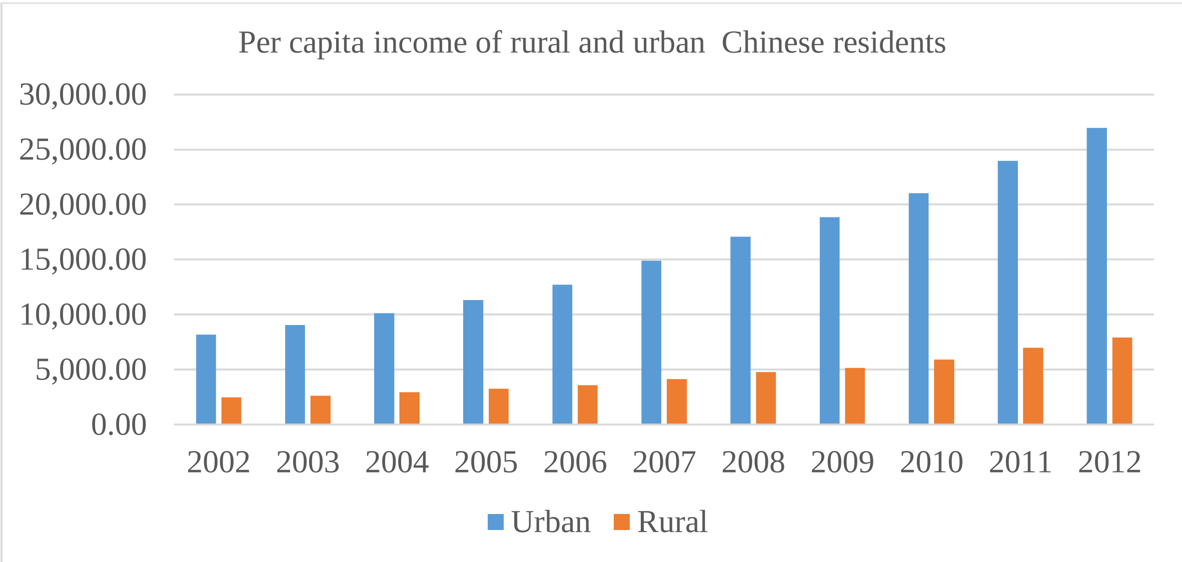
CHAPTER 1. BACKGROUND AND INTRODUCTION

Economics

China's economy has experienced rapid development in recent decades. According to the National Bureau of Statistics (NBS), China's gross domestic product (GDP) in 2012 was around 51,681 billion RMB. This was a dramatic increase from the 11,910 billion RMB GDP in 2002. Per capita income for urban citizens in 2002 was 8,177.40 RMB; this value increased to 26,959 RMB in 2012. For rural citizens, income increased from 2475.6 RMB to 7916.6 RMB over the same time period. Both urban and rural residents tripled their per capita income during the 10-year period (Figure 1.1).

Figure 1.1. Per capita income for rural and urban Chinese residents



According to the McKinsey Global Institute, in 2012, there were 13 million upper-middle income households in China. These households had incomes between 100,000 and 200,000 RMB, the equivalent of $15,000 to $30,000 United States (US) Dollars. The McKinsey Global Institute also predicted that 76 million Chinese households would be in this income range by 2015.

Between 2002 and 2012, the Engel coefficient dropped from 37.7 to 36.2 in urban China, and from 46.2 to 39.3 in rural China. The Engel coefficient indicates the proportion of income spent on food, which implies that as the coefficient decreases, the country is, by nature, richer. According to the Engel coefficient standard established by the Food and Agriculture Organization of the United Nations, both urban and rural China have now reached the well-to-do (30-40) level. Hence, China will require an increasing amount of food to feed its vast population in the future, as its economy grows.

Consumption Patterns

The food consumption issue in China is important for many reasons: (1) the income growth, (2) the large customer base, and (3) the Chinese customers' higher willingness to spend money on food, as compared to other countries. This conclusion can be drawn from income and Engel coefficient data; even though urban citizens have tripled their income during the 2002 to 2012 period, their percentage of income spent on food consumption barely changed, even after inflation adjustments. More specifically, according to NBS data, China's CPI index was 433.5 in 2002 (1978 base) and the CPI index in 2012 was 565; this indicates an approximate level of 30% inflation over this period.

Gale and Huang (2007) analyzed the reasons for this change. They found that Chinese customers tended to purchase greater-value-added products when income increased. This is consistent with the conclusion in the *Book of Han* that states that: "Food is the first thing for people." The food consumption data illustrates that food is still the most important and most essential element in Chinese culture. Hence, when income increases, Chinese people do not shift their spending to other areas immediately; instead, they first increase the quality of the food they consume.

This is also illustrated in the evidence of the frequency of Chinese customers that eat out. Ma, Huang, Fuller, and Rozelle (2006) and Bai, Wahl, Lohmar, and Huang (2010) found that as the income level increased in China, the frequency for Chinese customers to eat out also increased. In the meanwhile, the household expenditures on food eaten away from the home increased at a rate higher than the income increase. This increase in the demand of food away-from-home influences food producers, processors, and retailers (Mihalopoulos & Demoussis, 2001).

Fruits and Beverages

Along with China's economic development, peoples' preferences for food consumption have changed. Major changes include: (1) a shifting from staple foods to more value added food items, such as fruits; (2) shifts in dining at home to dining away from home (Bai, Seale & Wahl, 2013; Dong and Fuller, 2007); and (3) purchasing more food from retail markets (Lee, Lusk, Mirosa, & Oey, 2013).

The shift from staple foods to more value-added foods makes an analysis of China's fruit and beverage consumption important, because fruits and beverages are major food items. More specifically, fruit is a more value-added food item and its consumption is encouraged by government guidelines in the Outline of Food and Nutrient Development (2014). Beverages, on the other hand, are a major mass consumption good and are already considered part of the Chinese lifestyle.

The Regional Problem

In the past, because of transportation limitations and economic conditions, Northern China (north of the Yangtze River) rarely obtained high quality rice from the Southern region. At the same time, Southerners had challenges in obtaining wheat from Northern China. As such, people living in the different regions developed their diet based on the ingredients that they could access, and consequently, diet habits formed because of the ingredient differences.

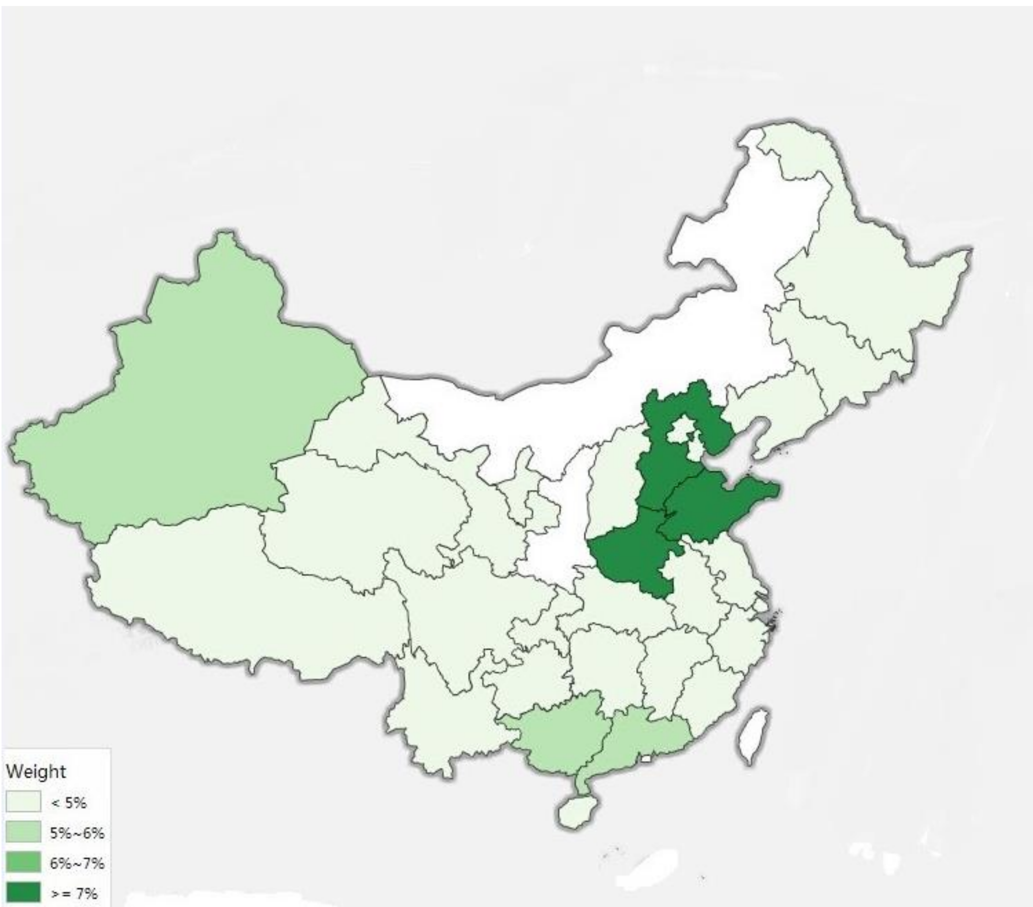
The production of grain has also influenced the types of alcoholic drinks available. In China, some alcoholic drinks are termed *baijiu*, which literally means strong traditional Chinese liquor. The northern city of Beijing is famous for its *baijiu* called *Erguotou;* the major ingredients in this liquor are wheat and corn. The western city of Xi'an is famous for a *baijiu* called *Baoji*, which is made of sorghum. Another northern city, Tsingtao, is famous for its beer, which is made of barley. On the other hand, the southern city of Shaoxing is famous for its wine called *Huangjiu*, which is made of rice.

Regional production differences are also found in fruit. Figure 1 illustrates that three provinces in Northern China produced more than 30% of China's fruit in 2012. In that same year, two provinces in Southern China, Yunan and Guizhou produced 11% of China's fruit. Xinjiang producing 5% of the total share. As such, all other provinces combined produced 54% of China's fruits.

The food industry in China is now much more developed compared to that before structure change in 1978, both technologically and economically. Producers are extending their production areas corresponding to transportation developments and customer needs. As such, the market boundary no longer exists. In this way, it is more convenient for people living in different areas to obtain different ingredients.

In addition, people are more willing to consume food that is not part of their customary and regionally based dietary habits. That being said, there is still evidence suggesting that people living in different areas have different preferences. For example, northerners are still more likely to consume wheat and southerners are more likely to consume rice as their staple foods (Huang, Rozelle, & Rosegrant, 1997).

Figure 1.2. Major fruit production area in China



The literature suggests that the influential factors for what a person will buy include: availability, monetary costs, and time constraints (Pollard, Kirk& Cade, 2002).

Alongside China’s economic development, so does the massive advancement in China’s transportation system. This allows the production area of food to extend, due to consumer demands and transportation conveniences. For example, historically, Shandong province was the only production area for apples in China; however, apples are now also produced in Shanxi province since recent decade. As such, it is easier for people living in different areas of China to obtain any types of fruits and beverages. Hence, it would be interesting to investigate how economic change would affect the lives of customers in the different regions of China.

Another reason why the geographic aspect is important is that the levels of development vary for the different regions in China. This would also result in consumption differences from region to region.

Problem Statement

Because China has a large population and its economic scale is increasing rapidly, China will need massive amounts of food in the future. This will have a major impact on China. It will also create great market potential and perhaps a world food security problem. It would also put more stress on value-added products, like fruits and beverages. Given the predicted significant increase in China's value-added food demand, China's fruit and beverage consumption is a topic that requires a more in-depth analysis.

In an analysis like this, regional differences are important to investigate. It would be really difficult and take a lot of time to include all of the necessary demographic characteristics in a model to gain a complete picture of China’s beverage and fruit consumption, because of China’s complicated demographic diversity. Since it is not efficient to analyze this situation from only the demographic aspect of food consumption in China, and because most of the literature on consumption analysis is focused solely on demographic characteristics, to better understand the consumption differences between geographic locations, demand becomes important. This knowledge will not only be useful for researchers, it could also help companies know how to target their markets more efficiently.

The next chapter of this dissertation, Chapter 2, will discuss the literature related to beverage and fruit consumption. This will be followed by Chapter 3, which discusses the consumption differences in beverages between regions. Chapter 4 will investigate the regional differences in fruit consumption. The final chapter, Chapter 5, will summarize the overall regional effects, with recommendations for future research.

CHAPTER 2. LITERATURE REVIEW

A significant amount of fruit and beverage investigations have already been conducted. This chapter talked about literature review of fruit and beverage consumption.

Fruit Literature

The philosophical aspect of fruit consumption has been discussed in Harker, Gunson and Jaeger (2003). They believe that customers can be segmented into different types in terms of responding to price changes and the various premiums they are willing to pay. However, quality has been found to be more important than price. That being said, after one bad fruit consumption experience, a customer is likely to shift to other brands or products. As such, when doing marketing, the preferences of different customers' needs must be considered.

Fruit consumption studies analyzed the elasticity angle of fruit consumption. Andayani and Tilley (1997) used an almost ideal demand system (AIDS) model to analyze fresh fruit demand in Indonesia from 1970 to 1993. They conducted research on four different fruit categories: apples, oranges, grapes and other fresh fruits. They found that three, the four fruit groups imported from the U.S. These fruits exhibited a more Marshallian own-price elasticity than fruit from other parts of the world. In addition, there was a strong substitution relationship between the different fruits, such as the price for apples being an important determinant of the quantity of oranges that were imported.

Schmitz and Seale (2002) conducted fruit research in Japan by using fruit import data from 1971 to 1997, regarding the different major fruits consumed in Japan. They chose to use the

Rotterdam model to analyze demand. They found that there is an elasticity difference between the major fruits consumed in Japan. They also found a substitution effect for fruits.

Feleke and Kilmer (1998) argued that suppliers could not increase the size of the market through price deductions. However, various promotions and differentiations would help to increase the market share.

Richards (1999) analyzed the Washington Apple Commission's promotion on apples using a two stage process model. He found that the promotion of Washington Apples decreased their long run sales, but promoted apple demand for other brands. This was because the promotion was expensive and led to an increase in the price of their apples. Since apples are not expensive, in general, people could find a cheaper alternative to replace it.

Several studies have investigated how demographics influences the consumption of fruit. According to a Canadian 2012 Health Report, there is a fruit consumption difference between different demographic groups. More specifically, people from a lower income consume less fruits and vegetables. However, their data only included questions like how many times people consume fruits and vegetables and the quantity of their consumption.

Yen, Tan and Nayga (2006) analyzed vegetable and fruit consumption in Malaysia using a bivariate ordered probability model and copula approach. Data were obtained from Malaysia's Non-Communicable Disease Surviellance-1 Survey, conducted by the Ministry of Health Malaysia in 2006. Their results are consistent with that of the Canadian 2012 Health Report, in that people with a higher education and income level consume more fruit. Canadians consume more fruit than Malaysians, which implies that ethnicity also plays an important role in fruit consumption.

Dunn et al. (2012) did research on how distance and cost influences fruit consumption in the rural Texas area. They collected survey data from six different counties in the Brazos Valley region. Comparing to national level, they found a positive relationship between the accessibility of fruits and the consumption amount of fruits in rural areas. They also found that fruit is more responsive to supermarket access. Fruit consumption amount was found to be positively related to household income. They also mentioned that car ownership could explain many of their results. In summary, they think that simply offering more locations providing fruit would be efficient in terms of fruit consumption, because of customers' economic constraints.

Shi et al. (2005) conducted research on the food habits and preferences of China's school adolescents in the Jiangsu province. They included fruit as one of their segments. They used several social-demographic indicators, like the education level, rural students, urban students, and the education level of their parents. They also included a new specific measurement called the family social economic status (SES), which measures how many different electronic devices one family has; this could be considered an indication of household income. The results indicated that adolescents from urban areas consumed more fruits and vegetables than those from rural areas. Students from households with high SES scores consumed more fruits and vegetables than those from households with low SES scores. In addition, consumption also increased as the education level of parents increased. That being said, their demographic characteristics had a correlation problem and their sample size was too small to reflect the problem they wanted to address.

Liu, Chang & Chen (2011) conducted a study on the regional differences in the consumption of fruit in China. To answer their question, they analyzed consumption survey data provided by the NBS in 2010. Three provinces were included as their observation area: Guangzhou, Shandong and Jiangsu. A quintile regression method was used to conduct the regional and time differences. Their results show that there was no regional disparity of fruit consumption in China. But because their fruit consumption data from the NBS was not segmented into specific fruits, their paper could only focus on total fruit consumption. As such, there was not enough information to state that there was a regional fruit consumption difference in China.

Beverage Literature

Many studies have analyzed the world's beverage consumption. Cochrane, Chen and Katherine (2003) argued that there is anecdotal evidence suggesting that people living in Northern China consume more alcohol than people living in Southern China. In addition, it has been said that rural residents drink weaker alcoholic beverages than people living in urban areas. Tibetan and Mongolians are believed to drink more alcohol than people in other ethnic groups. However, there is no data documenting these differences.

Caetano, Clark and Tam (1998) investigated alcohol consumption among the ethnic minorities in the U.S. and they concluded that alcohol-drinking patterns are based on a complexity of factors, including historical, psychological and social factors, as well as market factors, like taxation, and availability.

Perlman (2010) suggested that during the financial crisis in 2008, people in Russia tended to consume comparatively cheaper alcohol beverages, like samogon. Unemployed people were found to drink more than others (Perlman, 2010)

Malyutina et al. (2004) analyzed the World Health Organization MONICA Project's survey data collected in Novosibirsk, Russia. They used two socioeconomic measures: education and marital status. They found that divorced and widowed women were more likely to drink frequently. The difference between education levels remained constant during the three survey periods; but the difference became less.

Caetano and Clark (1997) pointed out that by excluding the factors of ethnicity, the region became a strong predictor of alcoholic consumption patterns. Their conclusion was based on alcohol consumption trend research using 1984 through 1995 data.

Bokak, McKee, Rose and Marmot (1999) analyzed how demographic aspects influence the drinking patterns of Russian people using the 6th New Russia Barometer survey data. This survey included alcohol consumption data from different regions of Russia. The results revealed that alcohol consumption in Far East Russia was less prevalent than that in the rest of the country. However, they did not discuss this issue any further.

Many studies have been conducted in China regarding alcohol consumption, but most of them started from the demographic aspect, rather than the regional aspect. Li et al. (1996) conducted a study based on self-administered questionnaire data from five public schools in Beijing. The surveyed sample consisted of students from the 6th, 8th and 10th grade, which are around 12, 14 and 16 years old, respectively. 1040 students were put into a sample pool. They used two-way ANOVA and Chi-square statistics to analyze the data. They found that approximately 70% of the total sample had reported consuming alcohol. 78% of the male students reported drinking alcohol. In addition, the rate of alcohol consumption increased with age increase, which means alcohol was widely used among Chinese adolescents.

Li et al. (1996) also mentioned that beer and wine were the mostly widely consumed beverages among adolescents. 54% of students reported consuming wine sometime in their life and 63% of students had reported consuming beer. The female students tended to consume more wine, rather than any other alcoholic beverages. This result is similar to a report conducted in New

Zealand in 2012 analyzing China's food consumption market, which states that wine is a popular alternative for the younger generation of Chinese. The author also mentioned that one of the limitations of their study was that the data was only collected in Beijing.

Zhou et al. (2006) analyzed the rural and urban food consumption difference using empirical data collected from the city of Huaihua in Hunan Province using household survey data. Even though no economic model was used in this paper, through a data analysis procedure, they concluded that there is a consumption difference between urban and rural people. Traditional distilled spirits, like rice wine and paddy wine, were more common with rural drinkers; urban drinkers consumed more beer and grape wine. They found that rural male drinkers were heavier than urban males; this is consistent with the results in the NBS from 2002 to 2012. Several limitations of their study have been mentioned. The first limitation is that their data was based on self-reporting: this may cause the results to be underestimated. The second limitation is that their sample collecting area was too small and they did not actually use estimations. As such, the results only reflect the consumption patterns of a limited area.

One multiple-location research study on alcohol consumption, directed by the WHO (Hao et al., 2004) was performed in China in 2011. They collected data from five different provinces. Hence, the study contained a lot of demographic information. Their results indicated that the estimated average cost for a drinker was around 16 RMB per week. In addition, men spent 50% more than woman on alcohol consumption. Since this study focused on the health conditions of Chinese residents, they did not discuss the differences in detail.

Recent trends in China's beverage consumption have been analyzed extensively. Regions were included in some of the studies on alcohol consumption. In Yen, Yuan and Liu (2009)'s paper, they conducted a quasi-maximum-likelihood estimator and used the copula approach to analyze how different explanatory variables, such as region, income and education level, influence the consumption of alcoholic beverages. They collected data from eight different provinces in China and divided alcoholic beverages into three different segments: beer, wine and spirits. They set Liaoning province as their regional base case.

Even though the Yen, Yuan and Liu (2009) paper primarily focused on the demographic aspect, their results revealed that people living in the Heilongjiang Province were more likely than people living in the Liaoning to consume each of the alcoholic beverages investigated. In addition, people living in Shandong, Hunan, Guangxi and Guizhou were less likely to consume alcohol beverages, compared to people in Jilin (Yen, Yuan & Liu, 2009). Their results also showed that men in Guangzhou were more likely to consume spirits, but less likely to consume wine. However, men in Guangxi were more likely to consume beer, rather than the other beverages. No discussions about the differences were made.

Pan, Fang and Malaga (2006) used 1993 WHO survey data to analyze regional differences in alcohol consumption in China. They used a probit regression model and set north as their excluded dummy variable. They found that people living in the north were more likely to consume both beer and wine than those living in the south (Pan, Fang & Malaga, 2006).

Zhang (2010) conducted research on the tea industry using survey data collected in Beijing. This study used a tobit model and an Almost Ideal Demand System model to test the influencing factors of tea consumption and the elasticity of tea. The results indicate that income is not the major factor that influences tea consumption at home. For food away-from-home, every 1000 RMB increase in spending on food away-from-home comes with a 0.1 kg increase in tea consumption.

Ethnicity and age were found to have a significant influence on tea consumption. Among all beverages, tea had a minimum own price elasticity, which provides additional evidence that the relationship between tea consumption and income is weak. Coffee, bottled water and milk consumption were found to be highly elastic. Bottled water and soda are complements to tea, but the cross price elasticity was low.

Review of the Models

Grown, Lee and Seale (1994) evaluated four demand models: the Rotterdam model, the Central Bureau of Statistics (CBS) model, the working Engel model and the CBS model. Their results suggests that the CBS demand model fits better than the other three models when using Japanese time series fruit consumption data from 1951 to 1972.

Some studies have investigated the elasticity of juice demand. Durham and Eales (2010) argued that fruits are price elastic. Their data was collected from two grocery stores located in the metro area of the Pacific Northwest, Portland. They used an ideal demand system and a QUAIDS model to generate the predicted elasticity. They found that fruits might be price inelastic at the aggregate level, because food consumption in industrialized countries is price-inelastic at the aggregate level of the market demand functions. This is not necessarily true at the point of sale.

Yen and Shonkwiler (1999) developed a two-step estimation procedure for a system with limited dependent variables. This model is useful for a censored system of equations.

CHAPTER 3. REGIONAL DIFFERENCES IN BEVERAGE CONSUMPTION IN CHINA

Introduction and Background

China's economy has developed rapidly in recent years. As such, there has been an increasing demand for food and beverages. Consequently, food consumption patterns have changed significantly. Major changes include: shifts from staple food such as rice to meat and seafood; shifts from dining at home to dining away from home (Bai, Seale & Wahl, 2013); and purchasing more food from retail markets (Lee, Lusk, Mirosa & Oey, 2013).

Beverage products, as a major packaged mass consumption good, are more acceptable than ever to Chinese customers. But if there are any beverage consumption patterns among the different regions in China remains unknown.

China has a long history of consuming alcoholic beverages. This history goes back to the Shang Dynasty, more than 3000 years ago. During its long history, China developed a culture that encourages social drinking and discourages solitary drinking. When doing business, or socializing with friends and family, drinking alcohol in a restaurant to conduct business smoothly or enhancing a friendship is a social norm in China (Cochrane, Chen, Conigarave & Wei, 2003). This 'culture of alcohol' creates a large market demand for alcoholic beverages in China.

China's annual per capita consumption of alcohol was 5.2 liters in 2008 (Yen, Yuan & Liu, 2009). Historical, social and economic reasons are not the only reasons why China's alcoholic beverage market is large.

Developed countries, like the U.S., the United Kingdom (UK) and Norway, prohibit alcohol consumption for teenagers. China, as a developing country, has established regulations controlling the sale of alcoholic beverages to adolescent. However, because of the strong traditions and social norms, these regulations are not enforced. Even more, during some special occasions, like New Year's celebrations and family gatherings, the older generation encourages their children to drink a little bit of alcohol.

Figure 3.1. Per capita alcohol consumption/purchases

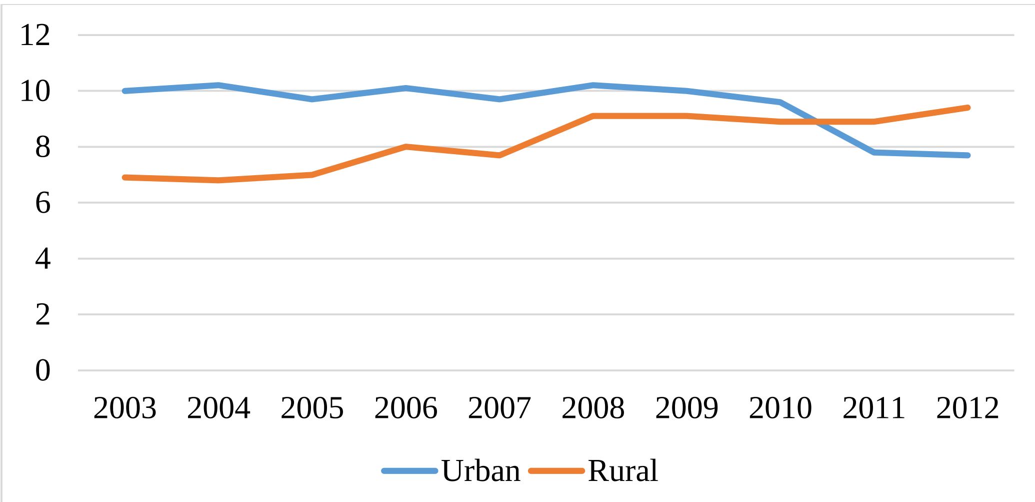


Figure 3.1 illustrates that per capita alcohol consumption in the rural areas of China increased from 2000 to 2007. More specifically, per capita alcohol consumption for people living in the rural areas was 7.0 liters in 2000; this value increased to 10.2 liters in 2007. After 2008, per capita alcohol consumption for rural citizens remained relatively stable, ranging from 9.7 to 10.2 liters per year. Note that all alcohol consumption has been converted to an equivalent to 65% alcohol by volume.

For urban alcoholic consumption, the NBS used an index of alcohol purchases, since urban markets are more developed and customers mostly buy alcohol for their own consumption. Per capita purchases of alcoholic beverage data showed an inverse trend to that of alcoholic beverage consumption in the rural area data during the 2002 to 2012 period, decreasing from 10 liters in 2000 to only 6.9 liters in 2012.

Min (2012) calculated that, in 1995, the production of the most famous traditional liquor in China, *baijiu*, was 7.91 million metric tons. To make this beverage, 1.788 million tons of rice was used. This amount of rice would feed 100 million people for one year.

China's beer and grape wine consumption are also significant. According to a Kirin Beer University report, China's consumption of beer ranked first in beer consumption in both 2011 and 2012, with 44,201,000 kiloliters in 2012, which is 23.6% of the world's consumption of alcohol. China's consumption of grape wine also ranked first place in 2013 (Chow, 2014).

Fuller, Baghin and Rozelle (2007) found that milk was a common beverage in China in 2006. Their survey was conducted in the cities of Beijing, Guangzhou and Shanghai in 2001. They found that over 90% of households were consuming milk.

According to data provided by the NBS, per capita dairy product consumption for rural citizens was 5.3 kilograms in China in 2012. In contrast, per capita fresh milk consumption in urban areas was 14 kilograms in 2012. The NBS also predicted that per capita dairy product consumption in China would reach 42 kg in 2020. The prediction is consistent with the conclusion of Dong (2006), who predicted that Asian dairy consumption and supply will illustrate an upward trend in the next decade. This trend is mostly driven by income and population growth.

Historically, orange is originally from China, 2500BC, this is part of reason why orange juice has the largest share of China's juice market. China's consumption of orange juice increased by 42.86% from 2007 to 2012. The per capita consumption in 2012 was 10.1 liters, even though, from the per capita level, it was low compared to that of Russia and the U.S. (Gao & House, 2013).

Because of China's large population multiplier, total orange juice demand in China is still large, while China's production of Valencia orange used for juicing is limited.

China's soymilk includes western style soymilk and traditional Chinese soybean beverages called DouJiang. DouJiang is treated as a kind of soup. People drink it while eating, especially for breakfast, as a substitute for milk. Western style soymilk is also very popular in China.

Carbonated soft drinks are considered an unhealthy drink by many people. However, there is still a large market for soft drinks in China. According to Mintel in 2011, China's consumption of carbonated soft drinks grew by about 10% between 2006 and 2010, reaching 10.3 liters in 2010. This value is high when compared to countries such as the U.S. and the UK (-1.5% and -1%, respectively). Since 96% of Chinese consumers continue to consume carbonated drinks, a large market potential exists.

Traditionally, green tea drink has been the only non-alcoholic beverage in China. Just like coffee in Western countries, tea is part of the Chinese lifestyle. It is considered a healthy beverage that is widely believed to reduce body fat and prevent cancer (Dulloo et al., 1999; Jian, Xie, Lee & Binns, 2004; Fujiki, Suganuma, Imai & Nakachi, 2002). That being said, tea beverages are a completely new drink in China, it is a soft drink with tea as a component. Beginning from virtually nothing in 1994, the consumption of tea beverages rapidly increased to 200,000 metric tons in 1997 and doubled in 1998 to 400,000 metric tons. In 2005, the sales of tea beverages in grocery stores exceeded the sales of soda and energy drinks (Ding, 2008).

Chinese people also drink bottled water. Doria (2006) suggests that the increase in the consumption of bottled water in China is due to concerns about the quality of tap water, water pollution, and health. According to Zenith International (2013), the bottled water market in China grew by 14% in 2012 from 2011 to 54 billion liters. The market value increased 230% since 2008, reaching $16 billion in 2012. A similar conclusion was drawn by Canadean (2013), who reported that China would overtake the U.S. in the consumption of packaged water at the end of 2013. Per capita consumption of bottled water was 30 liters in 2013 in China.

Problem Statement

The large volume of demand of beverages in China has attracted the attention of industry, researchers and policymakers. Lee, Lusk, Mirosa and Oey (2013) argued that consumer needs may be the same, but their attitudes, motivations and expressions of needs may vary. For China, with 55 minority groups, 7 separated administration districts and 34 provinces (23 provinces, including Taiwan, 5 autonomous regions, 4 municipality and 2 Special Administrative Region governments) with more than 1.3 billion people, the needs of customers are different.

The beverage consumption pattern literature has evaluated demand from various demographic perspectives, including ethnicity (Caetano, Clark and Tam, 1998; Midanik and Clark, 1994; Cochrane, Chen and Katherine (2003), age (Li et al., 1996), regional beliefs (Caetano & Clark, 1997), employment status (Perlman, 2010), marriage status (Malyutina et al., 2004), and urban-rural (Wang, Parson and Zhang, 2010) aspects.

Economic scales and social norms vary in different areas of China. Hence, different demographic characteristics could be incorporated into different regions (Ma, Huang, Fuller & Rozelle (2006); Min, Fang & Li (2012); Bai, Wahl, Lohmar & Huang (2010). As such, a region could capture the overall effect of the demographic characteristics on consumption. Evidence of regional differences has also been captured (Cochrane, Chen and Katherine, 2003; Pan, Fang and Malaga, 2006; Yen, Yuan & Liu, 2009). However, few studies have compared the difference in the consumption pattern of beverages between the different areas of China.

In this study, beverage consumption patterns 'at home' and 'away from home' for different regions in China will be identified and analyzed.

Data

Data for this study were collected from a 2011 household survey conducted in 11 different Chinese cities, covering China's six major administrative regions. The cities surveyed include: Beijing, Nanjing, Chengdu, Xi'an, Shenyang, Xiamen, Harbin, Taiyuan, Taizhou, Nanning and Lanzhou. Detailed household demographic information was recorded, along with meal-by-meal food consumption at home and away from home, for seven days. Detailed information regarding this survey can be found in Liu, Wahl and Bai (2013), Bai et al. (2012) and Bai et al. (2010).

In total, 2,342 households were included in this dataset. Household size ranged from one person to seven household members. Four groups in two consumption locations of beverages were chosen: (1) beer, (2) liquor and wine, (3) soft drinks and (4) healthy drinks. These beverages could be consumed at home or consumed away from home.

Empirical and Mathematical Methods

Demand Theory

Assume that the utility function for a consumer is $u(Q, z)$, where Q is the vector of n products this consumer has chosen. z is the factors that influence the consumption of that consumer; these factors could include regional and demographic characteristics. The income of that consumer is y, which is constrained by $P*Q=y$, where p is the price. It is a row vector with n order, hence:

$$\text{Max} \quad u(\mathrm{Q}, \mathrm{z})$$

$$\text{st.} \;\; \mathrm{y} - \mathrm{P} * \mathrm{Q} = 0 \qquad (3.1)$$

The consumer is seeking to maximize their utility, which means the goal is under the feasible budget constraint; as such the consumer would choose an appropriate Q to maximize their utility. So, when plugged into the Lagrangian multiplier, (1) becomes:

$$\max_{\mathrm{Q},\lambda} \mathrm{u}(\mathrm{Q}, \mathrm{z}) + \lambda(\mathrm{y} - \mathrm{P} * \mathrm{Q}) \min_{\mathrm{Q},\lambda} \qquad (3.2)$$

The solution for this maximum function is n demand functions, which are:

$$\mathrm{Q_i} = \mathrm{Q_i}(\mathrm{p}, \mathrm{y}, \mathrm{z}); \; \mathrm{i} = 1,2, \dots, \mathrm{n} \qquad (3.3)$$

The current research regarding consumer behavior normally uses an aggregate analysis or an individual analysis. It does not include an income distribution and characteristic differences, so the results may be biased.

Economic theory indicates that consumer behavior would change according to their income level. In addition, some goods may be luxury goods for some people, but necessities for others, which means the elasticities can change over time.

The expenditure share for each food item could be written as follows:

$$\omega_i \equiv \frac{p_i q_i}{m} \qquad (3.4)$$

Where: p_i is the price of good I; q_i is the quantity of good I consumed; and m is the total expenditure on all goods. When summing up all the weights, QUAIDS model should fulfill the condition that $\sum_{i=1}^{k} \omega_i = 1$, where k is the total number of goods.

QUAIDS Model

Many different models have been analyzed for demand systems. However, a large majority of these models do not show how the price index changes influence the demand for consumers. As such, if a price changes quickly, those models would not be suitable anymore.

Linear Engel curves lack sufficient flexibility when confronted with empirical data on household expenditures. The Quadratic Almost Ideal Demand System (QUAIDS) is a quadratic logarithmic preference that is data coherent. It provides an integrable demand system. It is a generalization of Deaton and Muellbauer's (1980) AIDS model. Its condition is similar to AIDS, but for adding up, it needs to fulfill one more condition: $\sum_{i=1}^{n} \lambda = 0$.

In the AIDS model, the relationship between the Engel curve and the logarithmic total expenditures is linear. For the QUAIDS model, the relationship between the Engel curve is powered by a logarithmic expenditure. Hence, when $\lambda=0$, the QUAIDS and AIDS model are the same. That being said, the QUAIDS model has both the flexibility of a non-linear Engel curve and integrability. This implies that it permits goods to be luxury at some point of time and necessities at others.

Fan, Wang and Sakamoto (2011) evaluated 6 different demand models using the same set of data. Their data was China's food consumption data. The models they used included: the linear expenditure model (LES), quadratic expenditure system (QES), an implicitly additive demand system (AIDADS), a modified, implicit, directly additive demand system (MAIDADS), an almost ideal demand system (AIDS) and a quadratic almost ideal demand system (QUAIDS). They evaluated six models using food consumption data from 30 different regions in 2008. By comparing the residual value from each model, they found that the QUAIDS model provided the best estimation; the second best model was the AIDADS model. Consequently, they think it is reasonable for most researchers doing research on China's food consumption to use the QUAIDS model.

According to Banks et al. (1992), the static QUAIDS budget share equations are:

$$\omega_i = \alpha_i + \sum_j \gamma_{ij} \ln(p_j) + \beta_i \ln\left[\frac{m}{a(p)}\right] + \frac{\lambda_i}{b(p)} \ln\left\{\frac{m}{a(p)}\right\}^2 + \varepsilon_i \tag{3.5}$$

Where: b(p) is the Cobb-Douglas price aggregator, w_i is the weight of the expenditures for each good i over total expenditures, and $\sum_i w_i=1$. In addition, p_j is the price of good j and m is the overall expenditure. b(p) is the C-D price index set; it can be defined as:

$$b(p) = \prod_i {p_i}^{\beta_i} \tag{3.6}$$

Where: a(p) is the price index that could take the translog form of:

$$\ln a(p) = \alpha_0 + \sum_{i=1}^{n} \alpha_i \ln p_i + \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} \gamma_{ij} \ln(p_i)\ln(p_j) \tag{3.7}$$

Where: i in the equation means different kinds of beverages or fruits.

Since QUAIDS is a modification of the AIDS model, in order to be consistent with economic theory, the parameters need to fulfill the restriction of homogeneity in Deaton and Muellbauer’s (1980) two equations:

$$\sum_j \gamma_{ij} = 0 \tag{3.8a}$$

$$\sum_i \alpha_i = 1, \qquad \sum_i \gamma_{ij} = \sum_i \beta_i = \sum_i \lambda_i = 0 \tag{3.8b}$$

For Slutsky symmetry, the parameters should satisfy the following restriction:

$$\gamma_{ij} = \gamma_{ji} \tag{3.8c}$$

Where Equation (3) could be described as a Marshallian, or uncompensated, demand function in the budget share.

According to the QUAIDS model estimates, the expenditure elasticity could be calculated as:

$$e_i = {}^{\mu_i}/_{w_i} + 1 \tag{3.9}$$

And the compensated price elasticity could be calculated as:

$$e_{ij}^{\mu} = \mu_{ij}/w_i - \delta_{ij} \tag{3.10}$$

The uncompensated price elasticity is:

$$e_{ij}^{c} = e_{ij}^{u} + e_i w_j \tag{3.11}$$

From Equations (8) to (10):

$$\mu_i = \frac{\partial w_i}{\partial \ln m} = \beta_i + \frac{2\lambda_i}{b(p)}\left\{\ln\left[\frac{m}{a(p)}\right]\right\} \tag{3.12}$$

$$\mu_{ij} = \frac{\partial w_i}{\partial \ln P_j} = \gamma_{ij} - \mu_i(\alpha_j + \sum_k \gamma_{jk} \ln P_k) - \frac{\lambda_i \beta_j}{b(p)}\left\{\ln\left[\frac{m}{a(p)}\right]\right\}^2 \tag{3.13}$$

Two Step QUAIDS

Shonkwiler and Yen (1999) stated that because direct maximum-likelihood estimation is difficult to use to evaluate multiple integrals, a two-step estimation is needed for a censored system. Bay (2013) further discussed how this could be conducted with the QUAIDS model. As such, we now consider the following system of equations with limited dependent variables:

$$y^*_{it} = f(x_{it}, \beta_i) + \varepsilon_{it} \qquad d^*_{it} = z'_{it}\alpha_i + v_{it}$$

$$d_{it} = \begin{cases} 1 & if\ d_{it} > 0 \\ 0 & if\ d_{it} \le 0 \end{cases} \qquad y_{it} = d_{it} y^*_{it} \tag{3.14}$$

$(i=1,......,n, \qquad t=1,....,T)$

Where: $f(x_{it}, \beta_i)$ is the right-hand side of the QUAIDS; it can be non-linear in β_i. The separate stochastic process has been conducted to govern the censoring of each dependent variable. w_{it} and d_{it} are the observed dependent variables for the i^{th} equation and the t^{th} observation, while y^*_{it} and d^*_{it} are the latent variables. x_{it} and z'_{it} are the vectors of the exogenous variables, β_i and α_i are the conformable vectors of the parameters, and ε_{it} and v_{it} are the random errors. Assume that the error term $[\varepsilon_{it}, v_{it}]$ for each i is distributed as a bivariate normal with cov(ε_{it}, v_{it})=δ_i. As such, the condition mean of y_{it} is:

$$\mathrm{E}(y_{it}|x_{it}, z_{it}; v_{it} > -z'_{it}\alpha_i) = f(x_{it}, \beta_i) + \delta_i \frac{\varphi(z'_{it}\alpha_i)}{\phi(z'_{it}\alpha_i)} \tag{3.15}$$

SinceE$(y_{it}|x_{it}, z_{it}; v_{it} > -z'_{it}\alpha_i) = 0$, the unconditional mean of y_i is:

$$\mathrm{E}(y_{it}|x_{it}, z_{it}) = \phi(z'_{it}\alpha_i) f(x_{it}, \beta_i) + \delta_i\, \varphi(z'_{it}\alpha_i) \tag{3.16}$$

When combining Equation (15) with Equation (4), the equation system would be:

$$\mathrm{w}_{it} = \phi(z'_{it}\alpha_i) f(x_{it}, \beta_i) + \delta_i\, \phi(z'_{it}\alpha_i) + \xi_{it} \tag{3.17}$$

The two-step estimation procedure first estimates the parameter $\alpha_i$with a probit model using a maximum likelihood to get $\widehat{\alpha_i}$. It then obtains the cumulative and density functions, ($\phi(z'_{it}\alpha_i)$ and $\phi(z'_{it}\alpha_i)$), respectively. Finally, a non-linear SUR is used to estimate $\xi_1, \ldots\ldots, \xi_1$ and $\beta_1, \ldots\ldots\ \beta_n$in the system with a maximum likelihood or iterative SUR.

$$\mathrm{w}_{it} = \phi(z'_{it}\alpha_i) f(x_{it}, \beta_i) + \delta_i\, \phi(z'_{it}\widehat{\alpha_i}) + \xi_{it} \tag{3.18}$$

Results and Conclusions

Households from different cities are not equally distributed; each city has around 200 samples of households. There are 2342 households with 3340 females and 3365 males in the dataset. The average age of the individuals in the sample is 41.69 years old. The average educational attainment of individuals in the sample is more than high school

Table 3.1. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
age	6703	41.69	19.01	0.1	96
education	7606	4.306	1.504	1	7
household income	2342	6126.78	4058.98	500	62893.08

Model Description

To address the zero consumption problem in the data generating procedure, the price for a household reported zero consumption is replaced by the average price of the district in which the household is located. If the problem continues to exist, we use the average price of the entire city. No zero price in the dataset existed after the procedures were performed.

In the first step of two-step model the people's decision of consuming a certain type of beverage was simulated using a probit model. We included 11 demographic variables, including the number of members in four different age groups of a household, the number of members in three different education levels of a household, the number of members in each gender group of a household and two disposable income dummy variables in our probit model. The price of each beverage was also included in the probit model.

In the second stage, the QUIADS model had four beverage groups consumed at home, four identical beverage groups consumed outside of the home, and 21 demographic variables. The demographic variables were created from the demographic information in the first stage. An additional dummy variable, the city where the households were located, was also included. Detailed information about the variables is presented in Table 3.2.

Table 3.2. Description table

Variable	Description
ct_i	1. Beijing 2. Nanjing, 3. Chengdu, 4. Xi'an, 5. Shenyang, 6. Xiamen 7. Habin, 8. Taiyuan, 9. Taizhou, 10. Nanjing, 11. Lanzhou
dd_i	1. Age 0-18, 2. Age 19-29, 3.Age 30-55, 4. Age>55
gd_i	1. Female, 2. Male
inc_i	1. Income<3000, 2. Income from 3000-6000, 3. Income>6000 (RMB)
$food_{ij}$	j=1 at home consumption, j=2 away from home consumption i=1. Beer 2. Wine and liquor, 3.Soft drinks, 4. Healthy drinks

Results

There were a total of 54 parameters in the QUAIDS model, including 10 city dummies, 2 income dummies and 9 other demographic characteristics. The results from the QUAIDS model are reported in Table 3.3. Surprisingly, the QUADIS results indicate that an additional member of each age group in a household is positively correlated with alcoholic beverage consumption. Each additional member from each age group will also decrease the spending share on soft drinks.

The additional member, with a mid-level and low-level education in a household, would increase the share of alcoholic beverage consumption at home and beer consumption away from home, but it is negatively correlated with the wine and liquor share away from home. The additional household member with a low-level education would also cause a household to spend more of their share on healthy drinks, but less on soft drinks away from home, as compared to an additional household member with a mid-level education. Moreover, households with highly educated members consume a larger share of beverages away from home, but less at home.

From an income perspective, when comparing high and low income households, it was found that low-income households spend less on beer at home and soft drinks away from home. On the other hand, mid-level income households consumed more beverages at home, but fewer alcoholic beverages and soft drinks away from home. Both mid-level income and low-income households spent more money on healthy drinks. This indicates that even though the price of a healthy drink is comparatively high, households from lower income levels still place a priority on consuming them.

Table 3.3. QUAIDS estimation for beverages

	B		WL		SD		HD	
AGE1	0.141	**	0.044	*	-0.003	*	-0.204	
	[-0.008]		[-0.09]		[-0.085]		[-0.452]	
AGE2	0.083	*	0.041	*	-0.014	*	-0.138	
	[-0.067]		[-0.094]		[-0.095]		[-0.386]	
AGE3	0.14	**	0.048	*	-0.001	*	-0.248	
	[-0.009]		[-0.087]		[-0.083]		[-0.496]	
AGE4	0.127	**	0.062	*	-0.004	*	-0.134	
	[-0.022]		[-0.073]		[-0.086]		[-0.382]	
ED1	0.035	**	0.009	**	-0.008	**	-0.054	*
	[0.017]		[-0.007]		[-0.018]		[-0.085]	
ED2	0.028	**	0.003	**	-0.008	**	-0.054	*
	[0.012]		[-0.011]		[-0.017]		[-0.08]	
ED3	-0.006	**	-0.004	**	-0.004	**	-0.031	**
	[-0.014]		[-0.009]		[-0.009]		[-0.044]	
GD1	-0.143		-0.051		0.009	*	0.19	*
	[-0.291]		[-0.184]		[-0.072]		[-0.057]	
GD2	-0.135		-0.063		0.016	*	0.195	*
	[-0.283]		[-0.196]		[-0.066]		[-0.052]	
Inc1	-0.02	*	0.018	**	0.007	**	0.095	**
	[-0.053]		[-0.011]		[-0.011]		[0.041]	
Inc2	0.008	**	0.002	**	0.004	**	0.01	**
	[-0.014]		[-0.018]		[-0.008]		[-0.027]	

Table 3.3. QUAIDS estimation for beverages (continued)

	BAFH		WLAFH		SDAFH		HDAFH	
AGE1	0.082	*	0.037	*	-0.044		-0.052	
	[-0.054]		[-0.079]		[-0.168]		[-0.198]	
AGE2	0.057	*	0.042	*	-0.024		-0.047	
	[-0.08]		[-0.073]		[-0.149]		[-0.193]	
AGE3	0.103	**	0.034	*	-0.032		-0.045	
	[-0.033]		[-0.081]		[-0.157]		[-0.191]	
AGE4	0.044	*	0.035	*	-0.068		-0.061	
	[-0.093]		[-0.081]		[-0.193]		[-0.206]	
ED1	0.024	**	-0.01	**	-0.002	**	0.004	**
	[0.007]		[-0.024]		[-0.017]		[-0.014]	
ED2	0.028	**	-0.003	**	0.006	**	0	**
	[0.012]		[-0.015]		[-0.008]		[-0.016]	
ED3	0.016	**	0.003	**	0.013	**	0.005	**
	[0.008]		[-0.004]		[0.006]		[-0.003]	
GD1	-0.084		-0.025		0.05	*	0.054	*
	[-0.22]		[-0.14]		[-0.073]		[-0.091]	
GD2	-0.08		-0.022		0.054	*	0.034	
	[-0.216]		[-0.137]		[-0.069]		[-0.111]	
Inc1	-0.118		0.029	**	-0.029	*	0.018	**
	[-0.149]		[0.004]		[-0.056]		[-0.014]	
Inc2	-0.024	**	0	**	-0.006	**	0.007	**
	[-0.044]		[-0.017]		[-0.025]		[-0.015]	

*** Significant at 10% level**
****Siginificant at 5% level**

Based on the results of the expenditure elasticities in Table 3.4, we can see that the elasticity of healthy drinks at home is the highest among all at home beverages consumed, with a mean of 1.04. Once expenditures on beverages increases, the demand for healthy drinks will increase at a rate faster than the increase in expenditures.

The expenditure elasticity for beverages away from home is different. Soft drinks are the most elastic, followed by wine and liquor, alcoholic beverages that contain more alcohol content than beer. The difference between at-home and away-from-home expenditure elasticity indicates that there are different consumption patterns at home and away from home. When consuming beverages at home, households are more income elastic to healthier beverages and weaker alcoholic beverages. However, when consuming beverages away from home, households are more income elastic to strong alcoholic products and soft drinks.

Table 3.4. Expenditure elasticity for beverages

Variable	Mean	Std.
B(AH)	0.9156	0.0289
W&L(AH)	0.6858	0.0458
SD(AH)	0.5924	0.0963
HD(AH)	1.03	0.005
B(AFH)	0.7811	0.0764
W&L(AFH)	0.8536	0.0319
SD(AFH)	1.109	0.0482
HD(AFH)	0.6626	0.0171

Tables 3.5 and 3.6 illustrate that wine and liquor have the highest own price elasticity for at home consumption, while beer has the highest own price elasticity for away from home consumption. There exists a different pattern between alcohol beverages at home and away from home.

Wine and liquor have a higher own price elasticity for both drinks at home and away from home. This indicates that customers accept that wine and liquor prices change away from home. They are more sensitive to beer price changes at home. Both beer at home and away from home have a higher own price elasticity than other beverages.

Healthy drinks have an elasticity close to 1 for both at home and away from home consumption. Soft drinks had the lowest own price elasticity for both at home and away from home consumption.

Looking at the cross price elasticity, healthy drink prices are both compensated and uncompensated elastic to all other beverages. The cross price elasticity between healthy drinks and soft drinks is the highest among all of the beverages, indicating a strong substitution effect between healthy drinks and soft drinks. Hence, when the prices of healthy drinks increase, the consumption of soft drinks increases four times more than the ratio of the price increase in healthy drinks.

Other cross price elastic beverages are soft drinks at home and beer away from home. The results show that they complement each other. This is reflected in the physical graph of the consumption pattern in China. Beer is considered a complement to soft drinks when consumed at home, but become substitutes of soft drinks when consumed away from home.

Table 3.5. Uncompensated elasticity for beverages

	B	WL	SD	HD	$B_{(AF)}$	$WL_{(AF)}$	$SD_{(AF)}$	$HD_{(AF)}$
B	-1.54	-0.76	-0.20	1.39	0.19	-0.17	0.26	-0.26
WL	-0.67	-2.47	0.31	2.37	-0.91	-0.35	0.37	0.15
SD	-0.54	-0.84	-0.92	4.37	-1.25	-0.40	1.64	-0.51
HD	0.06	0.00	-0.01	-1.06	-0.06	-0.04	0.02	0.13
$B_{(AF)}$	0.26	-0.99	-0.04	1.15	-2.41	-0.26	0.52	0.29
$WL_{(AF)}$	-0.29	-0.92	0.28	1.73	-0.56	-2.28	0.56	0.17
$SD_{(AF)}$	-0.48	-0.94	-0.02	0.89	-0.20	-0.27	-0.21	-0.22
$HD_{(AF)}$	-0.44	-0.49	-0.24	1.64	-0.14	-0.21	0.20	-1.05

Table 3.6. Compensated elasticity for beverages

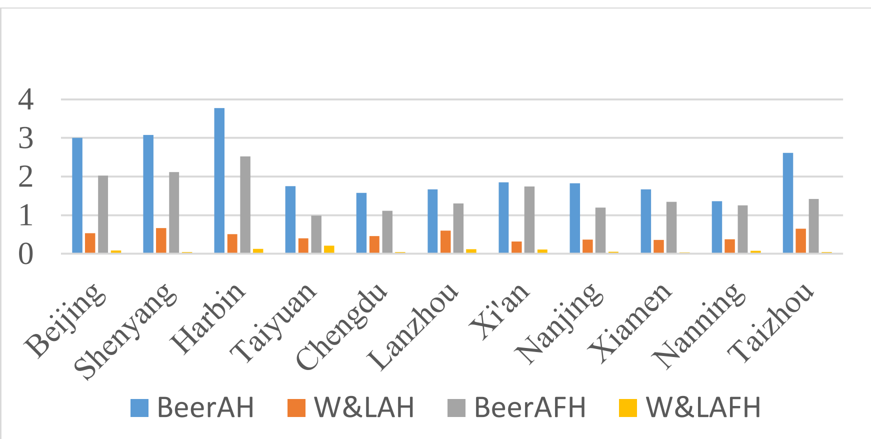
	B	WL	SD	HD	$B_{(AF)}$	$WL_{(AF)}$	$SD_{(AF)}$	$HD_{(AF)}$
B	-1.44	-0.69	-0.16	1.80	0.28	-0.11	0.33	-0.16
WL	-0.59	-2.42	0.33	2.68	-0.85	-0.30	0.42	0.22
SD	-0.47	-0.79	-0.90	4.63	-1.20	-0.36	1.68	-0.44
HD	0.17	0.07	0.02	-0.60	0.04	0.03	0.11	0.24
$B_{(AF)}$	0.35	-0.93	-0.02	1.50	-2.33	-0.21	0.58	0.38
$WL_{(AF)}$	-0.20	-0.86	0.31	2.11	-0.48	-2.22	0.63	0.27
$SD_{(AF)}$	-0.36	-0.86	0.02	1.39	-0.10	-0.20	-0.13	-0.10
$HD_{(AF)}$	-0.37	-0.44	-0.22	1.93	-0.07	-0.17	0.25	-0.97

Regional Differences

Looking at the regional differences for average beer consumption, both at home and away from home (Figure 3.2), we observed that the three Northern cities of Shenyang, Harbin and Beijing were in the first three places for average alcoholic beverage consumption. For average wine and liquor consumption at home, Shenyang, Harbin and Beijing were in first, fourth and fifth place, respectively, among the eleven cities. Lanzhou, a city located in Western China, ranked third.

When observing wine and liquor consumption away from home, we noticed that the northern cities of Taiyuan and Harbin ranked first and second, respectively. They were followed by the two western cities of Xi’an and Lanzhou.

Figure 3.2. Average alcohol consumption by city



The QUAIDS results in Table 3.7 show that when Lanzhou is the base case, most city dummies have a significant effect on the share of consumption for all beverages, besides healthy drinks at home. Xiamen, Harbin and Taiyuan were the only significant city dummies, when predicting the share of consumption of healthy drinks at home.

From a traditional point of view, people living in the northern and western parts of China consumed more alcoholic beverages than those in other areas, but there is only a few supporting studies that have shown this. This study illustrates strong empirical evidence that regional difference of alcoholic beverages exists.

Considering the statistical significance level of variables at 10 percent, the top six cities in Table 3.7 from the north and the west of China have a higher share of their consumption on alcoholic beverages away from home. When the confidence level increases to 15 percent, the northern cities of Harbin and Shenyang take the first two places for alcohol consumption at home.

Even though it is not strong enough to show the different non-alcoholic beverage consumption behaviors across the different regions in China, we see that a city effect is quite significant for all non-alcoholic beverages, except healthy drinks at home.

Table 3.7. City effects from the QUIADS model

		B		WL		SD		HD	
North	Beijing	0.061	**	-0.05	*	0.026	**	-0.05	
		[0.02]		[-0.085]		[0.003]		[-0.117]	
	Shenyang	0.165		-0.09		0.012	**	-0.16	
		[0.121]		[-0.129]		[-0.012]		[-0.23]	
	Harbin	0.182		-0.09		0.05	**	-0.26	
		[0.138]		[-0.127]		[0.025]		[-0.332]	
	Taiyuan	0.053	**	-0.04	*	0.01	**	0.031	**
		[0.009]		[-0.076]		[-0.014]		[-0.041]	
West	Xi'an	0.067	**	-0.01	*	0.016	**	-0.18	
		[0.023]		[-0.05]		[-0.008]		[-0.253]	
	Chengdu	-0.02	*	-0.04	*	0.015	**	0.059	**
		[-0.063]		[-0.073]		[-0.009]		[-0.012]	
East	Xiamen	0.08	**	-0.08		0.077	*	-0.01	*
		[0.031]		[-0.124]		[0.05]		[-0.091]	
	Nanjing	0.023	**	0.025	**	-0.01	**	-0.04	
		[-0.02]		[-0.012]		[-0.032]		[-0.111]	
	Taizhou	0.095	*	0.002	**	0.056	**	-0.33	
		[0.05]		[-0.038]		[0.032]		[-0.405]	
South	Nanning	0.058	**	-0.05	*	0.021	**	-0.06	
		[0.013]		[-0.094]		[-0.004]		[-0.138]	

Table 3.7. City effects from the QUIADS model (Continued)

		B_{AFH}		WL_{AFH}		SD_{AFH}		HD_{AFH}	
North	Beijing	-0.033	*	0	**	0.038	**	0.007	**
		[-0.071]		[-0.032]		[0.005]		[-0.033]	
	Shenyang	0.107	*	-0.039	*	0.058	**	-0.056	*
		[0.067]		[-0.073]		[0.022]		[-0.098]	
	Harbin	0.086	**	-0.052	*	0.105	*	-0.025	*
		[0.045]		[-0.085]		[0.069]		[-0.067]	
	Taiyuan	-0.019	*	-0.022	*	0.006	**	-0.021	*
		[-0.059]		[-0.056]		[-0.03]		[-0.063]	
West	Xi'an	0.102	*	0.003	**	0.044	**	-0.038	*
		[0.062]		[-0.03]		[0.007]		[-0.08]	
	Chengdu	0	**	-0.007	**	-0.022	*	0.009	**
		[-0.041]		[-0.04]		[-0.057]		[-0.032]	
East	Xiamen	-0.057		-0.031	*	0.025	**	-0.003	*
		[-0.102]		[-0.069]		[-0.016]		[-0.05]	
	Nanjing	-0.021	*	0.041	**	-0.006	**	-0.011	*
		[-0.06]		[0.008]		[-0.041]		[-0.052]	
	Taizhou	-0.015	*	-0.018	*	0.046	**	0.164	
		[-0.056]		[-0.052]		[0.009]		[0.121]	
South	Nanning	0	**	-0.023	*	-0.021	*	0.082	**
		[-0.042]		[-0.059]		[-0.059]		[0.038]	

*** Significant at 10% level**
****Siginificant at 5% level**

Similar evidence is also found when an elasticity analysis by city is applied (Table 3.8). Chengdu and Lanzhou, in the western part of China, had the highest expenditure elasticity on beer consumption at home, - 1.47 and 1.23, respectively. For beer consumption away from home, Beijing (0.95) ranked first for the expenditure elasticity; the other two northern cities of Harbin (0.82) and Shenyang (0.77) ranked third and fourth. For wine and liquor, the eastern cities of Nanjing and Taizhou ranked first and third for the expenditure elasticity for at home consumption.

The western city of Lanzhou, ranked second for healthy drinks; it is quite steady in at home consumption. Healthy drinks were found to be superior goods in different cities for consumption at home. There is no area that dominates the wine and liquor away from home consumption elasticity.

The non-alcoholic beverage regional difference is captured in the elasticity analysis. Based on the results, healthy drinks at home can be considered superior goods in all of the cities; no evidence for regional variation was observed. When looking at healthy drinks away from home, the northern cities of Shenyang and Harbin, had an expenditure elasticity of 0.25 and 0.46, respectively. The eastern city of Taizhou, has an expenditure elasticity of 0.73.

For soft drink consumption at home, there was a large elasticity difference in the different cities. The eastern city of Xiamen had the highest expenditure elasticity of 0.87 for soft drinks at home; Lanzhou had the lowest expenditure elasticity. Hence, we can imply that soft drinks are inferior goods in Lanzhou, as they had an expenditure elasticity of -0.04. However, soft drinks become superior goods when they are consumed away from home.

Table 3.8. Expenditure elasticity by city

Region	City	B	WL	SD	HD	B_{AFH}	WL_{AFH}	SD_{AFH}	HD_{AFH}
North	Beijing	0.854	0.609	0.314	1.046	0.946	1.103	0.975	0.651
	Shenyang	0.93	0.168	0.422	1.077	0.671	0.849	1.276	0.654
	Harbin	0.897	0.403	0.633	1.078	0.749	0.902	1.381	0.675
	Taiyuan	1.097	0.569	0.588	1.016	0.828	0.866	0.99	0.577
West	Xi'an	0.959	0.629	0.347	1.049	0.765	0.785	1.058	0.256
	Chengdu	1.466	0.752	0.466	1.012	0.397	0.56	1.142	0.651
	Lanzhou	1.226	0.725	-0.037	1.014	0.661	0.689	1.504	0.733
East	Xiamen	1.058	0.473	0.872	1.027	0.818	0.688	0.988	0.475
	Nanjing	1.167	0.775	-0.794	1.033	0.632	0.591	1.343	0.591
	Taizhou	0.974	0.727	0.793	1.169	0.715	0.869	1.059	0.752
South	Nanning	1.078	0.613	0.747	1.064	0.721	0.658	1.274	0.639

Conclusions

Our empirical results provide strong evidence of city and regional differences in alcoholic beverage consumption. We provide the empirical evidence by estimating a QUAIDS model. The evidence for the differences in the consumption of non-alcoholic beverages in the different regions was not found in this study.

This study found that households from lower income backgrounds spent larger amounts of their share of income on healthy drinks; this indicates that customers in China believe that the consumption of healthy drinks is very important. However, we could not conclude this in the same way when studying the consumption behaviors of households in beverages away from home. We also found that customers would choose products that have a better flavor or satisfaction when consuming beverages away from home.

Households with higher incomes consume more of a share of beverages away from home than at home. Low-income households tend to put a larger share of their income into liquor and wine consumption.

A substitution effect between healthy drinks and soft drinks was also found. We also conclude that beer is complementary to soft drinks in China, when consuming at home, but they were substitutes when consuming away from home.

The difference in the consumption pattern between at-home and away-from-home can be addressed in this study. While at home, households are more income elastic to healthier drinks and weak alcoholic beverages, but they are more income elastic to soft drinks and high alcohol content beverages when they consume these goods away from home.

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CHAPTER 4. REGIONAL DIFFERENCES IN FRUIT CONSUMPTION IN CHINA

Introduction and Background

A World Health Organization (WHO) report (2014) suggested that people should consume at least 400g of fruits and vegetables per day to prevent chronic diseases like cancer, diabetes, and obesity (WHO, 2003). Even though the per capita consumption of fruits for Chinese customers has increased, it still has not reached the level suggested by the WHO. In addition, low intakes of fruits and vegetables is one of the top 10 risk factors of global mortality (Steven, Tan & Nayga, 2011)

Fruit in China is traditionally considered a luxury food item According to Xu (2010), in Chengdu, more than 80% of the interviewees chose fruit as a gift when visiting their relatives or friends. Qing (2008) surveyed residences in Wuhan and found that the intention to buy melons, apples, and bananas was strongest among all of the fruits; this was followed by grapes, oranges and pears. Most consumers think that fruits are rich in nutrients, so the consumption of fruits will help digestion.

China's consumer preferences for food changed with its economic growth after China's economic structural change in 1978. Consequently, Dong and Fuller (2007) found that the expenditures on grains declined and the expenditures on fruit, and other more value added products, like meat, increased. Similar trends have also been found by the NBS. More specifically, per capita fruit consumption for rural residents increased from 5.9 kg in 1990 to 22.8 kg in 2012. Per capita fruit consumption for urban citizens during the same time period increased from 41.1 kg to 56.1 kg.

According to the Outline of Foods and Nutrient Development (2014), the State Council of the People's Republic of China set a six-year goal of food consumption that includes the target that per capita consumption for fruit should reach 60 kg per year in the 2014-2022 period. This means that the per capita consumption of fruits should remain at a current high and the per capita consumption of fruit for rural residents needs to be six times higher than the current level in order to achieve that goal.

Insight from the Literature

The elasticity of fruit demand for different nations has been widely discussed in the literature. Andayani and Tilley (1997) analyzed 1970-1993 Indonesian fruit import data and found that, for imported fruit demand, the own price elasticity for fruits imported from the U.S. and the rest of the world have strong substitution effects. That being said, oranges and grapes imported from the U.S. are more own-price elastic than those fruits from the rest of the world.

Schmitz and Seale (2002) ran a Rotterdam model on Japan's six major consumed categories of fruit import data from 1971 to 1997. The fruit included bananas, grapefruits, oranges, lemons, pineapples and other fruits (berries and grapes). They concluded that the cross product elasticity exists among the different fruit categories, which implies there were substitution effects among the different types of fruits in Japan.

When comparing fruit elasticity with the rest of the world, similar fruit elasticities have been found in China. Durham and Eales (2010) found that fruits are price elastic by using store level fruit consumption data. Han and Wahl (1998) found similar results in China in 1993, in that the price elasticity of fruits was more than vegetables; grapes were the most price-elastic.

Dunn, Johnson, Leidner and Sharkey (2012) used Brazos Valley Community Health Assessment survey data from six different counties located in the Brazos Valley region in Texas. Their probit regression results indicated that age had a significant association with fruit consumption. They also found that females consumed more fruit than males. Education was also an important indicator of fruit consumption. As the education level increases, fruit consumption also increases.

Tan, Yen, and Naygas (2011) used a bivariate ordered probability model to estimate the demand for different demographic groups by using 2006 Malaysian Non-Communicable Disease Surveillance-1 data. They concluded that as age increases, people are more likely to consume fruit. The Chinese are more likely to consume fruits, as compared to other ethnic groups. And people at a poverty income level consume fewer fruits. Non-smokers are more likely to consume fruits, as compared to smokers. The insights that the demographic characteristics, like age, ethnicity, and income level, have a significant effect on fruit consumption, is useful when considering the consumption pattern of Chinese consumers.

There are also a couple of studies that analyze how demographic characteristics influence the consumption of fruits using data from China. Shi, Lian, Kumar and Holmboe-Ottesen (2010) used survey data collected in Jiangsu Province of China and divided people into different income groups by how many different electronic devices their family possessed. They discovered that when there is no budget constraint, 51.4% of boys from urban areas are likely to increase their consumption of fruits, while this number is 56.8% for rural boys. 61.3% of girls from urban areas want to increase their consumption of fruits, while the number from the rural area was 68.2%.

Liu,Chang and Shen (2011) found evidence of regional differences of fruit consumption in China, but did not discuss it further. They used a different-to-different model and data from a survey of Chinese urban households conducted by the NBS that crossed three coastal provinces in China. They found that the change in fruit consumption for households in the different regions was different from the years of 1993 to 2001. In addition, an ordinary least squares regression predicted a 5.35 kg per capita increase per year for Jiangsu, but only a 1.85 kg of per capita consumption of fruit increase per year for Shandong Province. The disparities in the fruit consumption for households in Guangzhou were more significant than the households in Jiangsu. However, the authors did not further address the difference.

The consumption pattern of fruit has not been investigated extensively. Harker, Gunson and Jaeger (2003) stated that even though consumers could be divided into groups by their purchasing power, they would still think the quality of the fruit is more important than the price. That being said, the price remains an important indicator for people when making decisions to choose which fruits or which brands of fruits they buy.

Timothy and Vans (1990) provided an alternative understanding of the effect of promotions on fruits. Their results illustrated that after a promotion by the Washington Apple Commission, sales of apples declined in the long run, because the promotion increasing the cost thereby increased the price. Since apples are not a luxury food item, it is easy for people to purchase a cheaper alternative brand to replace their original choice.

Sun and Collins (2002) found an identical result in their research using retail level data collected in Guangzhou, China during July of 2000. Groups with higher purchasing power were found to buy more imported fruits. And people with the highest purchasing power actually expressed less intention to care about packaging, brands, and the quality of fruits.

Problem Statement

In the future, China will have a large increase in its fruit demand. This increase may influence the fruit market of the entire world, as a result of China's large population and economic development. This makes the consumption of fruit in China an important topic to analyze.

Previous research focused primarily on demographic characteristics and customer consumption decision analyses for fruit consumption. Due to China's population distribution variation and its varying economic levels, the consumption patterns for fruit in the different regions are largely different.

According to the NBS yearbooks, by province, in 2012, Tianjin had the highest per capita GDP (93,110 RMB) and Guizhou had the lowest (19,566 RMB). The Department of Agriculture of the People's Republic of China showed that Shandong produced 12.16% of the total fruit and ranked highest for food production in China; Tibet only produced 0.01% of the total share of fruit.

Demographics are really important for decision-makers and researchers to know when they are trying to better understand the fruit consumption patterns in China. The primary purpose of this paper is to analyze the differences in fruit consumption among the different regions and to present a detailed picture of these differences.

Data

This study used a 2011 diary-based household survey. The survey sampled households using a stratified and random approach. The households in the survey were from 11 different cities: Beijing, Nanjing, Chengdu, Xi'an, Shenyang, Xiamen, Harbin, Taiyuan, Taizhou, Nanning and Lanzhou. These cities covered six of the seven administrative regions. These administrative regions include East China, South China, Central China, North China, Northeast China, Southwest China, and Southeast China. They also include all four economic regions: East Coast, Central China, Northeast China and West China.

Detailed household demographic information about each household was recorded. Meal-by-meal food consumption data were also recorded for 7 days for both consumption at home and consumption away from home. The final dataset included 2,342 households. Eight different categories of fruit for consumption at home and away from home were included in this survey. These fruit categories include: apples, bananas, pears, grapes, melons, oranges and other fresh fruits, other dried fruits, and other fruit products.

The households from different cities were not equally distributed; each city had around 200 respondent households. There were 2,342 households with 3,340 females and 3,365 males in the dataset. The average age of the individuals in the sample was 41.69 years old. The average educational attainment of the individuals in the sample was more than high school.

Methods

The method used to estimate the demand system for food consumption has been discussed in the literature. Andayani and Tilley (1997) found that RSDAIDS provides an excellent explanation for the variation in Indonesian fruit imports from the US and other sources. Durham and Eales (2010) compared four models: the double-log, Almost Ideal Demand System (AIDS), Linear Approximate Almost Ideal Demand System (LA/AIDS) and the Quadratic Almost Ideal Demand System (QUAIDS). They used retail level data from the Portland city metropolitan area (Oregon, US). The QUAIDS model provided the smallest sum of the root mean square errors

(RMSE) for each case. Fan, Wang and Sakamoto (2011) had the same conclusion, after comparing six models for the demand system using China's food consumption data.

QUAIDS Model

The QUAIDS model is a generalization of Deaton and Muellbauer's (1980) AIDS model. Its condition is similar to AIDS, but for adding up, it needs to fulfill one more condition: $\sum_{i=1}^{n} \lambda = 0$. In the AIDS model, the relationship between the Engel curve and the logarithmic total expenditures is linear. For QUAIDS, the relationship in the Engel curve is powered by the logarithmic expenditure. Hence, when λ=0, the QUAIDS and AIDS models are the same.

The predicted weight given in the QUAIDS model may extended beyond the [0,1] interval. Hence, it has both the flexibility of a non-linear Engel curve and integrability, which means it permits goods to be luxury goods some of the time and necessity goods at other times.

According to Banks et al. (1992), the static QUAIDS budget share equation is:

$$\omega_i = \alpha_i + \sum_j \gamma_{ij} \ln(p_j) + \beta_i \ln\left[\frac{m}{a(p)}\right] + \frac{\lambda_i}{b(p)} \ln\left\{\frac{m}{a(p)}\right\}^2 + \varepsilon_i \qquad (4.1)$$

Where: b(p) is the Cobb-Douglas (C-D) price aggregator, w_i is the weight of the expenditure for the ith good, and the sum of the total weight equals 0. In addition, p_j is the price of the jth good and m is the overall expenditure. b(p) is the C-D price index set that could be defined as:

$$b(p) = \prod_i p_i^{\beta_i} \qquad (4.2)$$

a(p) is the price index and could take the translog form of:

$$\ln a(p) = \alpha_0 + \sum_{i=1}^{n} \alpha_i \ln p_i + \frac{1}{2} \sum_{i=1}^{n} \sum_{j=1}^{n} \gamma_{ij} \ln(p_i) \ln(p_j) \qquad (4.3)$$

i in the equation means different kinds of beverages or fruits. Since QUAIDS is a modification of the AIDS model, in order to be consistent with economic theory, the parameters need to fulfill the restriction of homogeneity for the two equations in Deaton and Muellbauer (1980). These two equations are:

$$\sum_j \gamma_{ij} = 0 \tag{4.4a}$$

$$\sum_i \alpha_i = 1, \qquad \sum_i \gamma_{ij} = \sum_i \beta_i = \sum_i \lambda_i = 0 \tag{4.4b}$$

For the Slutsky symmetry, the parameters should satisfy the following restriction:

$$\gamma_{ij} = \gamma_{ji} \tag{4.4c}$$

Where: Equation (3) could be described as a Marshallian, or uncompensated demand, function in the budget share.

According to the QUADIS model's estimates, the expenditure elasticity could be calculated as:

$$e_i = {}^{\mu_i}/_{w_i} + 1 \tag{4.5a}$$

And the compensated price elasticity could be calculated as:

$$e_{ij}^{\mu} = \mu_{ij}/w_i - \delta_{ij} \tag{4.5b}$$

The uncompensated price elasticity is:

$$e_{ij}^{c} = e_{ij}^{u} + e_i w_j \tag{4.5c}$$

From (5a) to (5c);

$$\mu_{ij} = \frac{\partial w_i}{\partial \ln P_j} = \gamma_{ij} - \mu_i(\alpha_j + \sum_k \gamma_{jk} \ln P_k) - \frac{\lambda_i \beta_j}{b(p)} \left\{ \ln \left[\frac{m}{a(p)} \right] \right\}^2 \tag{4.6}$$

Two Step QUAIDS Model

Because of the use of micro data, a zero consumption problem arises, because there are many households without any consumption of a certain type of fruit item. Shonkwiler and Yen (1999) stated that the plug-in of the probit model could help to solve this problem.

As such, we consider a system of equations with limited dependent variables:

$$y^*_{it} = f(x_{it}, \beta_i) + \varepsilon_{it} \qquad d^*_{it} = z'_{it}\alpha_i + v_{it}$$

$$d_{it} = \begin{cases} 1 & if\ d_{it} > 0 \\ 0 & if\ d_{it} \le 0 \end{cases} \qquad y_{it} = d_{it} y^*_{it} \tag{4.7}$$

$(i=1,\ldots\ldots,n, \qquad t=1,\ldots.,T)$

Where: $f(x_{it}, \beta_i)$ is the right-hand side of QUAIDS it can be non-linear in β_i. A separate stochastic process has been conducted to govern the censoring of each dependent variable. w_{it} and d_{it} are the observed dependent variables for the i^{th} equation and t^{th} observation, respectively. y^*_{it} and d^*_{it} are the latent variables. x_{it} and z'_{it} are the vectors of the exogenous variables. β_i and α_i are the conformable vectors of the parameters, while ε_{it} and v_{it} are the random errors. Assume that the error terms $[\varepsilon_{it}, v_{it}]$ for each i are distributed as a bivariate normal with a cov(ε_{it}, v_{it})=δ_i. As such, the condition mean of y_{it} is:

$$\mathrm{E}(y_{it}|x_{it}, z_{it}; v_{it} > -z'_{it}\alpha_i) = f(x_{it}, \beta_i) + \delta_i \frac{\varphi(z'_{it}\alpha_i)}{\phi(z'_{it}\alpha_i)} \tag{4.8}$$

Since$\mathrm{E}(y_{it}|x_{it}, z_{it}; v_{it} > -z'_{it}\alpha_i) = 0$, the unconditional mean of y_i is:

$$\mathrm{E}(y_{it}|x_{it}, z_{it}) = \phi(z'_{it}\alpha_i) f(x_{it}, \beta_i) + \delta_i\, \varphi(z'_{it}\alpha_i) \tag{4.9}$$

When combining Equation (4.9) with Equation (4.1), the equation system becomes:

$$\mathrm{w}_{it} = \phi(z'_{it}\alpha_i) f(x_{it}, \beta_i) + \delta_i\, \phi(z'_{it}\alpha_i) + \xi_{it} \tag{4.10}$$

The two-step estimation procedure first estimates parameter $\alpha_i$with a probit model using a maximum likelihood to get $\hat{\alpha_i}$ and then gets a cumulative density function: ($\phi(z'_{it}\alpha_i)$ and $\phi(z'_{it}\alpha_i)$). Finally, we use a non-linear SUR to estimate $\xi_1, \ldots\ldots, \xi_1$ and $\beta_1, \ldots \ldots\ \beta_n$ in the system by a maximum likelihood, or iterative SUR:

$$\mathrm{w}_{it} = \phi(z'_{it}\alpha_i) f(x_{it}, \beta_i) + \delta_i\, \phi(z'_{it}\hat{\alpha_i}) + \xi_{it} \qquad (4.11)$$

Results and Conclusions

To fix the zero consumption problem in the data generating procedure, the price for a household reported zero consumption is replaced by the average price of the district where the household is located. If the problem continues to exist, we use the average price of the entire city. No zero price in the dataset existed after the procedures were performed.

To accomplish our goal, we conducted two steps. In the first step, the people's decision to consume a certain type of beverage was estimated. We included 11 demographic variables, including the number of members in the four different age groups of a household, the number of members in the three different education levels of a household, the number of members in each gender group of a household and two disposable income dummy variables. The price of each beverage was also included.

In the second step, a QUIADS model that had four beverage groups consumed at home, four identical beverage groups consumed outside of the home and 21 demographic variables, will be run. The demographic variables were created from all of the demographic information in the first stage and an additional dummy variable for city, where the households are located. Detailed information about the variables is presented in Table 4.1.

Table 4.1. Description table

Variable	Description
cti	1. Beijing 2. Nanjing, 3. Chengdu, 4. Xi'an, 5. Shenyang, 6. Xiamen 7. Habin, 8. Taiyuan, 9. Taizhou, 10. Nanjing, 11. Lanzhou
ddi	1. Age 30-55, 2. Age 0-18, 3. Age 19-29, 4. Age>55
edi	1. Less than high school, 2. High school or occupational school, 3. College or higher
gdi	1. Female, 2. Male
inci	1. Income<3000, 2. Income from 3000-6000, 3. Income>6000
foodij	j=1 at home consumption, j=2 away from home consumption i=1. Apples and Bananas, 2. Pears, oranges, and other fresh fruits, 3. Melons and grapes, and 4. Other fruit products.

Results

The results of the QUAIDS model in table 4.2 illustrates that age and gender do not have any significant effect on fruit consumption. Low education members had a higher marginal effect on melons and grape consumption, than additional members of mid-level and higher education. And each additional highly educated member in a household would increase the expenditure share on melon and grape consumption; other fresh fruit consumption at home; apple and banana consumption away from home; and melon and grapes consumption away from home.

Compared with the high-income group, mid-level income and low-income households consume less bananas and apples away from home and melons and grapes away from home. The results also indicates that, when compared with high income households, mid-level income households consume more of their share of expenditures on melons and grapes at home, while low income households consume more of other fruit products.

Table 4.2. QUAIDS estimation

	AB		OFF		MG		OFP	
AGE1	0.044		-0.11		0.034		0.015	
	[0.572]		[0.23]		[0.702]		[0.81]	
AGE2	0.014		-0.101		0.066		-0.004	
	[0.855]		[0.271]		[0.457]		[0.951]	
AGE3	0.043		-0.117		0.065		0.007	
	[0.58]		[0.203]		[0.465]		[0.912]	
AGE4	0.047		-0.099		0.045		0.021	
	[0.546]		[0.28]		[0.608]		[0.735]	
ED1	-0.01		-0.018		0.046	**	-0.003	
	[0.287]		[0.114]		[0]		[0.64]	
ED2	-0.017	**	-0.015		0.038	**	-0.009	
	[0.041]		[0.129]		[0]		[0.192]	
ED3	-0.025	**	0.03	**	0.03	**	-0.001	
	[0]		[0]		[0]		[0.838]	
GD1	-0.045		0.118		-0.057		-0.014	
	[0.558]		[0.195]		[0.52]		[0.818]	
GD2	-0.047		0.092		-0.047		0	
	[0.543]		[0.313]		[0.592]		[0.994]	
Inc1	0.025		-0.016		0.003		0.024	*
	[0.126]		[0.394]		[0.862]		[0.062]	*
Inc2	0.003		-0.014		0.026	**	0.012	
	[0.804]		[0.295]		[0.041]		[0.175]	

Table 4.2. QUAIDS estimation (continued)

	AB_{AFH}		OFF_{AFH}	MG_{AFH}		OFP_{AFH}
AGE1	0.006		-0.013	0.015		0.01
	[0.809]		[0.77]	[0.657]		[0.87]
AGE2	0.006		-0.012	0.032		-0.001
	[0.794]		[0.788]	[0.355]		[0.98]
AGE3	-0.001		-0.014	0.016		0.001
	[0.964]		[0.749]	[0.633]		[0.987]
AGE4	-0.004		-0.018	0.01		-0.002
	[0.865]		[0.683]	[0.769]		[0.973]
ED1	-0.002		-0.002	-0.007	*	-0.003
	[0.542]		[0.707]	[0.081]		[0.674]
ED2	0.001		-0.003	0.002		0.002
	[0.774]		[0.58]	[0.518]		[0.718]
ED3	0.006	**	-0.002	0.006		0
	[0]		[0.337]	[0]		[0.985]
GD1	0.001		0.011	-0.008		-0.006
	[0.98]		[0.803]	[0.824]		[0.915]
GD2	0		0.008	-0.001		-0.005
	[0.997]		[0.858]	[0.977]		[0.93]
Inc1	-0.018	**	-0.001	-0.03	**	0.013
	[0]		[0.939]	[0]		[0.278]
Inc2	-0.013	**	-0.001	-0.016	**	0.002
	[0]		[0.897]	[0.001]		[0.782]

*** Significant at the 10% level**
****Significant at the 5% level**

Regional Effects

The statistical summary results in Figures 4.1 and 4.2 indicate that melon and grape, which are the fruit products of the survey season for most of households in this dataset by natural-consumption, ranked first in most cities for both at home and away from home consumption. All northern cities ranked in the first half of the eleven cities for average melon and grape at home consumption. Besides the melon and grape group, there was no significant difference in the average household consumption between the cities.

Figure 4.1. Average at home consumption of fruits

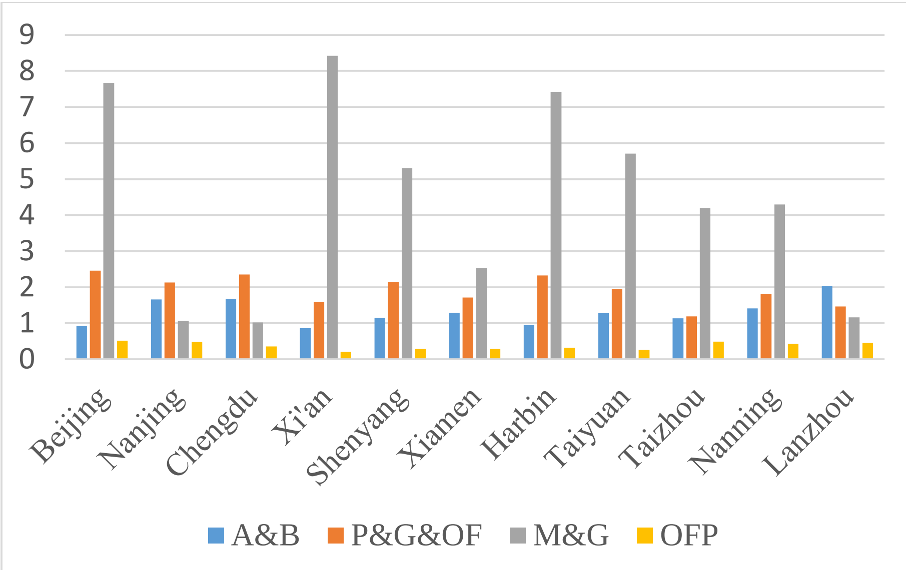
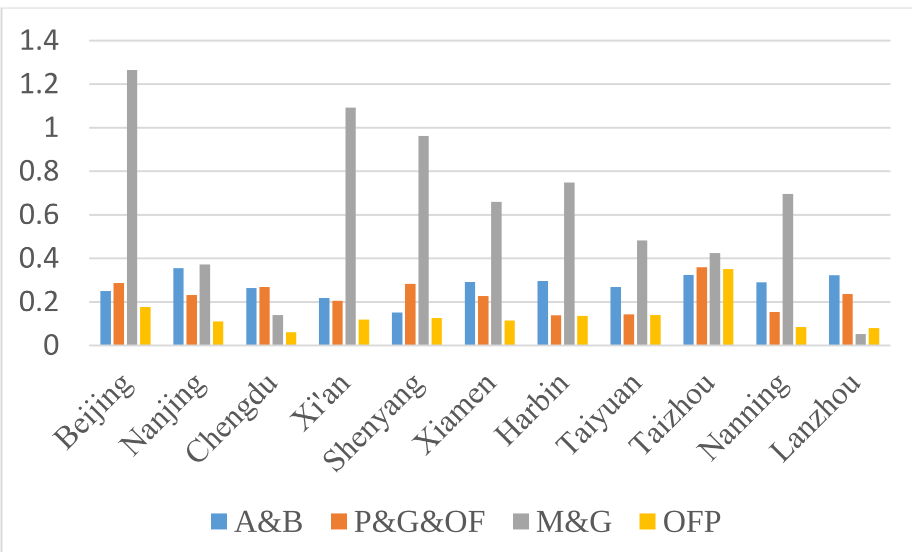


Figure 4.2. Average away from home consumption of fruits



The results of the QUAIDS model in Table 4.3 indicate that most city dummies are significant when predicting fruit consumption at home, but poor in the prediction of fruit consumption away from home. The northern cities of Beijing, Shenyang, and Harbin and the western city of Xi'an was found to consume less of a share of apples and bananas at home, when compared with the western city of Lanzhou. The southwestern cities of Chengdu and Nanning and the eastern cities of Nanjing, Taizhou, and Xiamen spent more of their share of fruit expenditures on apple and banana consumption at home. Shenyang was the only city to have a significantly higher consumption of pears, oranges and other fresh fruits, as compared to Lanzhou.

Xi'an and Harbin were the only two dummy variables that had higher marginal effects on the share of melon and grape consumption at home, as compare with Lanzhou. This implies that western cities dominated the consumption of melons and grapes. For other fruit products at home, the eastern city dummies dominated the marginal effect on expenditure share.

The away-from-home consumption of fruits, in terms of the melons and grapes group and the apples and bananas group, did not have a sufficient city dummy with a significant effect, so the regional effects were difficult to compare. The southwestern, western and northern cities had a more positive marginal effect on the share of pears, oranges, and other fruits away from home in terms of consumption. There was no significant regional difference for the other fruit products away from home.

Table 4. 3. Regional and city effects

		AB		OFF		MG		OFP	
North	Beijing	-0.065	**	-0.004		-0.093	**	-0.006	
		[0.001]		[0.881]		[0]		[0.708]	
	Shenyang	-0.082	**	0.124	**	-0.128	**	0.014	
		[0]		[0]		[0]		[0.409]	
	Harbin	-0.074	**	-0.042		0.108	**	-0.025	
		[0.001]		[0.105]		[0]		[0.139]	
	Taiyuan	-0.022		-0.097	**	-0.053	**	0.089	**
		[0.345]		[0]		[0.046]		[0]	
SW	Nanning	0.217	**	-0.088	**	0.029		0.035	**
		[0]		[0.001]		[0.257]		[0.047]	
	Chengdu	0.103	**	-0.007		-0.238	**	0.035	**
		[0]		[0.8]		[0]		[0.05]	
East	Nanjing	0.085	**	-0.031		-0.239	**	0.072	**
		[0]		[0.23]		[0]		[0]	
	Xiamen	0.074	**	0.012		-0.21	**	0.069	**
		[0.002]		[0.671]		[0]		[0]	
	Taizhou	0.048	**	-0.088	**	0.029		0.008	
		[0.031]		[0.001]		[0.257]		[0.656]	
W	Xi'an	-0.068	**	-0.069	**	0.103	**	-0.027	
		[0.002]		[0.007]		[0]		[0.115]	

Table 4.3. Regional and city effects (continued)

		AB_{AFH}		OFF_{AFH}		MG_{AFH}		OFP_{AFH}	
North	Beijing	0.004		0.033	**	0.045	**	0.086	**
		[0.497]		[0.004]		[0]		[0]	
	Shenyang	-0.004		0.034	**	0.011		0.03	*
		[0.507]		[0.005]		[0.249]		[0.071]	
	Harbin	-0.004		0.022	*	0.013		0.003	
		[0.531]		[0.072]		[0.186]		[0.848]	
	Taiyuan	-0.004		0.045	**	0.009		0.032	*
		[0.571]		[0.001]		[0.388]		[0.063]	
SW	Nanning	0.004		0.042	**	-0.019	*	0.015	
		[0.515]		[0.001]		[0.061]		[0.378]	
	Chengdu	0.028	**	0.058	**	-0.016		0.037	**
		[0]		[0]		[0.122]		[0.03]	
East	Nanjing	0.029	**	0.028	**	0.002		0.054	**
		[0]		[0.021]		[0.866]		[0.001]	
	Xiamen	0.018	**	0.034	**	0.004		-0.001	
		[0.013]		[0.013]		[0.728]		[0.969]	
	Taizhou	0.001		0.012		0.005		-0.015	
		[0.899]		[0.327]		[0.619]		[0.379]	
W	Xi'an	0		0.025	**	0.015		0.02	
		[0.988]		[0.04]		[0.121]		[0.21]	

*** Significant at 10% level**
****Significant at 5% level**

From an elasticity perspective, the at home expenditure elasticity for all fruit groups was quite stable throughout the cities. The results could still tell that the northern cities had a higher elasticity for melons and grapes. The northern cities were also more willing to purchase more fractions of those fruits when their expenditures on fruits increased.

Besides Xi’an’s melon and grape consumption, the other two western cities of Chengdu and Lanzhou were found to have a lower average consumption for each fruit group, but their expenditure elasticity for those fruit items were quite high. This is because Western China’s economic scale is comparatively lower than that of the other parts. The results also indicate that the eastern cities have a more stable elasticity and average consumption for all of the fruit groups.

The results in Table 4.4 show that pears, oranges and other fresh fruits have the highest expenditure elasticity for the at home group. This is interesting, because those fruits in the market for sale in this season. Recent information illustrates that Chinese customers have a really defensive attitude towards genetically modified food (GMO) products. Customers seem to have a positive attitude for human involved modification, as long as it is not from the genetic level. Melons and grapes have the highest expenditure elasticity among the away from home group; apples and bananas away from home were also elastic.

Table 4.5 illustrates that all fruits at home have more than a unit own-price elasticity for the uncompensated elasticity. Apples and bananas had the highest own-price elasticity for at home consumption. There was also an extremely high negative relationship with apples and bananas away from home. This might occur, because people's attitudes towards easily accessible fruits at home are quite flexible. Once the price increase, a lot of customers would quit consuming the product and only consume it again after a price drop.

The melons and grapes' away-from-home price would have a noticeable negative effect on the apples and bananas away from home consumption. This illustrates that melons and apples and bananas away from home complement each other. Melons and grapes are also a strong substitute for pears, oranges, and other fresh fruits, when consuming away from home. The results presented in Table 3.6 show that the compensated elasticities were similar to the uncompensated elasticities.

Most of the fruit group had a positive cross price elasticity. This makes sense, because the at home price and the away from home price were highly correlated.

Table 4.4. Fruit expenditure elasticities

Variable	Mean	Std. Dev.
A&B	0.928182	0.010595
OFF	1.100492	0.010358
M&G	0.9203059	0.005035
OFP	0.8472559	0.009748
$A\&B_{(AFH)}$	1.958413	0.093665
$OFF_{(AFH)}$	0.5562752	0.044363
$M\&G_{(AFH)}$	3.671798	0.158395
$OFP_{(AFH)}$	0.669443	0.031811

Table 4.5. Uncompensated elasticity

	A&B	OFF	M&G	OFP	$A\&B_{(AFH)}$	$OFF_{(AFH)}$	$M\&G_{(AFH)}$	$OFP_{(AFH)}$
A&B	-1.68	0.30	0.45	0.00	-0.21	0.00	0.35	-0.13
OFF	-0.02	-1.29	0.23	0.03	-0.02	0.11	-0.11	0.01
M&G	0.11	0.24	-1.23	-0.09	0.10	0.00	0.00	-0.10
OFP	-0.08	0.46	0.08	-1.56	0.03	0.13	0.29	-0.23
$A\&B_{(AFH)}$	-3.56	0.96	2.97	-0.46	-0.53	0.74	-0.61	-0.96
$OFF_{(AFH)}$	-0.94	1.04	0.19	-0.41	-0.09	-0.98	0.78	-0.34
$M\&G_{(AFH)}$	0.83	-1.47	-0.09	0.01	-1.67	2.08	-0.16	-1.69
$OFP_{(AFH)}$	-0.53	0.93	0.18	-0.34	0.04	0.40	0.24	-1.84

Table 4.6. Compensated elasticity

	A&B	OFF	M&G	OFP	$A\&B_{(AFH)}$	$OFF_{(AFH)}$	$M\&G_{(AFH)}$	$OFP_{(AFH)}$
A&B	-1.52	0.57	0.74	0.09	-0.20	0.04	0.36	-0.08
OFF	0.17	-0.98	0.58	0.14	0.00	0.15	-0.10	0.06
M&G	0.26	0.50	-0.94	0.00	0.12	0.04	0.01	-0.05
OFP	0.06	0.70	0.35	-1.47	0.04	0.16	0.30	-0.19
$A\&B_{(AFH)}$	-3.22	1.52	3.59	-0.26	-0.49	0.82	-0.58	-0.86
$OFF_{(AFH)}$	-0.84	1.20	0.37	-0.35	-0.08	-0.96	0.79	-0.31
$M\&G_{(AFH)}$	1.47	-0.42	1.08	0.37	-1.61	2.22	-0.11	-1.50
$OFP_{(AFH)}$	-0.42	1.12	0.39	-0.27	0.05	0.43	0.25	-1.81

Conclusions

The average fruit consumption was quite similar for all of the cities. The evidence of a regional difference was found in the QUIADS estimation. It illustrated that Southwest and Eastern China spent a larger proportion of their expenditures on apples and bananas at home. Households from West China spent a larger proportion of their expenditures on melons and grapes at home, but less of pears, oranges and other fresh fruits away from home. The northern cities had a higher elasticity and volume of consumption for melons and grapes, but they had a low consumption elasticity for apples and bananas. The eastern cities had a more balanced diet for each fruit group.

The results illustrate that the demographics, besides the city, did not offer a significant prediction value for fruit consumption. The city dummy was only good for production for fruit consumption at home.

From elasticity aspect, grape and melon have the highest away-from-home expenditure elasticity while other fresh fruits have the highest at-home consumption elasticity. This indicates that people are more elastic to fruits from current season when consume away from home but more acceptable to fruits that not from current season when consume at home. While consuming away from home, grapes and melons became strong substitution of other fresh fruits.

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CHAPTER 5. CONCLUSIONS

Regional Differences

Regional differences have been identified for both beverages and fruit in China. For beverage consumption, people living in Northern and Western China have a higher per household consumption of alcoholic beverages. The consumption of non-alcoholic beverages had no significant regional differences. Three northern cities had the highest per household consumption of beer for both at home and away from home. Northern China had a lower elasticity away from home for healthy drinks.

All parts of China had a similar total average consumption of fruits, but the preferences were different. The households from Eastern China preferred to consume a balanced amount of each fruit, but households from Northern China consumed more watermelons and grapes, but fewer apples and bananas.

The demographic characteristics were found to be useful when predicting the consumption share of beverages. They were not that effective when predicting the consumption of fruits.

Income Effect

The empirical results suggest that income plays an important role when people choose whether to consume and how much they will consume. As income increases, the households would consume more of the beverages away from home, especially alcoholic beverages. Income had no significant influence on fruit consumption.

Effect of Education

Education plays a different role for alcoholic beverages in China than other countries. Households that are higher educated have more of a possibility of consuming alcohol away from home, but those households with more lower educated members are more likely to consume alcoholic beverages at home. Household members with a higher educational background would put a larger share on away from home alcoholic beverage consumption. For fruit consumption, education always influences it in a positive way. Households with higher educated members tend to consume more of a share of fruits, as compared with lower educated households.

Effect of Age

An increase in the number of members in a household was always positively related to the share of alcoholic beverage consumption, but this effect was lowest for children, among all of the age groups. A household with more middle-aged and young members tended to consume more shares of alcoholic beverages. An additional young member had the highest effect on away from home beer consumption.

Summary of the Other Findings

A strong substitution effect was found between beverage consumption at home and away from home. This means that, for a certain type of beverage, away from home consumption can be substituted for at home consumption. For fruit, two consumption locations were quite segmented. Customers were willing to have more healthy drinks at home, but better flavored or stronger alcoholic beverages away from home. Beer was a complement for wine and liquor. Beer can also be complementary for soft drinks at home. But it became a substitute for soft drinks, when consumed away from home.

Recommendations for future study

When doing research on alcoholic beverage consumption, we found that there is one interesting consumption difference between Asian customer and customer from rest of the world. That is Asian people tend to drink alcoholic beverage while eating, but customers from rest of the world like to drink alcoholic beverage separate from eating. This will influence consumption of alcohol from different aspects. For example, people from China are more likely to consume at a restaurant but people from United States are more likely to consume at a bar. This may also have impact on how people communicate, and how much of alcoholic beverages they would consume as well.

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