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DEMAND FOR PORK AND MEAT IN CHINA

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DEMAND FOR PORK AND MEAT IN CHINA

THESIS

A thesis submitted in partial fulfillment of the
requirements for the degree of Master of Science in
Agricultural Economics in the
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By

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ABSTRACT OF THESIS

DEMAND FOR PORK AND MEAT IN CHINA

As the per capita disposable income increases, the demand for meat is boosting in China. Pork, accounting for the largest part of Chinese meat consumption, plays an important role in meat demand in China. This study use data collected from a 2014 survey on Chinese meat consumption; four widely different Chinese cities, Beijing, Changsha, Tianjin and Wuhan are selected to provide a more complete view of Chinese pork and meat demand. We use both OLS model and Tobit model to analyze the effects of consumers' socio-demographic characteristics such as age, gender, income, and education on pork and meat demand. Results show that income, marital status, household size have statistically significant effects on pork and meat demand in China. Household heads with children under 18 years old tend to prefer uncooked meat while households with household heads who identify themselves as urbanites tend to spend a significant larger amount of money on cooked or semi-cooked meat.

KEY WORDS: Pork, Meat, OLS, Tobit, China, Demand

Hao Dong

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CHAPTER 1: INTRODUCTION

Over the past three decades, China has experienced rapid economic growth coming along with rapid nutrient transformation and changes in food structure: fiber-dominated traditional dietary systems are being replaced by meat-based Western dietary systems (Yu and Abler 2009; Tian and Yu 2013). Meat, traditionally a rare and precious food, was consumed only during festivals and major ceremonies such as weddings and funerals. Nevertheless, it has become the daily food for most Chinese consumers. According to the Food and Agriculture Organization of the United Nations (FAO) food balance sheet statistics, China's per capita meat consumption increased from 10.3 kilograms in 1978 to 55.6 kilograms in 2011. Considering the size of China's large population, the Chinese meat industry will inevitably affect world meat industry in the context of a globalized world.

China is the largest pork consumer in the world. In 2014, China consumed 57 million metric tons of pork in total, which accounted for more than half of the global pork consumption (109.9 million metric tons). On average, a Chinese consumer consumes 39 kg of pork per year (about one-third of a pig). According to the projection of the OECD and the Food and Agriculture Organization of the United Nations, Chinese consumers will contribute to half of the global pork consumption increase in the next decade. Also, China is the largest pork producer worldwide, slaughtering 621 million pigs in one year; this accounted for 48% of the world

slaughter and yielded 47.6% of the world pork production (Wang, 2006). Without a doubt, China will continue to influence the world's pork industry in every aspect.

In the past, China was self-sufficient in pork consumption. However, the situation has changed in recent years. In 2007, China began to import significant quantities of pork for the first time in order to make up for the domestic supply shortage. From 2007 to 2014, Chinese pork imports significantly increased, with an annual average growth rate of 150%. Given this astounding appetite for pork, even a small change of Chinese pork imports can account for a significant amount of the world's exports. Thus, understanding the Chinese pork consumption patterns is not only important to the Chinese pork industry, but also beneficial to all stakeholders in the world pork supply chain.

There is a need for more detailed analyses of the Chinese pork market. Consumers, as the indispensable subject, greatly influence the pork market. Ahmed and Mohamed (2007) stated that other than the effects of evolving relative prices and rising incomes, growth in meat consumption is associated with changes in consumers' dietary patterns, tastes, preferences, and the overall level of marketing and distribution channels. Newman and Matthews (2002) suggested that markets for different types of meat offer unique characteristics that meet the needs of consumers with different lifestyles. For example, younger, urban and professional consumers tend to prefer prepared meals because they value convenience. However, processed

food contains large amounts of salt, nitrates and chemical preserves that can be harmful to human health (Wang and Beydoun, 2009). Consumers who value health will prefer fresh food to processed food. Overall, social-demographic characteristics are associated with meat consumption.

The purpose of this study is to first provide an overview of the current Chinese pork and meat consumption using data collected from a 2014 survey on Chinese meat consumption. Second, data from four widely different Chinese cities, Beijing, Changsha, Tianjin and Wuhan, are gathered to provide a more complete view of Chinese pork and meat demand. Third, we further examine the effects of Chinese consumers' demographic characteristics on pork and meat demand.

This paper will proceed as follows. Chapter 2 presents background information on the history, demand, supply and trade of pork in China. In Chapter 3 we will present relevant literatures on pork and meat demand in China and all over the world, especially focused on consumers' social-demographic features and their effects. In Chapter 4 we will talk about the data collection, the design of the survey and the statistic description of the data. Chapter 5 explains the research methodology, variables and empirical models used in analyzing our data. Chapter 6 displays and interprets the empirical results, followed by a discussion of the results. Chapter 7 draws conclusions of this study and offers ideas for future analysis.

CHAPTER 2: BACKGROUND

2.1 History of Pork and Pork Demand in China

Pork has been at the center of Chinese culture, cuisine and family life for thousands of years. Historians believe that 10000 years ago people in China were the first to domesticate wild boars in the world (Bosse *et al.*, 2015). The character for the Chinese word “family” is a pig under a roof, which reflects pigs as the symbol of household wealth. Pigs, as one of the most important family assets, were extremely valued by ancient Chinese families. Moreover, the Pig is one of the 12 signs of the Chinese zodiac. Those who are born in the year of the pig are thought to be diligent, generous and born with luck. In addition, pigs are thought to be a symbol of prosperity, fertility and virility in Chinese culture. There are a number of poems, stories and other art works about them. Miniature clay pigs were found in graves from the Han Dynasty (206BC-220AD). Also, pigs have always been an important part in Chinese traditions of commemoration and festivity for a long time. In the Chung Yeung Festival (a major festival in Chinese culture on the ninth day of Lunar September), male elders would gather at the tomb of their ancestors and slaughter a pig as a symbol of the continuous contribution to their ancestors.

Back in the days of the modern era, almost every rural home once owned a pig. Pigs were so important and common that they werfe even part of the household recycling system. They consumed food waste and their droppings were valued for

fertilizing crops and plants. More importantly, pork has always been central to Chinese cooking recipes, and the Chinese do not waste any part of the pig. Pigs' faces are served whole as a gourmet treat; their feet and tails are very popular and even brains are used for certain meals. From foot to tail, the Chinese eat the whole hog.

For a long time in China's history, pork was a luxury for most people that could only be consumed rarely. Before 1949, the establishment of the People's Republic of China, meat in general was a luxury. Only 3% of Chinese people's annual calorific intake was from meat. After that, meat became even scarcer, especially in the late 50s and early 60s. However, the economic transformation that happened in the late 70s and early 80s changed the situation a lot. Today, the case is totally different. Pork is not a luxury anymore. Instead, Chinese people consume a large amount of pork every day. On average, Chinese people eat 39kg of pork a year (nearly a third of a pig), more than the Americans (who typically prefer beef), and five times more per person today than what they ate in 1979 (Wang, 2006).

But new issues occur. The roaring demand for pork requires a huge amount of domestic feeding crops, such as soy and corn, which China cannot produce. China has to import a large amount of feeding crops to meet the increasing need. At present, about 80% of China's pork output comes from individual households, which are extremely small (Pan, 2002). Because there are millions of small farms that react to

free market signals, this hog market is more volatile than that under coordinated arrangements. Also, poor sanitary and pork safety problems cannot be ignored. For example, animal disease is usually a problem of individual household hog farming, which would cause human health problem if not treated. Feed pollutions such as pesticide residues and microbial contamination are also possible pork safety problems.

2.2 Live Pig and Pork Production in China

For a long time, China has been the largest live pig and pork producing country in the world. About 48-50% of the world's live pigs are grown in China (Wang, 2006). In 2014, the total meat production was 87 million tons, increasing 3.34 million tons from 2013. Specifically, the pork production was 56.7 million tons, increasing 1.78 million tons, or 3.2%, from 2013. In Figure 2.1, from 1980 to 2014, the pork production constantly increased, while in 2007 there was a major decrease in pork production. The decrease of production in 2007 was not only due to the outbreak of blue ear disease, but also to the low price caused by oversupply in fall 2005 to fall 2006 (Zhang, 2008).

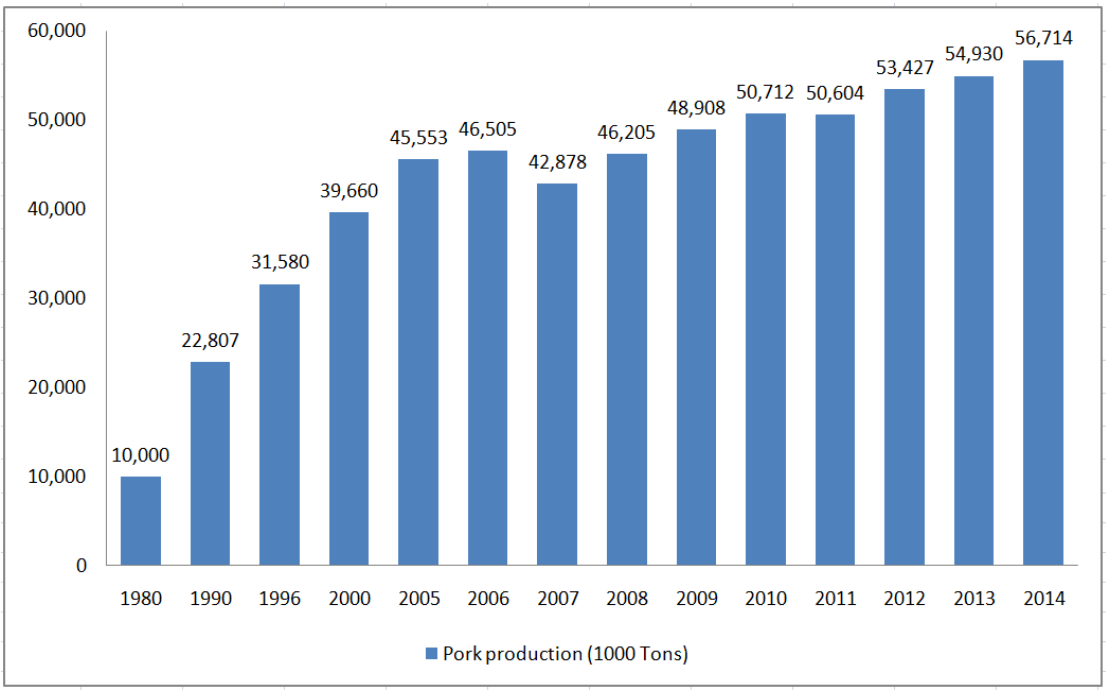

Figure 2.1 1980-2014 China's pork production

Sources: 2015 China Statistical Yearbook; Data in year 1980 and 1990 is based on Wang (2005)

Table 2.1 shows that in 2014, China had 465.8 million pigs on farms and slaughtered 735 million pigs. In 1990, about 310 million pigs were slaughtered from a 336 million national population of pigs (Wang, 2005). Table 2.2 shows that from 1990 to 2004, the percentage of the percentage of China's pork production to the world's total pork production has increased from 33.6% to 48.6%; the percentage of the world's pork production in China has increased from 32.6 to 47.6%. These data indicate that China's pork productivity increased drastically in the last 25 years.

Table 2.1 Change in pig productivity from 1980-2014

Year	Stock (1000 head)	Slaughter (1000 head)	Pork production (1000 Tons)	Slaughter as % of stock	Pork/stock pig (kg/y)
1980	300,000	139,860	10,000	46.62	33.3
1990	336,240	309,969	22,807	92.19	67.8
1996	362,836	412,252	31,580	113.62	87.0
2000	416,336	518,623	39,660	124.57	95.3
2005	433,191	603,674	45,553	139.36	105.2
2006	418,504	612,073	46,505	146.25	111.1
2007	439,895	565,083	42,878	128.46	97.5
2008	462,913	610,166	46,205	131.81	99.8
2009	469,960	645,386	48,908	137.33	104.1
2010	464,600	666,864	50,712	143.54	109.2
2011	468,627	663,261	50,604	141.53	108.0
2012	475,922	697,895	53,427	146.64	112.3
2013	474,113	715,573	54,930	150.93	115.9
2014	465,827	735,104	56,714	157.81	121.7

Sources: 2015 China Statistical Yearbook; Data in year 1980 and 1990 is based on Wang (2005)

Table 2.2 The percentage of China's pork product to world production

Year	Pig slaughter (%)	Pork production (%)	Pig stock on farms (%)
1990	33.6	32.6	42.3
1998	46.2	46.1	44.3
2000	44.9	45.0	46.3
2004	48.6	47.6	49.4

Wang (2001) divided China into 4 key pig-producing regions: Yangzi River Region (Anhui, Zhejiang, Jiangsu, Jiangxi, Hunan, Chongqing, Sichuan, and Guizhou provinces) with 43.8% of China's national pork production; Northern China Region (Hebei, Henan, and Shandong provinces) with 21.6% of national pork production; Northeast region (Heilongjiang, Jilin, and Liaoning provinces) with 6.3% of national pork production; Southeastern coast region (Guangdong, Fujian, Yunnan, and Hainan provinces) with 13.2% of national production. The Yangzi River and Northern China regions are the two most important pork producing and distributing areas in China. Figure 2.2 shows that, in 2014, Sichuan, Henan, Hunan, Shandong, Hubei, Yunnan, Guangdong, and Hebei were the eight leading provinces in pork production, contributing to 54% of the national production.

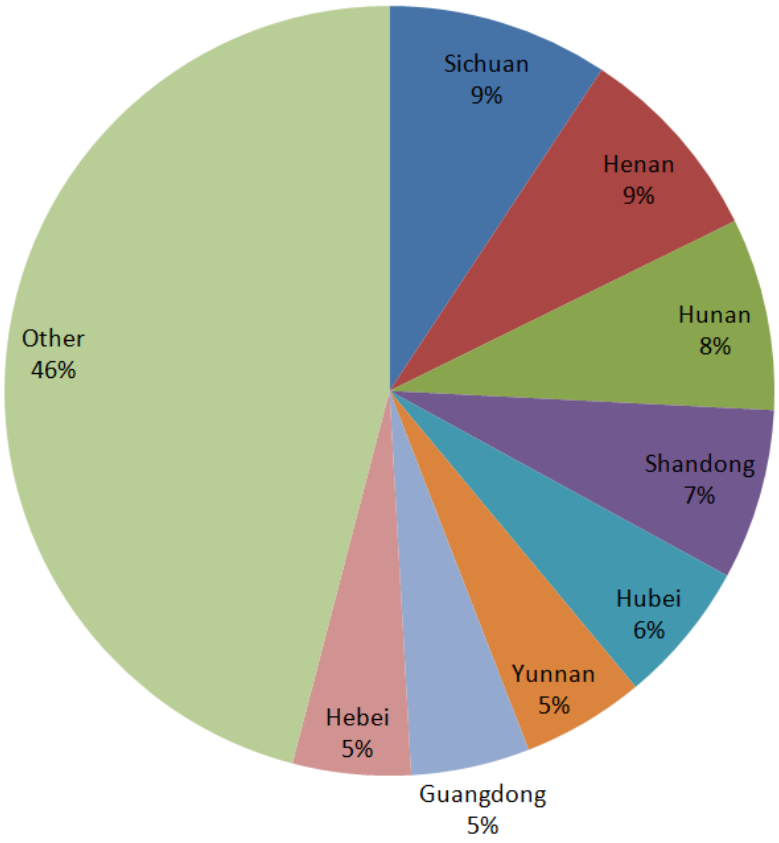

Figure 2.2 The percentage of provinces' to national pork production in 2014

Source: 2015 China Statistical Yearbook

2.3 Pork Consumption in China

China reached profound and lasting economic growth in the last 3 decades; Chinese people's income and living standard have been improved significantly. Data from the National Bureau of Statistics of China shows that the Per Capita Disposable Income of Urban Households increased by 11.46 times between 1978 and 2012, and the increase in the Per Capita Disposable Income of Rural Households is even larger in the same time period. The Engle Coefficient (i.e., food expenditure as a proportion

of total household spending) of Urban Households (%) decreased from 57.5 to 36.2 during 1978 to 2012; the Engle Coefficient of Rural Households (%) decreased from 67.7 to 39.3 during the same time period (Figure 2.3).

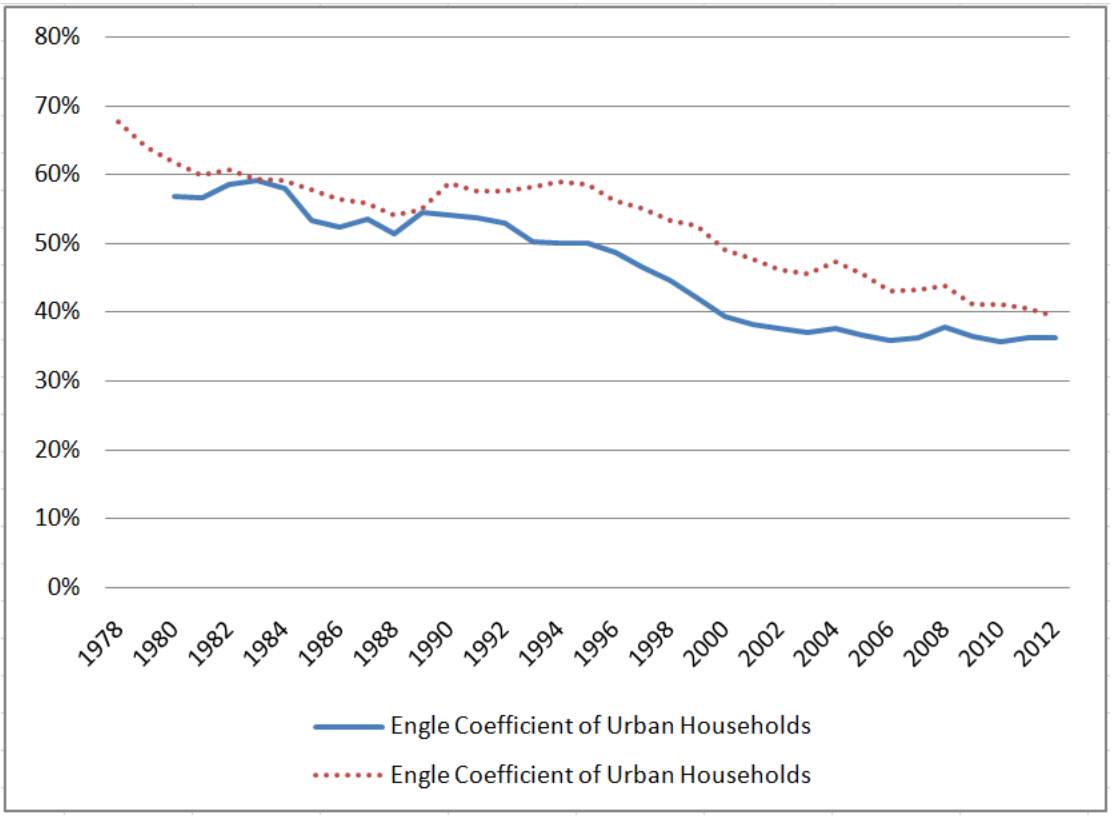

Figure 2.3 1978-2012 the Engle coefficients of urban and rural households (%) in China

Source: China Statistical Yearbook

The increase in income and living standard has resulted in changes to Chinese people's lifestyle and dietary patterns. The proportion of grains is decreasing while animal protein is increasing. Figure 2.4 shows that, pork, as Chinese people's favorite meat, has an overall increasing trend in consumption. While the market share of other meat is rising, pork is still the leading meat in China. Table 2.3 shows that Chinese consumers are so fond of pork that it keeps taking up more than half of

Chinese people's meat intake.

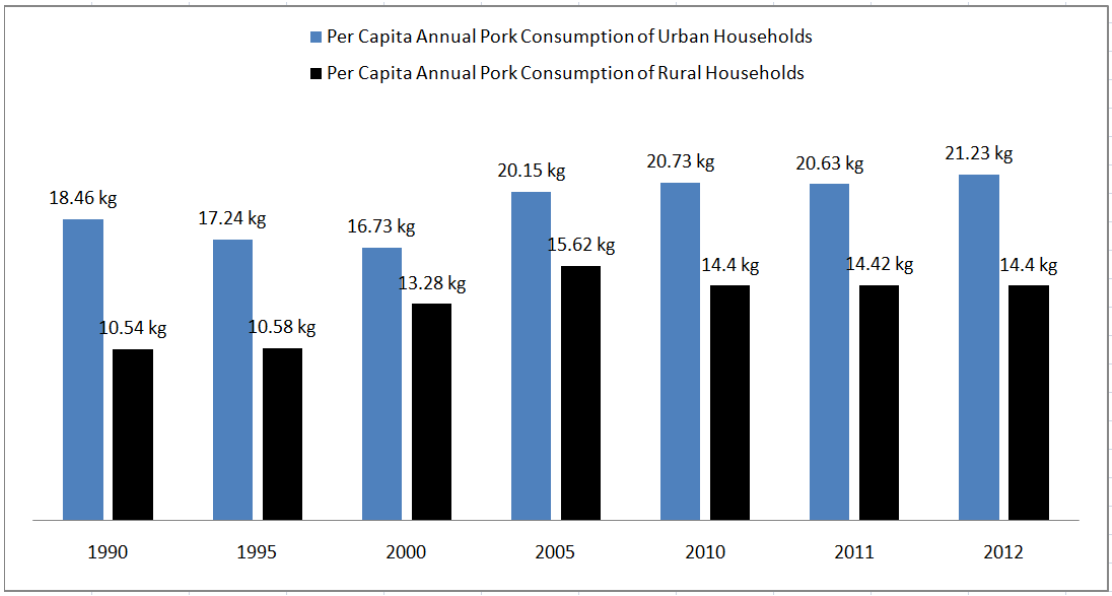

Figure 2.4 1990-2012 per capita annual pork consumption of urban and rural households in China

Source: 2013 China Statistical Yearbook

Table 2.3 Pork output and its share in total meat (1000 tons) in China

Year	Total meat	Pork meat	Pork share in total meat
1996	45,840	31,580	68.9%
1997	52,688	35,963	68.3%
1998	57,238	38,837	67.9%
1999	58,207	38,907	66.8%
2000	61,246	40,314	65.8%

Source: China Statistical Yearbook, various issues

Chinese consumers' preference for pork is highly complementary to that of the U.S. consumers (Amponsah, 2003). Chinese consumers tend to discount those premium cuts (loins and tenderloins) most in demand in the U.S. market, and prefer small pieces of strong-tasting variety meats (stomach, tongue, kidney and so on) that are less desired by the Americans. For instance, the ratio of pork tongue price to loin price in China is 135% while the same ratio in the United States is only 41% (Table 2.4). Hence, both Chinese and U.S. consumers will benefit from lower pork price if the U.S. export variety meat to China.

Table 2.4 Price comparison for pork cuts and variety meats in China and the U.S.

Pork product	China price ($/lb.)	Ratio of product price to loin price in China	U.S. price ($/lb.)	Ratio of product price to loin price in U.S.
Loin	1.20	1.00	1.32	1.00
Lung	0.24	0.20	0.03	0.02
Stomach	2.16	1.50	0.54	0.40
Kidney	1.56	1.30	0.17	0.13
Lark	0.72	0.60	0.25	0.19
Feet	0.87	0.72	0.20	0.15
Boneless Butt	1.20	1.00	0.81	0.61
Ham	1.27	1.06	0.84	0.63
Tongue	1.61	1.35	0.55	0.41
Small Intestine	0.70	0.50	N/A	N/A
Large Intestine	0.38	0.31	N/A	N/A
Nape of Neck (incl. bones)	1.32	1.10	0.10	0.07
Head Mask	0.33	0.28	N/A	N/A

Source: Hayes (1997)

2.4 China's Pork Trade

China is the largest consumer and producer in the world, and highly self-sufficient. Thus, China's pork trade is not in a large scale. Before 2006, China was a net pork exporter, with an importing amount of 200-300 thousand tons.

However, in recent years, Chinese pork imports increased. The reason is that Chinese pork prices have significant fluctuations. In 2007, the blue ear disease led to great decrease in pork production, and the pork price increased, boosting the pork trade with other countries. In that year, China imported 436.2 thousand tons of pork, and continued to increase for the following years (Table 2.5). It is worth noting that, in 2009, the pork import had a major decrease. That is because, at that time, there was a break out of H1N1 pig flu in the United States, Canada and Mexico, and China suspended the importing from the United States.

Although China's pork import is constantly increasing, the imported pork only make up for a small portion of the total national pork consumption. The percentage of imported pork to the total national pork amount is only 2.54% in 2013 (Table 2.5).

Table 2.5 The percentage of imported pork to national pork consumption 2007-2013

Year	2007	2008	2009	2010	2011	2012	2013
Imported pork	43.62	91.20	52.90	90.40	134.98	135.90	139.50
Total pork consumption	4287.82	4610.50	4890.76	5071.24	5060.43	5342.70	5493.03
Percentage of imported to total (%)	1.02	1.97	1.08	1.78	2.67	2.54	2.54

Source: China Customs Yearbook, various issues

China's pork importing sources are highly concentrated. From 2011 to 2014, on average, the top 3 importing sources were the United States, Denmark and Germany (Table 2.6). Among the top 3 sources, the U.S. contributed to the market far more than the other two countries. Nevertheless, we can tell that there's a trend of source diversification since the amount from countries other than the five major sources increased a lot, from 1.5% to 11.8%. This diversification is helpful for the stability of China's pork importing.

Table 2.6 Sources of imported pork products in China (%)

Source Country	2011	2012	2013	2014 (Jan. to Aug.)	Average
U.S.	59.3	43.4	27.6	33.1	40.9
Denmark	15.5	16.2	17.7	19.4	17.2
Germany	3.8	11.5	17.1	11.3	10.9
Canada	9.3	9.9	12.5	8,9	10.1
Spain	5.7	7.9	9.5	9.4	8.1
France	5.0	4.4	6.3	6.1	5.5
Others	1.5	6.7	9.3	11.8	7.3
Total	100	100	100	100	100

Source: China Customs Yearbook

CHAPTER 3 LITERATURE REVIEW

3.1 Role of Pork Production in China

Pork is the main meat product consumed and produced by the Chinese. Although the share of pork in total meat consumption has been steadily declining since the 1980s, it still exceeds 60% of total meat consumption. In this context, some recent studies are particularly concerned with Chinese pork production.

Traditional small-scale pig free-range methods are shrinking while large-scale pig farms are booming. According to a study by Yu and Abler (2014), the proportion of free-range hog production was 85% in 1991 but dropped to 48% in 2009. About half of the pork was still produced in China by small-scale backyard farmers in 2009.

Tian *et al.* (2015) studied the efficiency of pig production in rural areas. They investigated the technical efficiency of Chinese hogs and their determinants, using data from a 2004 to 2010 household survey by the Research Center for Rural Economy (RCRE).They found that the average technical efficiency of pig production in China was 59%. More importantly, large-scale and professional farmers have higher technical efficiency than other farmers. Eastern China's pork production technical efficiency is higher than those of the central and western regions. The total factor productivity (TFP) of farmer pork production decreased by 20.6% from 2004

to 2010; this was mainly due to negative technological changes, because there was no substantial change in scale efficiency and technical efficiency. The study also pointed out that the technical efficiency of hog production in China could be raised by 40% through methods of specialization, education, and technology spillovers from the eastern region to the central and western regions.

Zhou *et al.* (2015) used provincial aggregated data to study the environmental efficiency and technical efficiency of pig production in China. The study found that feed was the most efficient input factor, with a yield elasticity of 0.55, well above other inputs such as capital and labor. As for environmental factors, the output elasticity coefficient of nitrogen is 0.29 on average. Hog production scale elasticity is slightly larger than 1, that is, the scale of hog production is increasing returns to scale.

3.2 Literature of Pork Consumption in China

Previous studies provide evidence that income, regions, and living in urban or rural area affect pork consumption in China. Data from Li and Zhang (2001) suggested that pork consumption by urban residents was higher than that if rural residents, with a ratio of 1.6:1.The growth of domestic pork consumption was due to an increase in urban resident consumption. Pork demand has also grown in the rural areas as the economy and living standard has improved. The increase in pork

consumption was observed in the urban areas where rural workers have migrated to find jobs.

Disparity in incomes is a growing issue because economic development is uneven among the eastern and western regions in China.

Pan and Kinsey (2002) divided Chinese pork consumers into three groups: 1) consuming at a low level due to a lack of both supply and purchasing power (consumers in rural area); 2) meeting basic requirements for pork and consuming in a traditional way (low and middle class consumers); and 3) looking for brand and premium pork products (upper class and white-collar workers).

According to research conducted by Wang *et al.* (2014), the determinants of pork consumption in urban western China and the different consumption patterns across income strata were investigated with respect to income elasticity and price elasticity of demand. The paper proposes that consumers' decisions to purchase pork rely on both non-economic and economic factors. Accordingly, there's a large difference among the factors that determine the consumers' decision of how much pork to buy across the three income strata. As the results indicate, the income elasticity for low-income households is higher than those of middle-income and high-income households.

Previous studies suggest a trend in pork consumption that Chinese consumers' attitude has changed from demanding quantity to prioritizing quality and safety.

Ortega *et al.* (2009) provided an assessment and measurement of consumers' preferences as well as their attitudes toward imported pork in urban China. According to a survey conducted in 2008, estimated LOGIT models reveal that certain factors such as individuals' age, shopping location, and food safety concerns can significantly influence their willingness to pay for U.S. pork. Moreover, other factors affecting consumers' purchasing behavior of western-style pork cuts versus traditional Chinese cuts are also assessed. Consumers' previous lean-meat additive scare and a lack of confidence in the Chinese food inspection system count for their safety concerns for pork consumption.

Wang *et al.* (2010) did a research based on the data of a consumer survey in Jilin province. This paper analyzed consumers' perceptions of pork quality and safety, their willingness to pay for quality and safety pork, and used quantitative analysis to analyze consumers' purchasing quality pork and its influencing factors. The results showed that consumers' perception of pork quality and safety was relatively low, and the premium paid by consumers to high quality and safe pork was not high. Wang *et al.* (2010) also claimed that consumers' choice for purchasing high quality and safe pork is mainly affected by pork quality, consumers' safety concerns, as well as their education.

Liu *et al.* (2012) did a survey on Beijing pork consumers. The survey found that the "Clenbuterol-tainted pork" incident has an impact on pork consumption. Even

though the product consumption of "Shuanghui" (the largest Chinese pork company that happened the "Clenbuterol-tainted pork" scandal) fell, it still occupies the first position in the pork market. Consumer confidence in pork products decreased,. Consequently, people believe that the superior pig farms, customs clearance, quality supervision and inspection are the main ways to prevent such incidents. Consumers choose pork mainly based on the quality, the price and pork cuts, and compare to the maximum they are willing to pay for pork. And finally, the most popular pork cuts are pork belly and loin.

Yu, Gao, and Zeng (2014), and Yu, Yan and Gao (2014) point out that wealthy consumers have tendency to pay more for high quality food products such as "green food" and "organic food". For example, Chinese consumers are willing to pay 40% more than the price to buy "green" pork and 60% more than the price to buy organic pork. However, in China, consumers' trust in pork safety certification is still a major problem.

3.3 Studies on Meat Consumption

Previous literature on meat consumption has provided an idea of how meat demand responds to changes in price, income, as well as socio-demographic variables. Bansback (1995) and Huston (1999) argued that non-economic factors have been becoming more important in meat consumption patterns in recent years.

Also, Garcia-Jimenez and Mishra (2011) used Probit regressions to determine what influences consumers' decisions of purchasing meat products in U.S. Mejia and Peel (2012) investigated how demographic variables, particularly income, may affect cereals and meat consumption in Mexico. Van Phuong *et al.* (2014) conducted a research relating the Vietnamese' meat consumption to social-demographic characteristics of Vietnamese households. The analysis of demand for pork and poultry in Vietnamese households demonstrates that the meat demand in Vietnam is significantly affected by socio-economic and demographic factors of households. Research of Tan *et al.* (2015) indicates that household size, location of residence, ethnicity, age, education, and income are closely associated with patterns of household expenditures for fresh, frozen, and processed meat.

Some studies focused on the relationship between household size and meat consumption. Coffey, Schroeder, and Marsh (2011) suggested that there is a direct correlation between the number of family members and the quantity of ground beef consumed, while the relation between the number of family members and the quantity of beef steak demanded is reversed. Davis, Yen, and Lin (2007) found that the household size positively influence the consumption of chicken broiler parts and negatively influence the quantity of pork; Yen and Lin (2008) determined that household sizes negatively influence the consumption of poultry.

Income is an important factor that affects consumers' meat consumption and

preference. Coffey, Schroeder, and Marsh (2011) hypothesized that the households with higher incomes tend to purchase meat of better quality. In addition, Sheng, Tey *et al.* (2010) claimed that household income negatively influences the quantity of white meat consumed. Less wealthy households tend to view red meat as a source of daily protein while ignoring the higher health risk associated with it. As income increases, consumers are more likely to focus on a product's quality than quantity (Yu and Abler, 2009). It is expected that the proportion of meat consumed outside the house will increase as future income increases because wealthy consumers prefer to eat in restaurants and have processed food. Neglecting this part of the demand analysis will result in a lower estimate of income elasticity (Min *et al.* 2015).

Chen *et al.* (2015) provided a meta-analysis of the elasticity of food demand in China. The income elasticity of red meat (pork, beef, and lamb) is similar in this analysis. The income elasticity of these three meats is about 0.6, while the income elasticity of poultry is about 0.85, which is slightly higher than the red meat products. To demonstrate the dynamics of expenditure elasticity, Burggraf *et al.* (2015) estimated China's demand elasticity for meat products from 1997 to 2009. They found that the elasticity of unconditional meat expenditure remained at around 1.0 and did not change much during this time period (except for a slight decrease in pork products). The results of the study suggested that China's meat consumption will continue to increase with the future growth of income. In 2009, the expenditure elasticity of pork, beef, lamb, and poultry were 0.88, 1.04, 1.64, and 0.67

respectively.

There is a difference in meat preferences across regions, partly because of the differences inaccessibility to meat and type of residence (urban/rural) with respect to time available for home cooking. Newman, Henchion, and Matthews (2001) and Newman and Matthews (2002) suggested that urban residents prefer processed meat because of its convenience and shorter preparation time required. Burton, Dorsett, and Young (2000) found that metropolitan consumers in Britain are more likely to purchase meat and devote bigger sums of money to it. As for developing Asian countries, Ishida, Law, and Aita (2003) indicated that rapid urbanization and lifestyle changes were leading to greater consumption of both meat and food in general.

There is evidence to show that gender affects meat purchasing. Burton, Dorsett, and Young (2000) suggested that although there has been a change in this tendency, female-managed households are traditionally more likely to buy meat than male-managed households. The change can be explained by the fact that women have recently entered the labor market, thus becoming more interested in convenience-oriented meals. Wardle *et al.* (2004) found that men in Malaysia generally are perceived as the head of the households, who have greater power and responsibility; however, women tend to play an important role in food purchasing because they are more concerned with health and nutrition issues.

Studies have investigated how age can affect the quantity of meat consumption. Newman, Henchion, and Matthews (2001) concluded that older consumers have a tendency to purchase more meat than younger consumers for the following reasons: on the one hand, households managed by older individuals are likely to buy larger quantities of meat or have higher budget for better quality meat; on the other hand, younger individuals tend to seek convenience in meal preparation and accordingly prefer processed meat than fresh meat. However, Yen, Lin, and Davis (2008) argued that meat consumption generally declines with age mainly because of age-related changes in lifestyles, tastes, and preferences that are driven by increasing health concerns.

China is currently experiencing a change in its population structure as it enters an aging society. Regardless of the age structure of the population, using current elasticity to predict future meat consumption will cause large deviations. Min *et al.* (2015) stated that meat consumption tends to be lower in households with elderly members due to health problems while holding other factors constant. Thus, considering the demographic changes, the future growth of China's meat consumption may not be as large as forecasted with current elasticity.

Previous literature shows evidence that profession and occupation can influence meat consumption. Newman, Henchion, and Matthews (2001) stated that career professionals headed households spend less money on lamb, pork, bacon, ham,

chicken, and minced meat than households headed by blue-collar people. These results may be due to the negative perception of meat among consumers of professional social status. At the same time, career professionals are more likely to be short of time thus prefer processed meat that require less time to prepare to fresh meat that takes longer time to cook.(Newman, Henchion, and Matthews, 2001).

Education is another factor that affects meat purchasing behavior. Consumers who are better educated tend to purchase less meat and spend less money on red meat than consumers who are less educated (Yen and Lin 2008). This is because better educated consumers may have better dietary knowledge and/or access to scientific information thus they may be more aware of the risk of cholesterol and chronic diseases that may be caused by meat consumption. In addition, better educated consumers are more likely to purchase higher-quality traditional cuts of meat compared to other less educated consumers who purchase other types of meat (Newman, Henchion and Matthews, 2001).

CHAPTER 4: DATA

4.1 Data Collection and Design of Survey

The data we use are collected from a 2014 survey on Chinese meat consumption from four widely different Chinese cities: Beijing, Changsha, Tianjin, and Wuhan. Over 1000 randomly selected consumers responded to the survey. During July to August 2014, trained graduate students randomly selected respondents in front of supermarkets and grocery stores where Chinese consumers mainly purchase pork. These stores were chosen such that they differed in size, neighborhood, as well as their target customer base. Respondents were approached during both week days and weekends at various times to reduce coverage error.

There are 3 main components of this survey. First, consumers were asked about their pork purchasing habit, and how often they read labels on packaged meat products, as well as how much they trust information on food labels coming from different labeling entities. The second part is a choice experiment where consumers were asked to react to five pork attributes in addition to the price. The five attributes were: identification of source farm and processor, identification of transporter and distributors, organic quality, country of origin, and food safety certification from a third party. The third part asks questions about how the individual perceives the pork from five foreign countries (U.S, Canada, Germany, Spain, and Denmark) and how the individual thinks of the five countries. The last part of the survey contains

questions about basic demographic information such as gender, age and income.

4.2 Descriptive Statistics

Descriptive statistics will provide useful information about the pork and meat demand in China. The following is a brief summary of the statistic description of our data.

Data was collected from a total of 1,041 respondents, 173 (16.62%) from Beijing, 238 (22.86%) from Tianjin, 449 (43.13%) from Wuhan, 166 (15.95%) from Changsha, and 15 (1.44%) of the respondents did not answer which city they came from (**Table 4.1**). These four cities are major large cities, which in general represent trends of pork and meat consumption.

Table 4.1 Respondents from four cities

City	Frequency	Percent
Beijing	173	16.62%
Tianjin	238	22.86%
Wuhan	449	43.13%
Changsha	166	15.95%
Did Not Answer	15	1.44%
Total	1,041	100%

Table 4.2 displays descriptive statistics of socio-demographic dummy variables. About 61% of the total respondents of our sample are female, whereas females account for 48.77% of the national population (Statistics, 2015). This result makes intuitive sense when considering the female role in shopping behavior. About 10% of the consumers in our sample is vegetarian or have a vegetarian in his/her family. This rate is higher than what we expect, but acceptable. Being a vegetarian or having a family member who is vegetarian might have a significant impact on the pork and meat consumption behavior that should be taken into account. About 69% of the respondents are married, which might indicate that generally married people purchase pork and meat in supermarkets and grocery stores more often than unmarried people in China. Those unmarried individuals might consume pork and meat more often in restaurants. Only 41% of the respondents have at least one child who is under 18 years old; that is, most of the respondents do not have children at home. In addition, 60% of the respondents identify themselves as rooted in urban areas, while 40% of the respondents identify themselves as rooted in rural areas. Compare this to the 2014 population statistics: 54.77% of the Chinese population consisted of urban population while 45.23% was rural population (Statistics, 2015). It is worth noting that the survey was conducted in 4 large cities in China, and there are a lot of respondents who came from rural areas. This result reflects the rapid urbanization that China is going through.

Table 4.2 Descriptive statistics of socio-demographic dummy variables

Variable	Variable Description	N	Mean	Std Dev	Minimum	Maximum
Female	Consumer is female	1,041	0.61	0.49	0	1.00
Vegetarian	Consumer has vegetarian in family	1,041	0.10	0.30	0	1.00
Married	Consumer is married	1,041	0.69	0.46	0	1.00
Kids18	Consumer has children under 18	1,041	0.41	0.49	0	1.00
City	Consumer identifies himself/herself as rooted in city	1,041	0.60	0.49	0	1.00

Table 4.3 shows the descriptive statistics of socio-demographic continuous variables. The mean age of people in our sample is around 37. Also, the average number of family numbers in the respondents' household is 3.56. The average household monthly income of the respondents is 11,070 RMB. The current exchange rate is 100 USD equal to 687.9 RMB. To make this clear, in 2014, the Chinese national per capita disposable income was 20,167.1 RMB, the per capita disposable income of urban residents was 29,381.0 RMB, and per capita disposable income of rural residents was 9,892.0 RMB (Statistics, 2015). The sample average household monthly income is higher than the national average level, but is acceptable. The average length of education is about 14.5 years. A high school graduate has been in school for 12 years, and a undergraduate degree holder from college or university has been in school for 16 years in general.

Table 4.3 Descriptive statistics of socio-demographic continuous variables

Variable	Variable Description	N	Mean	Std Dev	Minimum	Maximum
Age	Consumer's age	1,041	37.48	13.45	18.00	84.00
Income	Consumer's household monthly income before tax (1000 RMB)	1,041	11.07	10.67	0.50	65.00
Edu	Consumer's years of education	1,041	14.50	2.88	6.00	23.00
Familynumber	Number of family members in consumer's household	1,041	3.56	1.40	1.00	28.00

Table 4.4 compares the population statistics and the sample statistics of Beijing, Tianjin, Wuhan, and Changsha. We can see that Wuhan has the largest number of respondents and the largest proportion of respondents to population number. All the four cities have larger proportion of female respondents than the population statistics. The average age of respondents from Beijing (38.04) and Wuhan (39.58) are older than that of Tianjin (34.94) and Changsha (34.74). The average household incomes of the four cities are Beijing 12.27, Tianjin 12.24, Wuhan 10.35, and Changsha 10.22.

Table 4.4 Population and sample statistics of four cities

	Beijing		Tianjin		Wuhan		Changsha	
	Population	Sample	Population	Sample	Population	Sample	Population	Sample
Number	19,612,000	173	15,469,500	238	9,785,392	449	7,044,118	166
Female (%)	48.40	60.69	45.64	51.68	48.57	68.37	49.16	54.82
Age	N/A	38.04	N/A	34.94	N/A	39.58	N/A	34.74
Vegetarian	N/A	0.05	N/A	0.16	N/A	0.12	N/A	0.04
Income	N/A	12.27	N/A	12.24	N/A	10.35	N/A	10.22
Married	N/A	0.70	N/A	0.63	N/A	0.76	N/A	0.58
Edu	11.5	14.62	N/A	14.78	N/A	14.00	N/A	15.30
Familynumber	N/A	3.39	N/A	3.77	N/A	3.57	N/A	3.43
Kids18	N/A	0.38	N/A	0.42	N/A	0.43	N/A	0.39
City	N/A	0.66	N/A	0.58	N/A	0.60	N/A	0.58

Note: Population statistics are from Beijing Statistical Information Net, Tianjin Statistical Information Net, Wuhan Statistical Information Net, and Changsha Statistical Information Net

Table 4.5 reveals the descriptive statistics of pork and meat expenses. The average amount of pork that respondents purchase in a month is 5.65 kg. The average price of pork that respondents purchase is 33.7 RMB/kg. The average expense for cooked or semi-cooked food in a month is 651.04 RMB. The average expense for cooked or semi-cooked meat in a month is 233.03 RMB, approximately 36% of the total amount spent on cooked or semi-cooked food. The average total uncooked meat expense in a month is 343.95 RMB. The average total pork expenditure for one month is 188.86 RMB, approximately 85% of the total amount spent on uncooked meat.

Table 4.5 Descriptive statistics of pork and meat expenses

Variable	Variable Description	N	Mean	Std Dev	Minimum	Maximum
Q5a	Pork amount (500g)	1,041	11.30	10.33	0	200.00
Q5b	Pork average price (RMB/500g)	1,041	16.85	9.91	10.00	300.00
Q2	Total uncooked meat expense (RMB)	1,022	343.95	657.87	0	10000.00
Q3	Cooked or semi-cooked meat expense (RMB)	1,018	233.03	221.36	0	2000.00
Q4	Cooked or semi-cooked food expense (RMB)	1,017	651.04	801.02	0	12500.00
TPE	Total pork expenditure (RMB)	1,041	188.86	257.52	0	7000.00
Proportion	Total pork expenditure/total uncooked meat expense	1,019	0.85	1.02	0.01	16.85

CHAPTER 5 METHODOLOGY

5.1 OLS Model

Ordinary least squares (OLS) is a widely used method to analyze demand. It seeks to find the coefficients by minimizing the square of the error (the differences between the observed responses in the given dataset and those predicted by a linear function of a set of explanatory variables and the coefficients).

Below is our model specification used in analysis:

Cooked or semi-cooked food expenditure $= \beta_{10} + \beta_{11}$*Female $+ \beta_{12}$*Age $+ \beta_{13}$*Vegetarian $+ \beta_{14}$*Income $+ \beta_{15}$*Married $+ \beta_{16}$*Edu $+ \beta_{17}$*Familynumber $+ \beta_{18}$*Kids18 $+ \beta_{19}$*City $+ \varepsilon_1$

Cooked or semi-cooked meat expenditure $= \beta_{20} + \beta_{21}$*Female $+ \beta_{22}$*Age $+ \beta_{23}$*Vegetarian $+ \beta_{24}$*Income $+ \beta_{25}$*Married $+ \beta_{26}$*Edu $+ \beta_{27}$*Familynumber $+ \beta_{28}$*Kids18 $+ \beta_{29}$*City $+ \varepsilon_2$

Total uncooked meat expenditure $= \beta_{30} + \beta_{31}$*Female $+ \beta_{32}$*Age $+ \beta_{33}$*Vegetarian $+ \beta_{34}$*Income $+ \beta_{35}$*Married $+ \beta_{36}$*Edu $+ \beta_{37}$*Familynumber $+ \beta_{38}$*Kids18 $+ \beta_{39}$*City $+ \varepsilon_3$

Total pork expenditure $= \beta_{40} + \beta_{41}$*Female $+ \beta_{42}$*Age $+ \beta_{43}$*Vegetarian $+ \beta_{44}$*Income $+ \beta_{45}$*Married $+ \beta_{46}$*Edu $+ \beta_{47}$*Familynumber $+ \beta_{48}$*Kids18 $+ \beta_{49}$*City $+ \varepsilon_4$

The proportion of total pork expenditure to total uncooked meat expenditure $= \beta_{50} + \beta_{51}$*Female $+ \beta_{52}$*Age $+ \beta_{53}$*Vegetarian $+ \beta_{54}$*Income $+ \beta_{55}$*Married $+ \beta_{56}$*Edu $+ \beta_{57}$*Familynumber $+ \beta_{58}$*Kids18 $+ \beta_{59}$*City $+ \varepsilon_5$

where β represents parameters to be estimated and ε represents the random error term. The description for each variable in the model may be found in the descriptive statistics tables (Table 4.2, Table 4.3, and Table 4.4).

5.2 Tobit model

Most Chinese households consume pork and/or other meat for their daily meal. Nevertheless, according to the descriptive statistics, 10% of the respondents have family members who are vegetarian. It is possible that a sizeable number of households do not consume pork and/or other meat. Thus, there may exist zero expenses in the dataset not because households consume zero amount given the current price or market conditions. Instead, these are not consumers no matter what level of the prices may be. In this case, using the OLS model to analyze pork and meat consumption will generate biased coefficient estimates. Therefore, employing a

Tobit model is necessary in order to deal with both zero and non-zero values of the dependent variable (Van Phuong *et al.*, 2014).

The Tobit model was devised by Tobin (1958). In the Tobit model, it is assumed that the dependent variable has a number of its values clustered at a limiting value, usually zero (McDonald *et al.*, 1980). In the case of our study, the pork and meat consumption have values clustered at zero. The Tobit model has been widely used to analyze consumption with censored data. Van Phuong *et al.* (2014) explained the Tobit model with lower limit of zero as follows:

$$y_i^* = x_i'\beta + v_i, \quad i = 1, \ldots, n \tag{3}$$

$$\begin{aligned} y_i &= y_i^* \quad \text{if } y_i^* > 0 \\ &= 0 \quad \text{if } y_i^* \leq 0 \end{aligned} \tag{4}$$

where y_i represents the dependent variable, x_i represents a vector of independent variables, β represents a vector of unknown coefficients, and v_i is a vector of independent and identically distributed normal random variables assumed to have mean of zero and constant variance, σ^2. As stated in the above equation, y^* is observed only when it is positive, and if y^* is less than zero, it is not unobserved. Thus, y_i is censored at zero. The following equations describes the conditional and unconditional marginal effects:

$$\mathrm{E}(\boldsymbol{y}_i) = \boldsymbol{x}_i\boldsymbol{\beta}\mathrm{F}(z) - \sigma f(z) \tag{5}$$

$$\mathrm{E}(\boldsymbol{y}_i^*) = \boldsymbol{x}_i\boldsymbol{\beta} - \sigma f(z)/\mathrm{F}(z) \tag{6}$$

$$\partial\mathrm{E}(\boldsymbol{y}_i)/\partial\boldsymbol{x}_i = \mathrm{F}(z)(\partial\mathrm{E}(\boldsymbol{y}_i^*)/\partial\boldsymbol{x}_i) - \mathrm{E}(\boldsymbol{y}_i^*)(\partial\mathrm{F}(z)/\partial\boldsymbol{x}_i) = \mathrm{F}(z)\boldsymbol{\beta} \tag{7}$$

$$\partial\mathrm{E}(\boldsymbol{y}_i^*)/\partial\boldsymbol{x}_i = \boldsymbol{\beta}(1 - zf(z)/\mathrm{F}(z) - f(z)^2/\mathrm{F}(z)^2) \tag{8}$$

$$\partial\mathrm{F}(z)/\partial\boldsymbol{x}_i = f(z)\boldsymbol{\beta}/\sigma \tag{9}$$

where $z = \boldsymbol{x}_i\boldsymbol{\beta}/\sigma$, is the normalized index, f(z) is the standard normal density function, and F(z) is the cumulative standard normal distribution function.

CHAPTER 6 RESULTS

The OLS model and the Tobit model have been used in this study to analyze how nine socio-demographic characteristics affect pork and meat demand in China. Five dependent variables are examined with both the OLS analysis and Tobit analysis, namely "Q4" (cooked or semi-cooked food expenditure), "Q3" (cooked or semi-cooked meat expenditure), "Q2" (total uncooked meat expenditure), "TPE" (total pork expenditure), and "Proportion" (the proportion of total pork expenditure to total uncooked meat expenditure) in the questionnaire.

6.1 Results of the OLS Analysis

Table 6.1 shows the overall estimate results of the OLS models. The R^2 and adjusted R^2 reflect how models fit. The R^2 and adjusted R^2 for Q2 are both about 0.23, while the R^2 and adjusted R^2 for other four models are around or less than 0.05, which indicates good fit. The following is a breakdown of each variable, with explanation and interpretations provided for each variable.

The independent variable "Female" represents those respondents who are female. The coefficients for this variable are not statistically significant in all five OLS models. This indicates that holding other factors constant and compared to a male household head, a female household head does not make a significant

difference on the amount of pork and meat consumed in the household. This is perhaps because of the similar lifestyles and appetites of males and females in China when it comes to pork and meat.

Variable "Age" is the continuous variable that represents the age of the respondent. The coefficients for all the five OLS models are not statistically significant. This means that age is not a significant factor for pork and meat demand. The respondents' age was from 18 to 84. Younger aged consumers were not chosen for the survey because they have limited purchasing power in terms of household grocery shopping in China. This result suggests that holding other factors constant, Chinese households heads within this range of age purchase the same amount of pork and meat, and indicates similar appetites from young people to the elderly.

Variable "Vegetarian" represents that the respondents have a vegetarian in their family. The coefficients for this variable are statistically significant in the OLS models for "Q4" and "Q2", but not statistically significant in the OLS models for "Q3", "TPE", and "Proportion". It suggests that, holding everything else constant and measured at sample mean, a household head with vegetarian family members spends 138.56 RMB more on cooked or semi-cooked food expenditure, and 293.01 RMB more on total uncooked meat expenditure. But having a vegetarian family member does not affect a household spending on cooked or semi-cooked meat expenditure, total pork expenditure, and the proportion of total pork expenditure to total uncooked

meat expenditure.

Variable "Income" represents the respondents' monthly household income, with a unit of 1000 RMB. The coefficients for this variable are statistically significant in the OLS models for dependent variables "Q4", "Q2", "Q3", and "TPE", but insignificant for "Proportion" as another dependent variable. This suggests that holding everything else constant and measured at sample mean, a 1000 RMB increase in consumer's household income will lead to 7.86 RMB more on cooked or semi-cooked food expenditure, 2.98 RMB more on cooked or semi-cooked meat expenditure, 9.94 RMB more on total uncooked meat expenditure, and 4.86 RMB more on total pork expenditure. Overall, the higher household income is, the more money the household head will spend on pork, meat, and food. However, household income does not affect the proportion of total pork expenditure to total uncooked meat expenditure according to this result.

Variable "Married" is the dummy variable for the question that considers consumers' marital status. "Married"= 1 represents the respondent is married. The coefficients for this variable are statistically significant in the OLS models for "Q4" and "Proportion", yet insignificant in models for "Q3", "Q2", and "TPE". Holding everything else constant and measured at sample mean, compared to a household with an unmarried household head, a household with a married household will spend 131.34 RMB more on the cooked or semi-cooked food per month, and 0.21 less on

the proportion of total pork expenditure to total uncooked meat expenditure. However, according to this result, being married does not affect a households' total uncooked meat expense, cooked or semi-cooked meat expenditure, or total pork expenditure.

Variable "Edu' is a variable that represents consumers' total years of education. The coefficient is statistically significant in the OLS model for "TPE", but not significant in models for "Q4", "Q3", "Q2", and "Proportion". Holding everything else constant and measured at sample mean, one more year of education of the household head will lead to a 6.19 RMB decrease in the household’s total pork expenditure. This negative relationship between education and pork consumption may be related to the fact that well-educated consumers are more aware of pork's nutritional deficiencies, such as relatively high fat and low protein, so these consumers tend to consume less pork and prefer alternatives such as beef, chicken, and fish. Education of the household head does not affect cooked or semi-cooked food expenditure, cooked or semi-cooked meat expenditure, total uncooked meat expenditure, or the proportion of total pork expenditure to total uncooked meat expenditure.

Variable "Familynumber" represents the number of family members in the respondent's household. The coefficients for this variable are statistically significant in the OLS models for "Q4" and "Q2", but insignificant in models for "Q3", "TPE",

and "Proportion". Holding everything else constant and measured at sample mean, consumers with one more family member in their household will lead to 53.27 RMB increase in cooked or semi-cooked food expenditure, and 171.77 RMB increase in total uncooked meat expenditure. However, the number of family members does not affect cooked or semi-cooked meat expenditure, total pork expenditure and the proportion of total pork expenditure to total uncooked meat expenditure.

Variable "Kids18" is the dummy variable addressing whether or not the respondents have a child under 18 in their households. "Kids18"= 1 represents the respondents have one or more children under 18 in their households. The coefficient for this variable is statistically significant in the OLS model for "Q2", but insignificant in models for "Q4", "Q3", "TPE", and "Proportion". This indicates that, holding everything else constant and measured at sample mean, household heads who have children under 18 in their households spend 28.38 RMB more on total uncooked meat expense than those who do not have children younger than 18 at home. On the other hand, having children at home does not affect cooked or semi-cooked food expenditure, cooked or semi-cooked meat expenditure, total pork expenditure, and the proportion of total pork expenditure to total uncooked meat expenditure. From this result we can tell that consumers with children at home tend to prefer unprocessed food such as uncooked meat to cooked or semi-cooked food. This is perhaps because such consumers are conscious about their children' health, and they want to provide fresh and nutritious food to their children.

Variable "City" is the dummy variable for the question that asks whether the respondents identify themselves as rooted in urban areas or rural areas. "City" represents the respondents identifying themselves as urbanites. The coefficients for this variable are significant for the OLS models for "Q4", "Q3", "Q2", and "Proportion", but insignificant for "TPE". It indicates that, holding everything else constant and measured at sample mean, household heads who identify themselves as rooted in urban areas spend 175.32 RMB more on the cooked or semi-cooked food, 55.60 RMB more on the cooked or semi-cooked meat, 135.47 RMB more on total uncooked meat, and 0.13 less the proportion of total pork expenditure to total uncooked meat expenditure than those who identify themselves as rooted in rural areas. However, this factor does not affect consumers' total pork expenditure. We can see that, overall, there is a huge difference of food and meat consumption between rural and urban consumers, with a possible reason of different lifestyles and budget concerns.

Table 6.1 OLS analysis results

Variable	Variable Description	Cooked or semi-cooked food expense (RMB)	Cooked or semi-cooked meat expense (RMB)	Total uncooked meat expense (RMB)	Total pork expenditure (RMB)	Total pork expenditure/total uncooked meat expense
		Coefficient (Std. Error)	Coefficient (Std. Error)	Coefficient (Std. Error)	Coefficient (Std. Error)	Coefficient (Std. Error)
Intercept	Intercept	45.35 (195.77)	110.69** (54.25)	-676.11*** (144.78)	252.82*** (62.85)	1.44*** (0.26)
Female	Household head who is female	26.49 (51.25)	14.13 (14.16)	-17.83 (37.67)	-13.30 (16.39)	0.03 (0.07)
Age	Age Household head	2.81 (2.70)	0.45 (0.75)	2.50 (1.98)	-0.43 (0.86)	-0.001 (0.004)
Vegetarian	Household head who has vegetarian in family	138.56* (82.22)	2.96 (22.75)	293.01*** (60.54)	4.36 (26.45)	0.07 (0.11)
Income	Household monthly income (1000 RMB)	7.86*** (2.44)	2.98*** (0.68)	9.94*** (1.80)	4.86*** (0.79)	-0.003 (0.003)
Married	Household head who is married	131.34* (77.08)	5.24 (21.30)	-39.12 (56.04)	-15.43 (24.38)	-0.21** (0.10)
Edu	Years of education of	-1.08	-0.85	8.47	-6.19*	-0.01

	household head	(9.86)	(2.73)	(7.26)	(3.16)	(0.01)
Familynumber	Number of family members in household	53.27***	7.51	171.77***	-2.63	-0.03
		(19.02)	(5.28)	(13.98)	(6.12)	(0.02)
Kids18	Household head who has children under 18	23.19	28.38*	13.73	-0.40	-0.06
		(55.21)	(15.30)	(40.61)	(17.68)	(0.07)
City	Household head who identifies himself/herself as rooted in city	175.32***	55.60***	135.47***	26.63	-0.13*
		(52.74)	(14.63)	(38.73)	(16.89)	(0.07)
Number of observations read		1,041	1,041	1,041	1,041	1,041
Number of observations used		1017	1018	1022	1,041	1019
R^2		0.0551	0.0521	0.2394	0.0429	0.0220
Adjusted R^2		0.0467	0.0436	0.2327	0.0346	0.0133

Note:*, **, and *** represent significance ate 10%, 5%, and 1% level.

6.2 Results of the Tobit Analysis

Table 6.2 displays the integrated estimate results of the Tobit models. The scale parameter (Sigma) are all estimated to be significant and this suggests that the Tobit model is preferred to the OLS model. Nevertheless, the significance or insignificance of the coefficients of each independent variables are consistent to the OLS analysis. Also, the parameter estimates from the Tobit models are similar to the estimates form the OLS models, thus they will not be demonstrated specifically in this section. Below is a brief analysis of the significant and insignificant variables in the five Tobit models.

As the Tobit analysis results show, "Q4", which represents cooked or semi-cooked food expenditure, is significantly affected by variables "Vegetarian", "Income", "Married", "Familyumber", and "City". Independent variable "Q3", which represents cooked or semi-cooked meat expenditure, is also affected by variables such as "Income", Kids18", and "City". In addition, variable "Q2", representing total uncooked meat expenditure, is significantly affected by "Vegetarian", "Income", "Familynumber", and "City". Moreover, "TPE", representing total pork expenditure, is shown to be significantly affected by "Income" and "Edu". At last, "Proportion", which represents the proportion of total pork expenditure to total uncooked meat expenditure, is significantly affected by "Married" and "City".

However, the Tobit analysis results demonstrate and insignificant impact of independent variables "Female", "Age", "Edu", and "Kids18" on cooked or semi-cooked food expenditure (dependent variable "Q4"). Variables "Female", "Age", Vegetarian", "Married", "Edu", and "Familynumber" don't seem to bear any significant effect on cooked or semi-cooked meat expenditure ("Q3") either. Also, Variables "Female", "Age", "Married", "Edu", and "Kids18" don't have statistically significant impact on total uncooked meat expenditure ("Q2"). Additionally, the proportion of total pork expenditure to total uncooked meat expenditure ("TPE") is not significantly affected by "Female", "Age", Vegetarian", "Married", "Familynumber", "Kids18", and "City". Lastly, variable "Proportion" is not significantly affected by variables "Female", "Age", Vegetarian", "Income", "Edu", "Familynumber", and "Kids18".

Table 6.2 Tobit analysis results

Variable	Variable Description	Cooked or semi-cooked food expense (RMB)	Cooked or semi-cooked meat expense (RMB)	Total uncooked meat expense (RMB)	Total pork expenditure (RMB)	Total pork expenditure/total uncooked meat expense
		Coefficient (Std. Error)	Coefficient (Std. Error)	Coefficient (Std. Error)	Coefficient (Std. Error)	Coefficient (Std. Error)
Intercept	Intercept	43.90 (195.40)	110.27** (54.90)	-677.29*** (144.35)	252.62*** (62.59)	1.44*** (0.25)
Female	Household head who is female	24.46 (51.16)	12.93 (14.34)	-19.99 (37.56)	-13.59 (16.32)	0.03 (0.07)
Age	Age Household head	2.76 (2.69)	0.31 (0.76)	2.55 (1.97)	-0.44 (0.85)	-0.001 (0.003)
Vegetarian	Household head who has vegetarian in family	139.74* (82.04)	1.45 (23.06)	289.43*** (60.44)	2.86 (26.37)	0.07 (0.11)
Income	Household monthly income (1000 RMB)	7.91*** (2.43)	3.03*** (0.68)	10.00*** (1.79)	4.87*** (0.78)	-0.003 (0.003)
Married	Household head who is married	133.30* (76.92)	10.39 (21.60)	-38.08 (55.91)	-14.86 (24.28)	-0.21** (0.10)
Edu	Years of education of	-1.09	-1.11	8.24	-6.23**	-0.01

	household head	(9.84)	(2.76)	(7.24)	(3.15)	(0.01)
Familynumber	Number of family members in household	52.89***	8.42	172.35***	-2.40	-0.03
		(18.98)	(5.34)	(13.95)	(6.09)	(0.02)
Kids18	Household head who has children under 18	24.77	27.32*	13.76	-0.42	-0.06
		(55.11)	(15.49)	(40.50)	(17.60)	(0.07)
City	Household head who identifies himself/herself as rooted in city	177.88***	56.91***	135.21***	26.55	-0.13*
		(52.65)	(14.80)	(38.62)	(16.82)	(0.07)
Sigma		780.36***	218.69***	574.47***	251.98***	1.01***
		(17.35)	(4.91)	(12.73)	(5.53)	(0.02)
Number of respondents		1017	1018	1022	1,041	1019
Lower bound		0	0	0	0	0
Number of observations lower bound		4	20	3	1	0
Log-likelihood		-8188	-6814	-7922	-7227	-1459
R^2		0.056	0.052	0.259	0.045	0.022

Note:*, **, and *** represent significance ate 10%, 5%, and 1% level.

Table 6.3 displayed the average marginal effects of the independent variables on the conditional levels and unconditional levels on the five dependent variables. The conditional marginal effect indicates a corresponding effect on the level of monthly expenditure conditional on expending (i.e. among those who consume) while the unconditional marginal effect indicates the effect on the monthly level of expenditure unconditionally (i.e. for the whole population of interest) (Tan *et al.*, 2015). We will focus on the unconditional marginal effects here, in order to compare the results to the OLS analysis, which is for the whole population of interest. The following is a brief interpretation of the unconditional marginal effects of each independent variable on the dependent variables if significant.

The results show that, holding everything else constant and measured at sample mean, a household head with vegetarian family members spends 110.39 RMB per month more on cooked or semi-cooked food expenditure, and 202.72 RMB more on total uncooked meat expenditure.

Income has statistically significant effect on pork and meat demand. Holding everything else constant and measured at sample mean, a 1000 RMB increase in consumer's household income will lead to 6.25 RMB more on cooked or semi-cooked food expenditure, 2.57 RMB more on cooked or semi-cooked meat expenditure, 7.01 RMB more on total uncooked meat expenditure, 3.74 RMB more on total pork expenditure.

Marital status is also a significant factor. Holding everything else constant and measured at sample mean, compared to a household with an unmarried household head, a household with a married household will spend 105.31 RMB more on the cooked or semi-cooked food per month, and 0.17 less on the proportion of total pork expenditure to total uncooked meat expenditure.

In addition, holding everything else constant and measured at sample mean, an additional year of education of the household head will lead to a 4.79 RMB decrease in the household's total pork expenditure.

The number of family members is shown to be a significant factor. Holding everything else constant and measured at sample mean, an additional family member in consumers' household will lead to 41.79 RMB increase in cooked or semi-cooked food expenditure, and 120.72 RMB increase in total uncooked meat expenditure.

Moreover, holding everything else constant and measured at sample mean, household heads who have children under 18 in their households spend 23.16 RMB more on total uncooked meat expense than those who do not have children younger than 18 at home.

Furthermore, holding everything else constant and measured at sample mean,

household heads who identify themselves as rooted in urban areas spend 140.52 RMB more on the cooked or semi-cooked food, 48.24 RMB more on the cooked or semi-cooked meat, 94.70 RMB more on total uncooked meat, and 0.10 less the proportion of total pork expenditure to total uncooked meat expenditure than those who identify themselves as rooted in rural areas.

Table 6.3 The marginal effects from the tobit analysis

	Cooked or semi-cooked food expense (RMB)		Cooked or semi-cooked meat expense (RMB)		Total uncooked meat expense (RMB)		Total pork expenditure (RMB)		Total pork expenditure/total uncooked meat expense	
	Unconditional M.E.	Conditional M.E.	Unconditional M.E.	Conditional M.E.	Unconditional M.E.	Conditional M.E.	Unconditional M.E.	Conditional M.E.	Unconditional M.E.	Conditional M.E.
Female	19.32	24.36	10.96	12.75	-14.00	-19.91	-10.44	-13.42	0.02	-0.47
Age	2.18	2.75	0.27	0.31	1.78	2.54	-0.33	-0.43	-0.001	0.02
Vegetarian	110.39*	139.18*	1.23	1.43	202.72***	288.23***	2.20	2.82	0.06	-1.24
Income	6.25***	7.88***	2.57***	2.99***	7.01***	9.96***	3.74***	4.80***	-0.003	0.06
Married	105.31*	132.77*	8.81	10.24	-26.67	-37.92	-11.41	-14.67	-0.17**	3.82**
Edu	-0.86	-1.09	-0.94	-1.10	5.77	8.20	-4.79**	-6.15	-0.01	0.21
Familynumber	41.79***	52.68***	7.14	8.30	120.72***	171.64***	-1.84	-2.37	-0.03	0.56
Kids18	19.57	24.67	23.16*	26.94*	9.63	13.70	-0.32	-0.41	-0.05	1.06
City	140.52***	177.17***	48.24***	56.10***	94.70***	134.64***	20.39	26.21	-0.10*	2.36*

Note:*, **, and *** represent significance ate 10%, 5%, and 1% level.

CHAPTER 7: CONCLUSIONS AND FUTURE WORK

7.1 Conclusions

As the per capita disposable income increases and the many changes in lifestyle and dietary preferences, Chinese consumers' demand for meat is surging. It is important for producers and retailers to understand the current meat demand. This study uses data from a survey conducted in 2014 from four major cities across China: Beijing, Tianjin, Wuhan, and Changsha. We focus on meat demand, especially on pork demand, since pork accounts for the largest share of meat consumption in China. We examine how socio-demographic characteristics affect pork and meat demand using both OLS models and Tobit models. The analysis demonstrates that pork and meat demand are affected by many socio-demographic characteristics. Below are our findings from the results.

First, income is found to be positively related to cooked or semi-cooked food expenditure, cooked or semi-cooked meat expenditure, total uncooked meat expenditure, and total pork expenditure. The per capita disposable income in China has been on a rising trend and is expected to continue to grow in the future. As income rises, a higher demand for the above product may be expected. This result gives Chinese producers and retailers motivation to increase production and promotions on pork, meat, and processed and semi-processed food and meat product, as a response to the increasing demand. Also, pork and meat that are high quality and

with a corresponding higher price may be popular in the future, as Chinese consumers have more income to spend on food.

Second, we find that compared to households with household heads who identify themselves as rooted in rural areas, households with household heads who identify themselves as urbanites tend to spend a significant larger amount of money on the cooked or semi-cooked food, cooked or semi-cooked meat, and total uncooked meat. This result echoes those of Newman *et al.* (2001) and Newman *et al.* (2002) suggesting that urban residents prefer processed meat because of its convenience and shorter preparation time required, and those of Ishida *et al.* (2003) indicating that urbanization leads to greater consumption of both meat and food in general. This tells meat retailers in China to put more promotion effort into sales on urban areas. Also, urban consumers have a faster pace of life, thus they tend to prefer food that requires less time to prepare. Manufacturers and retailers should introduce more meat and products that are semi-prepared or ready to eat, in order to attract more urban consumers who wants to save time.

Third, we find that marital status is a significant factor. Compared to a household with an unmarried household head, a household with a married household head will spend more on cooked or semi-cooked food per month. Married consumers tend to prefer time-saving food product. Retailers can promote such cooked or semi-cooked food and target at the married consumers.

Moreover, based on the results, we come to the conclusion that consumers with children younger than 18 at home tend to prefer uncooked meat to cooked or semi-cooked meat. Consumers with children are more conscious about health and nutrition factors of food product, for the sake of taking care of their children. Retailers that sell fresh meat can target at those consumers with children at home. Producers should print large and clear nutrition contents on the packaging, highlighting the nutrition value of their products, and add slogans such as "safe for small children", "nutrition for teenagers" to attract those parents.

In addition, household size is shown to have a positive relationship with the cooked or semi-cooked food expenditure and total uncooked meat expenditure. This finding is consistent with the results of Coffey *et al.* (2011) and Davis *et al.* (2007). As the Chinese government has relaxed the one child policy, the family structures in Chinese households will become more complex. Thus, households with larger sizes will increase, and greater degrees of difference in the preferences of family members are likely to occur. We suggest that retailers can target at relatively large households as part of the market segmentation and promotion strategies. Specific marketing methods can be considered, such as offering large size family packs and specially designed mixed cuts in order to meet different tastes among family members.

Besides, the coefficients for variable "Vegetarian" are positive. This result may

be due to statistical problems such as multicollinearity and omitted variable bias. The factor that consumers have a vegetarian in their households may be highly correlated with other factors that we involved. Further study should work on this problem.

Last but not least, gender and age of a household head were not significant in explaining pork and meat consumption, which conflicts with findings of Burton, Dorsett, and Young (2000) and Newman, Henchion, and Matthews (2001). Our result tells retailers and advertisers that marketing and promotions targeted at different age groups and genders may not be as rewarding as the other strategies described above.

7.2 Limitations and Future Work

Limitations of this study will be noted in this section in order to give a direction on how future work can progress. First, more consumer characteristics should be involved in future studies. Our study investigates the effect of nine key socio demographic characteristics on consumers' pork and meat demand. However, there are more factors that may be influential, such as occupation, religion, and ethnic group. Also, in order to better understand future pork and meat demand in China, the Chinese consumers' willingness to pay for new pork and meat varieties can be studied.

Second, the survey was conducted in Beijing, Tianjin, Wuhan, and Changsha. Although they are good representations of the pork and meat consumption trend in urban areas of China, the average households income is higher than that the average households income in the country. It will be useful to have data from smaller cities, western areas, and rural areas to make the results more representative. This will help us better understand the pork and meat consumption of an average citizen in China.

Third, this study uses recall questions through a survey to measure demand. Given the increasing popularity of grocery and home scan data, a future study may take advantage of these sources that may include larger number of consumers and more precise measures of demand and related quantities.

Lastly, this study investigates the demand for meat in China especially focusing on pork. Although pork is the main meat for Chinese, there are a number of consumers do not consume pork, but prefer substitutes due to reasons of religion, nutrition, or price. Studying other popular meat such as poultry, beef and sea food could strengthen the results. A more complete understanding of meat consumption in all meat varieties in China will be a thought-provoking future research area.

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