Segmentation of Retail Food Store Formats in Qingdao, China

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Abstract

This study empirically estimates a multivariate binary choice model for four categories of food shopping store formats. The results indicate that in the Qingdao market, traditional counter parts such as wet markets and small grocery stores have been dominated by supermarkets and hypermarkets. At the same time, the rapid growth of hypermarkets in Qingdao is significantly challenging current supermarkets in this city, but they do not compete extensively with wet markets and small grocery stores. Further development of various categories of the food shopping store format is linked to store owned characteristics, potential interrelations among existing retail formats, as well as consumers' demographics and shopping habits.

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

Introduction and Background

In the past decade, following opening to private economy and foreign direct investment (FDI), China's food retail system, which used to be dominated by traditional retailers such as state-owned (SOEs) and collective-operated enterprises and wet markets and small shops, has been dramatically diversified and transformed (Wang, 2002). Particularly, through the introduction of self-service supermarkets since the middle of 1990s and later the entry of the one-stop shopping hypermarket (e.g. Wal-Mart and Carrefour). These so called modern retailers have accelerated the transformation and reshuffling of China's retail system. As a consequence, both traditional retailers and their modern counterparts now are facing fierce competition especially in larger cities.

Then several questions arise: will the traditional food retailers disappear from cites? In other words, will they survive or die? How will the large retailers transform themselves to better fit the changing market demand in the future? And what are the potential relationships among current available shopping store formats? The experiences in other countries or regions such as Latin America countries and East Asian countries (Reardon, Timmer and Berdegue, 2003) may provide a conceptual basis for these questions, China is an extremely complicated case however, not only because of its immense size, dense population and diverse cultures, but also because of its unbalanced economic development, less developed infrastructure and the current market situation.

With consistent quality, competitive prices, friendly shopping environment, and attractive one-stop shopping format, hypermarkets, particularly international retailers have grown the fastest in recent years (Bean, 2006). Its further diffusion and expansion in China, however, may be slowed by supply side restrictions which include small sized and

unorganized farmers, as well as less developed distribution channels (Hu et al., 2004). As the oldest modern retail format, although its number continues to grow in most cities, especially in second and third outlier cities, supermarkets are facing keen competition from hypermarkets and convenient stores (Bean, 2006).

To date, the rapid development of modern retailers has not forced traditional retail formats simply to disappear. Some state-owned or collective-owned retailing enterprises simply transformed into self-serviced supermarkets, some repositioned themselves as department stores with adding a particular section selling food in direct competition with both supermarket and hypermarkets, and others have targeted particular customers competing with the emerging convenient stores. As an important part of China's traditional food market, wet markets, despite in some cases being forced to close due to poor sanitary conditions and unregulated marketing behavior, still function well in most cities, particularly in rural areas. In cities, many of these outdoor wet markets have moved to indoor operations.

There does not seem to be ready answers to the questions since none of these formats have an exclusive advantage over others. Therefore, future directions may be not only rooted in marketing strategies and related policies, but also closely linked to Chinese consumers' demographics and buying habits, as well as the potential interrelationships among formats.

Although they are generally descriptive several studies have been conducted to address the development and current situation of the Chinese food retail system and to discuss their future trends (e.g. Mousteraski, 2001; Reardon, Timmer and Berdegue, 2003; Gale, 2003; Hu, Yu and Reardon, 2003; Hu et al. 2004; Regmi and Gehlhar, 2005; Wang

and Zhang, 2005). Samuel, Li and McDonald (1998) examined the purchasing behavior of Shanghai buyers of processed food and beverage products. They suggested that the value or weight of purchases were mainly influenced by distance traveled to shop, the gender of shopper and income. As the authors explained, the limited quantities purchased on each shopping occasion lowered the numerical variation of the dependent variable. Wong and Yu (2002) indicated the differences in shopping patterns between higher income and lower income households in China.

To narrow our scope of study, we concentrate on estimating consumers' choice among food shopping formats in a multivariate binary probit model. By doing so, our objectives are to identify the determinants of the future development of various retail formats and the potential interrelationships among them, and go forward to explore their implications and potential challenges on government policies and marketing strategies.

In the following section, we review the multivariate binary probit model. In the third section the survey, data and variables are presented, including background information on the retail market in Qingdao. Estimated results from multivariate probit model are presented in section four. The last section summaries the main findings and concludes with a brief discussion of implications.

Multivariate Binary Probit Model

In this study, consumers' choices among shopping formats are characterized by a multivariate binary choice model, which can be specified as follows:

$$\begin{aligned} \mathbf{y}_{ik}^{*} &= \mathbf{X}\boldsymbol{\beta}_{ik} + \boldsymbol{\varepsilon}_{ik} \\ y_{ik} &= \begin{cases} 1 & \text{if } y_{ik}^{*} > 0 \\ 0 & \text{otherwise} \end{cases}, \; k = 1,2,3,4; \;\; i = 1,2,...,N \end{aligned} \tag{1}$$

where $\mathbf{y}_{k}^{*}$ is a N by 1 vector in which the i^{th} element y_{ik}^{*} represents the net benefit to

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

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

$$\ln L = \sum_{i=1}^{N} \omega_i \ln \Phi(\mu_i;\Omega) \qquad (2)$$

where ω_i is an optional weight for observation *i*, and Φ is the multivariate standard normal distribution with arguments μ_i and Ω, where μ_i which can be denoted as $\mu_i = (K_{i1}\beta_1 X_{i1}, K_{i2}\beta_2 X_{i2}, K_{i3}\beta_3 X_{i3}, K_{i4}\beta_4 X_{i4})$, while has a matrix form with elements $\Omega_{jk} = 1$ for $j = k$ and $\Omega_{jk} = \Omega_{kj} = K_{ij}K_{ik}\rho_{jk}$ for $j \neq k$, $j,k = 1,2,3,4$, with $K_{ik} = 2y_{ik} - 1$.

Several simulation methods have been developed to overcome the computational difficulty for estimating the multivariate binary model. For example, the frequency method by Lerman and Manski (1980), the importance sampling method by McFadden (1989), etc. Recently, the most popular method is the Geweke-Hajivassiliou-Keane (GHK) smooth recursive conditioning simulator (Borsch-Supan et al., 1992; Borsch-Supan and

Hajivassiliou, 1993; Keane, 1994). A brief review can be found in Greene (2003). The GHK simulator exploits the fact that a multivariate normal distribution function can be expressed as the product of sequentially conditioned univariate normal distribution functions, which can be easily and accurately evaluated. The GHK is unbiased for any given number of replications R, and hence generates substantially smaller variances than the frequency similar (Borsch-Supan and Hajivassiliou, 1993).

As is usual for discrete choice models, the estimated marginal effect of an explanatory variable on the probability of shopping in a given store format is a function of the estimated parameters and the data. Because the marginal effects in a multivariate probit model are complicated and because most our explanatory variables are dummy variables, we generate estimated marginal effects numerically as follows:

First, we calculate the predicted probability for each store format for a benchmark set of characteristics. This benchmark is set for convenience such that all dummy variables are set to zero, which corresponds to an individual with the a series of characteristics. Second, an individual dummy variable (for example the gender dummy) is set to equal to 1 (all others set at zero) and the predicted probability for each store format is again calculated. This process is repeated for each dummy variable in each equation (each time with all other dummy variables set equal to zero). The estimated effect of a change in the dummy variable in the predicted probability of shopping in store format *k* is equal to

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

where $\hat{p}_i$ denotes the predicted probability for the i^{th} store format, x_j is the j^{th} dummy variable in **X**, and all other dummy variables (not the j^{th}) are set to zero for both cases. Thus, the estimated marginal effect is the discrete change in the predicted probability

with respect to a discrete one-unit change in one dummy variable, *ceteris paribus*, where the predicted probabilities in both the base case and the alternative case are based on the multivariate normal distribution.

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

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

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

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

where $\hat{\boldsymbol{\beta}}_k$ and $\hat{\boldsymbol{\Sigma}}$ are estimated parameters and covariance matrices respectively from multivariate probit model regressions. Due to space limitations we will not report all joint and conditional probabilities since a four-equation multivariate probit model will generate hundreds of probability combinations.

Survey and Data Description

The data set used in this study was collected from in-person interviews of 838 urban residents in Qingdao, China in the summer of 2005. Qingdao is one of 14 coastal cities first opened to foreign markets in 1984. This city is on the southern tip of the Shangdong Peninsula along the Yellow Sea, and is currently divided into 7 urban districts. In 2003, the total population was 2.24 million. Over the past five years, city GDP growth averaged about 17 percent reaching $26 billion in 2004. Annual per capita disposable income in 2005 was 12,920 yuan, which was about 2,000 yuan higher than national level (10,493

yuan) and Shandong province level (10,744 yuan), but lower than main metropolitan cities such as Beijing (17,653 yuan) and Shanghai (18,645 yuan) in the same period.

As in many other larger cities in China, the revolution in the food retail sector started in the mid 1990s and accelerated at the end of 90s. The entry of outside players and the keen competition brought to the domestic counterparts played extremely important roles in the transformation. Following Japan-funded Jusco and Malaysian-funded Parkson which opened their first stores in Qingdao in 1998, Carrefour (France), Wal-Mart (the U.S.), Metro (German), RT Mart (Taiwan), and Dafuyuan (Taiwan) sequentially made inroads into this city. The lucrative market even attracted a number of domestic retailers from other provinces. For example, Shanghai Hualian has 6 stores, and the Beijing Jian Hypermarket (Huapu in Chinese) has also opened stores in Qingdao. Facing the fierce competition, some traditional food retailers chose to expand to compete. For example, Qingdao Liqun opened its first supermarket with 5,000m^2 in size in April 1999, and over the next few years opened more than 10 stores of various sizes. Also, the Beifang Guomao Group opened a 4,000m^2 supermarket in the first floor in its shopping mall building. Others, however, repositioned themselves to particular customer groups, or simply went out of business. For example, Eastern Commercial Co. targeted its own food retail store, Dongfang, which is the only supermarket in the old part of Qingdao. Meanwhile, the other traditional retail formats (mainly consisted of wet markets, mom and pop stores and fruit stands) still play their traditional roles although they are no longer the dominant factor. As consequence, various retail formats can now be found in Qingdao---from big department stores to mom and pop shops, from indoor supermarkets to outdoor free market bazaars, and from domestic stores to foreign owned super-centers.

Further complicating the analysis of this diversified retail sector, is the Chinese terminology where convenience store should be translated into Chinese as "bianmingdian" or "bianmingdian," but this word was widely used by a lot of mom and pop stores, or variety stores, which in Chinese should be more properly called "xiaomaibu" or "menshibu." Supermarket (in Chinese terminology is "chaoshi") is another case widely abused in China. From small sized food stores to big shopping stores, all can named as "chaoshi", regardless if it actually has convenience store characteristics or operates as a real shopping center, or hypermarket.

We solved this problem by asking consumers to describe main characteristics that they themselves thought of for a number of descriptions of the various store formats in the field pre-test. Four categories of food shopping formats were finally contained in our official questionnaire. They are wet market, small grocery store, supermarket, and hypermarket, corresponding to "nongmaoshichang," "xiaomaidian or bianmingdian," "chaoshi," and "gouwuzhongxin or zhongheshichang". For the first and fourth, there was no confusion of the use of these terms. The second one, small grocery store, was translated into "xiaomaidian or bianlidian" to cover mom and pop stores, fruit stands as well as convenience stores (Chinese convenience stores tend to be somewhat smaller than their western counterparts). In the survey, it was emphasized to respondents that at "chaoshi" a shopping store mainly offering primarily food items, there were more than two cash registers. Therefore, the comprehensive shopping stores such as Shifang Liqun and Dafuyuan were categorized into hypermarket although they were named "chaoshi," while Northern Guohuo was treated as a small grocery store since it had only two cash registers.

The survey was performed in four food shopping locations in four of the seven urban districts: Shinan, Shibei, Sifang, and Licang. Geographically, Shinan is viewed as the old downtown, located south of Qingdao city, while Sifang and Shibei are located in the center of the city with Shibei as new downtown, and Licang located further up the peninsula and in the outskirts of the city. In 2003, the percentage of Qingdao's population in these four districts was 21.0 percent, 20.8 percent, 16.8 percent, and 12.5 percent, respectively. These locations were chosen to ensure a random sample encompassing a cross section of the Qingdao population and to survey consumers at the same time in a place where actual purchasing decisions were made in an effort to better elicit their true preferences. Four university graduate students were hired and trained to conduct this survey. The training included two-days of indoor training and one-day of field training. In the first two days, we explained the objectives of the study, the survey methods, focusing particularly on the way to ask each question. The four students were also asked to interview each other to familiarize themselves with the questionnaire. In the field training, we focused attention to the selection of sample individuals, and provided helpful tips to asking survey questions. Each interviewer was asked to finish at least ten respondent interviews in this training.

To avoid potential selection bias from individual sampling, respondents were randomly selected with the criterion that the interviewer was to solicit every third consumer that came into the survey area following the completion of the last interview. To improve the data quality, we signed contracts with the selected food stores and paid 200-400 Yuan per day to each store for the survey area reservations. As a reward for participating in the survey, every respondent was given a gift card redeemable at the food

shopping stores. Using this card, respondents could purchase products less than 15 Yuan (equivalent to about U.S. $1.80) in the store, without a cash refund. Finally, the surveyed samples were required to be randomly withdrawn from the adult urban population (18 years and older) to guarantee the preciseness of collected information.

Four main sample statistics were used to test the sample's representatives of the population. The test results indicate that our selected sample is relatively representative of the characteristics of the adult population in the study area (see last two columns in Table 1). The average family size in sampled households is 3.248, which is not significantly different statistically from the general population. The monthly per capita disposable income in sampled respondents is 1,078 Yuan, which is only 1 Yuan higher than the reported level by the Qingdao Statistic Bureau. Although the test results show that the other two statistics, share of females in the sample (66.3 percent) and the unemployment rate (6.1% percent, are significant higher than their corresponding population level, we believe that these biases are expected and acceptable. The higher share of female respondents is believed to be because the survey was conducted in food shopping stores. Actually, a higher share of females in a sample can make results more representatives when studying consumers' food consumption behavior because women normally play a larger role in family food shopping in China. The higher the unemployment rate in the surveyed sample is also expected because the population level used as the baseline is the registered unemployment rate, which currently is self-reported to local unemployment registration offices in China. It is widely recognized that not all of unemployed people reported their status to the office (e.g. ADB, 2002).

Table 1 also shows that the surveyed sample is distributed widely among various

consumers. The majority of the total surveyed respondents were in their late 30's or early 40's, with an average age of 38 years. Among the 838 surveyed Qingdao respondents, nearly three-fourths had a high school education level or higher and almost the same percentage was the main food shopper in their households. The monthly household disposable income for half of the sample ranges between 2,000 and 4,000 Yuan, or $250 and $500.

The statistics for Qingdao consumers' food shopping frequency and food shopping store visit frequency are presented in Table 2. It is easy to see that Qingdao urban consumers prefer to make food shopping frequently since 90 percent of samples individuals reported that they did food shopping at least 2-3 times a week. The possible reasons are rooted in small refrigerators, relatively low rates of car ownership as well as Chinese consumers' extreme sensitivity to the freshness and quality of the food that they buy (Bean, 2006). Summarized results also exhibited, in 2005, that the wet markets were still playing an important role in Chinese consumers' grocery choices for food shopping. In same year, more than 80 percent and 50 percent of respondents visited supermarkets and hypermarkets at least once within two weeks for food shopping respectively, while less than 20 percent of them reported they bought food products from small and independent stores with the same frequency.

The most frequently used forms of transportation used by shoppers included walking and taking the bus, accounting for 63 percent and 27 percent respectively. Unlike the case in developed countries such as the U.S. and the EU, only a minority of shoppers (4 percent) able to drive a car for food shopping in Qingdao (Figure 1). In terms of the most important factor in choice of where to shop for food, 62 percent of samples reported

quality, followed by store location (15 percent), price (8.9 percent) and food variety (8.6 percent). In addition, more than 5 percent of respondents thought that the shopping environment and service was the most decisive factor for their choice (Figure 2).

Estimated results

The log-likelihood function in (2) is used to obtain parameter estimates for Qingdao urban consumers' food shopping store format choice. The simulated estimates of multivariate binary probit model with 30 replications are reported in Table 3. The detailed definition, unit and coding of explanatory variables are provided in Table 4. The statistical significance of the model is examined by using a likelihood ratio test of the null hypothesis that all slope estimates are zero. The statistic of Chi-squared with 51 degree of freedom is 411.74, indicating rejection of the null hypothesis.

As our primary interest is with respect to interrelationship of the four categories of shopping store format in term of consumers' choice, the estimated correlation coefficients and standard errors are presented at the bottom of Table 3. A likelihood ratio test rejects the null hypothesis of that off-diagonal elements in covariance matrix of errors are zeros. That is, applying a univariate probit model for each format has no significant difference from running the multivariable probit model.

A positive correlation coefficient between the wet market and small grocery stores is found to be statistically significant at the 1% level. It is not hard to understand, given that wet markets specialize mainly in fresh vegetables, fresh fruit, staple and special crop products, livestock and poultry products, while small grocery stores in China normally concentrate on dried and packaged food items, bottled or canned seasonings, etc. Recall that another store format contained in the small store category in this study is

convenience stores or Bianlidian, which offer similar products to mom and pop stores or Xiaomaibu, but follows relatively standard operation to the latter. This result indicates a complementary relationship between traditional wet markets and small grocery stores in Qingdao.

The correlation between supermarkets (or chaoshi) and hypermarkets is significantly negative, indicating a strong competitive relationship between these two so called modern retail formats. To more precisely understand this result, it is useful to recall identifications of these two formats in this study. A supermarket is defined as any store that offers mainly food products, while a hypermarket is defined as any store that sells food products in addition to other products. Therefore, the identification excludes those stores which operate as hypermarkets but have “chaoshi” named in Chinese terminology. In later discussion, we will further demonstrate that the competition mainly embodies the challenge of the rapid growth of hypermarket to supermarket.

It is surprising that the modern retail formats, supermarket and hypermarket, did not bring significant pressure on the wet market (or nongmaoshichang) and small grocery stores (or xiaomaibu or bianmingdian). Bean (2006) in a GAIN report (USDA, FAS) provided a footnote for this finding: “Chinese consumers are extremely sensitive in freshness of food products. Traditional wet markets satisfy their demand although the sanitary standards in these markets still need to be improved. At the same time, however, the selection and quality of vegetables in most supermarkets are poor, and hypermarkets are too far for daily and instant shopping demand.” People may argue why a lot of wet markets have disappeared in many cities. A reasonable guess based on our findings is that the “supermarketization” (first see in Gale and Reardon, 2004) of wet markets in some

cities is the consequence of governments or governors seeking to demonstrate political performance rather than being abandoned by consumers.

Applying expressions (3)-(5), the unconditional marginal effects and several joint and conditional probabilities are calculated and presented in Table 5. The probabilities of all success and all failure are 9.1 percent and 0.6 percent respectively. The predicted choice probabilities for each format show that supermarkets or chaoshi (87.3 percent) were most likely to be visited for food shopping in Qingdao, followed by wet markets (70.5 percent), hypermarkets (55.9 percent) and small grocery stores (29.5 percent). Compare with the probabilities to choose each format conditional on hypermarkets failure, the probability that conditional on hypermarkets success to choose supermarket for food shopping is significantly lower (73 percent) than its counterpart (94.1percent), but no significant changes for wet market and small grocery store formats. These results support our above finding, i.e. the growth of hypermarkets in Qingdao brought competition pressure to supermarkets which just emerged a couple of years earlier than hypermarkets, but did not challenge traditional wet markets and small grocery stores in this market.

A number of socioeconomic and demographic variables are found to significantly influence Qingdao urban consumers' choice of food retail store format (See Table 3). Females, as expected, are more likely to shop for food in supermarkets and hypermarkets than males. Relatively, middle aged consumers (31-50 years) and seniors (51 years and up) are more likely to buy food products in wet markets, supermarkets, and hypermarkets; but less likely to buy food in small grocery stores. The fast working and living pace of young people compared to older people may be the reason that young people (under or

equal 30 years) shop for food in “xiaomaibu” or “bianmingdian” more frequently than others. There are no significant influences of household income on the probabilities that consumers buy food in small grocery stores or supermarkets, but significantly higher income groups are more likely to buy food in hypermarkets and less likely to buy from wet markets than the lower income persons.

In addition, notice that the estimates of MIDINC and HIGHINC in the supermarket equation are negative although they are not statistically significant. This implies that consumers may tend to dislike food shopping from current “chaoshi” in the long run, as their income grows. DAILYSHOP is a dummy variable, which is applied to represent consumers’ food shopping habits, taking one if the respondent usually buys food at least 2-3 times a week, and zero otherwise. Estimated results in Table 3 indicate that consumers who prefer frequent shopping are more likely to shop in wet markets and supermarkets as well as hypermarkets. The significant estimated coefficients for district dummies suggest that the development of various formats of food retail stores is unbalanced across regions, especially between the city center and the outskirts in Qingdao. In addition, as expected, those who most walk to go food shopping significantly prefer wet markets, small stores and supermarkets because these stores are in their neighborhood. However, those who mostly travel by car, take a bus or a free shuttle for food shopping are more likely to choose hypermarkets as destination. Given the high population density and limited space to improve city transportation infrastructure, the traditional wet markets and small grocery stores will likely play an important role in Qingdao for some time. In a sense, the compulsory policies in some cities to eliminate wet markets may not be appropriate in a market-directed economy.

Finally, those consumers who ranked variety or quality of offered food products as the most important factor for their choice of food shopping place are more likely to shop in hypermarkets. This preference reflects the great returns to the one-stop shopping format and consistent and trusted food quality offered in hypermarkets.

Summary and Conclusion

Using the survey data collected for individual consumers in Qingdao, China, this study empirically estimated a multivariate binary probit model for four categories of food shopping store formats. By doing so, this study not only indicated several extremely important interrelationships among the formats, but also identified determinant factors for consumers' decision for food shopping store choices.

Main findings show that the rapid growth of hypermarkets in Qingdao is significantly challenging another modern retail supermarket format, which emerged in this city only a couple of years earlier than hypermarkets. However, hypermarkets might not bring significant pressures into the traditional wet markets or small grocery stores and new convenience stores. The possible reasons are linked to store characteristics such as market position and quality control, and may also be related to potential substitutability or complementarity among various formats, as well as consumers' demographics and shopping habits.

These results suggest that the traditional wet markets and small grocery stores might exist for a long period, implying that current compulsive policies to close them in some cities might not be an appropriate action in a market-directed economy. Meanwhile, this study also suggests that current supermarkets who offer mainly food products are facing increasing competition from hypermarkets. In the future, supermarkets may have the

choice to grow to become a hypermarket or shrink to become a more professional convenience store might be future choice. Currently, supermarkets in China are somewhat smaller than their counterparts in developed countries. Large and professional food supermarkets were thus not covered in this study. However, this format may be a good choice for current food supermarkets to transform to in the future.

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Appendix

Table 1, Sample Statistics and Representative Tests

	Sample Mean	Std. Dev.	Population Mean	P-value[a]
Sample Distribution				
Shinan District	0.239	0.427		
Shibei District	0.236	0.425		
Sifang District	0.242	0.429		
Licang District	0.283	0.451		
Respondent's Individual Characteristics				
Age (year)	38.05	13.64		
Under 30	0.377	0.485		
31-50	0.401	0.490		
Older than 50	0.222	0.416		
Female of Total	0.663	0.473	0.495 [b]	Pr>t=0.0000
Unemployed	0.061	0.239	0.030 [c]	Pr>t=0.0001
Education Level (binary; yes=1)				
Primary school or illiteracy	0.039	0.195		
Middle school	0.230	0.421		
High school or equivalent	0.370	0.483		
2-year college or equivalent	0.228	0.420		
4-year college	0.126	0.333		
Advanced or professional degree	0.006	0.077		
Main Food Shopper in Household	0.754	0.431		

(next)

Table 1, Sample Statistics and Representative Tests (*cont.*)

	Sample Mean	Std. Dev.	Population Mean	P-value[a]
Household Characteristics				
Monthly Per Capita Disposable Income (1000 Yuan)	1.078	0.566	1.077 [c]	Pr>|t|=0.9483
Less than 2,000	0.210	0.408		
2,001-4,000	0.498	0.500		
More than 4,001	0.292	0.455		
Household Size (people)	3.248	1.092	3.191 [b]	Pr>|t|=0.1298
Total Observations	838			

a. Null Hypothesis, Ho: sample mean=population level.

b. 2003 data as population level since 2005 data are unavailable. The household size is from the 2004 Qingdao Statistical Yearbook, and the share of females is calculated based on the data from the 2004 Shandong Statistical Yearbook. We believe there are no significant differences for these data between 2003 and 2005.

c. Data are from the Qingdao 2005 Economic and Social Development Annual Report released by the Qingdao Bureau of Statistics.

Table 2, Food Shopping and Shopping Store Visit Frequencies in Qingdao

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

Table 3, Results from the Multivariate Binary Probit Model

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

Number of Replications R:	20
Log-Likelihood Function:	-1633.82
LR Chi2(51) test:	411.74
Prob>Chi2(51):	0.0000
Number of Observations:	838

(next)

Table 3, Results from the Multivariate Binary Probit Model (*cont.)*

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

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

Table 4, Variable Definition, Unit and Coding

Variable	Definition and Unit	Coding
FEMALE	Respondent gender	Female=1, male=0
YOUNG*	Respondent age is under 30 (include) years	Yes=1, No=0
MIDAGE	Respondent age is between 31 and 50 years	Yes=1, No=0
SENIOR	Respondent age is up 50 years	Yes=1, No=0
EDU	Respondent education level	Continuous
LOWINC*	Household monthly disposable income less than 2,000RMB	Yes=1, No=0
MIDINC	------ranges from 2,001-4,000RMB	Yes=1, No=0
HIGHINC	------greater than 4,000RMB	Yes=1, No=0
DAILYSHOP	At least three-time food shopping a week	Yes=1, No=0
SHIBEI	District dummy	Yes=1, No=0
SIFANG	District dummy	Yes=1, No=0
SHINAN	District dummy	Yes=1, No=0
LICANG*	District dummy	Yes=1, No=0
FASTFOOD	At least once visit foreign fast food restaurant	Yes=1, No=0
WALK	The most often used transportation to shop food is walk	Yes=1, No=0
CAR	------is car	Yes=1, No=0
BUSSHUTT	------is public bus or free shuttle offered by retailer	Yes=1, No=0
VARIETY	The most important factor for shopping store choice is variety of offered products	Yes=1, No=0
QUALITY	------ is quality of offered products	Yes=1, No=0
OTHERFT*	-------is others excluded variety and quality	Yes=1, No=0

*Baseline category in regression.

Table 5, Marginal Effects and Predicted Probabilities of Multivariate Probit Model

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

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

Figure 1, Most Often Used Transportation For Food Shopping

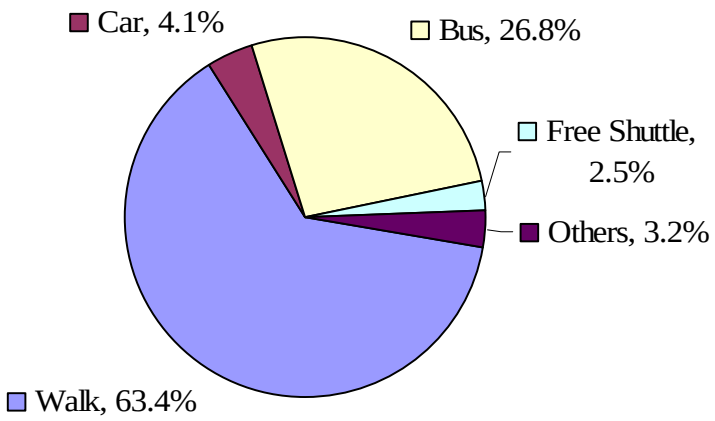

Figure 2, Most Important Factor For Food Shopping Store Choice