Modeling Food Retail Format Choice and Shopping Frequency Decision in Urban Ghana: A Multivariate Ordered Probit Regression Application

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Abstract

The goal of this study is to investigate consumer food shopping behavior in terms of food shopping frequencies at open-air markets, from hawkers, and in supermarkets. The study uses primary data collected in urban Ghana in 2011. The present paper contributes to the development of methods for analysis of consumer food shopping behavior by considering the correlation between different food retail formats in an emerging African economy. Results of multivariate ordered probit model indicate that open-air markets still dominate the food supply system in urban households of Ghana, and the food shopping frequency in open-air markets is not significantly related to other food retail stores. While the food shopping frequency in supermarkets and from hawkers are found to be significantly positive. The study also provides insights about the joint distribution and conditional distribution of food shopping frequency in these retail outlets, providing valuable practical knowledge to both public sectors and private organizations.

Key words: joint distribution, conditional distribution, cross equation correlation

1 Introduction

In the recent decades, because of the substantial economic growth and rapid disposable income increase, a tremendous dietary transition has been occurring in developing countries. Consumers are becoming more concerned about the diversity, nutrition, and quality of food products they eat (Kearney, 2010; Moser et al., 2011; Mashinini, 2006). The changing food consumption patterns along with the fast urbanization lead to a dramatic change of the food retail environment (Louw et al., 2007).

Besides the traditional food outlets, several new types of facilities, including supermarkets, have been integrated into the food retail system and play an increasingly important role in food supply system. For example, by 2000, among Latin American countries, the share of supermarkets in national food retail exceeded 50 percent (Reardon et al., 2003). The late wave of supermarket expansion arrived at Africa in late 1990s, first at Eastern and Southern Africa, and later it reached West Africa (Reardon et al., 2004). Supermarket subsector has been a significant part in the agri-food sector with roughly 55% share in overall food retail of South Africa, while in Eastern Africa, such as in Kenya, even many small-to-medium sized towns have supermarkets (Reardon et al., 2003; Crush and Frayne, 2011). However, in West Africa, the role of new emerging retail formats received little attention due to lack of adequate resources to conduct consumer survey. The lack of data further limits research on food retail environment and consumer food shopping behavior in that area. However, international or domestic food retailers demand studies in their considerations whether to access the current food retail system. An examination of consumer profiles is sought to make entrance decisions and formulate retailers marketing strategies. Development of food retail system will further promote the local economic and contribute to the stability of food supply chain.

This study fills the knowledge gap by investigating food shopping frequency and its determinants in both traditional and modern retail formats (i.e., open-air markets, hawkers, and supermarkets), using a primary data set collected by a survey of urban households in Ghana in 2011. The main goal is to contribute to the development of methods for analysis of consumer food shopping behavior in terms of their shopping

frequency and store choice, using the multivariate ordered probit estimation. This method allows capturing the potential cross-equation correlations and pays particular attention to the joint distribution. The present paper expands the study of Meng et al. (2014) and focuses on the applied estimation method. The introduction of a new food retail format such as supermarket does not necessarily mean the complete elimination of the traditional food retail stores. Quite opposite, shopping in several food retail stores simultaneously is quite common, especially at the early stage of food retail system transition. Goldman (2000) pointed out that "consumers who regularly shop in supermarkets continue to purchase fresh food in traditional outlets". Therefore, it is of particular interest to consider the potential correlation of consumer shopping decision in several food retail formats. By considering the across-store correlation, the multivariate version of estimation method increases the efficiency of results and provides robust and in-depth information about consumer food shopping behavior. In previous studies, researchers, rather than examining the joint distribution, focused on marginal distribution related to each food retail outlet, and ignored the potential correlation between those food stores (Florkowski et al., 2002; Meng et al., 2014). The current study employes multivariate ordered probit model to investigate the potential relationship of food shopping decision related to different retail outlet types, and further study the joint food shopping frequency.

The present study extends the existing research about food retail system in three ways. First, it targets on urban area of Ghana, a West Africa country. Very few researches focused on food supply chain in this region, however, both public sectors and private food retailers seek information of food retail environment and consumer food consumption patterns. Second, this paper investigates both supermarket and traditional food retail store from consumer's choice viewpoint, and develops the corresponding consumer profile and identifies shopping behavior. While most of previous studies on food retail stores, focused solely on supermarkets (Mai and Zhao, 2004; Min, 2006; Theodoridis and Chatzipanagiotou, 2009), or compared supermarkets and traditional food outlets simply by their product features such as price and variety (Goldman and Hino, 2005; Minten and Reardon, 2008). Third, the multivariate ordered probit method is

employed in the current paper, which allows us to investigate across-store correlations and examine consumers' joint shopping decision.

The structure of this paper is as follows. After the brief discussion of the conceptual famework in Section 2, Section 3 presents the data and provides the summary of descriptive data analysis. The details of model and estimation method are explained in Section 4 while Section 5 presents the results of multivariate ordered probit estimation. Concluding remarks are in Section 6.

Results of this study show that open-air markets still dominate the food retail chain in urban area of Ghana, with nearly 70 percent of households purchasing food there once a week or even more often. Consumer food shopping frequency in the open-air markets does not relate to the shopping frequency in two other retail outlets (i.e., supermarkets and hawkers). Open-air markets are preferred by large households, especially those with the retired or unemployed members. Moreover, the food shopping frequencies in supermarkets and hawkers are found to be significantly positive. That is, households often shopping food in supermarkets are more likely to frequently patronize hawkers in food shopping . Hawkers are usually located at crossroads, while supermarkets are often reached by cars or bus. Thus, people have an opportunity to buy some food products from hawkers on their way to supermarkets. Supermarkets, as a modern food outlet format, are gradually accepted in urban areas, especially by high-income and well-educated married households. Because of convenience, hawkers are still an integral part of the food supply system, especially in the Northern part of Ghana.

The study provides detailed knowledge about food shopping behavior of urban households in Ghana, especially about their food retail format choice and shopping frequency. Such valuable knowledge helps food retailers to understand new food consumption trends and patterns in order to promote their retail format. Furthermore, it guides public sector in assuring food access and security through various retail formats in a changing environment. Comparing with previous methods with independent equations results of the multivariate ordered probit estimation are more efficient to qualify

consumer shopping behavior. This method can be applied to a wide range of topics when across equation correlation needs to be considered.

2 Conceptual framework

According to the classical consumer demand theory, households make their consumption decisions to maximize their utility levels. Given the stable price assumption applied in cross-sectional data, the optimal food consumption depends on income and households preferences. The unobserved household preferences can be shaped by their member socio-demographic characteristics. In the present study, food shopping frequency related to each food retail format is assumed to be proportional to food consumption, and is a function of income and household socio-demographic characteristics.

The current study investigates food shopping behavior in terms of shopping frequency in both modern food retail outlets (i.e., supermarkets) and traditional food outlets (i.e., open-air markets and hawkers). Shopping in each retail format is modeled in a separate equation, while the cross equation correlation might be present. The correlations are likely because purchasing food from multiple food retail formats simultaneously is quite common in developing countries. Consumers who regularly patronize supermarkets might still purchase their fresh food in traditional outlets (Goldman, 2000). For example, in China, consumers buy their food in supermarkets "selectively", and they still shop in the traditional markets to buy fruits and vegetables (Mai and Zhao, 2004). Therefore, there might be a potential correlation between the food shopping frequencies in different food retail store types. To be more specific, a household use a food retail outlet often might be more (less) likely to purchase their food in another food outlet. In other words, several food retail outlets might be compliment or competitive to each other in terms of consumer food shopping choice.

3 Data

Survey data were collected by trained enumerators in three big cities of Ghana (i.e., Accra, Takoradi, and Tamale) during 2011, using a structured, pre-tested questionnaire.

Respondents were randomly selected in these three cities to represent the urban population in Ghana. During the interview, respondents were asked to share information about their food shopping habits such as retail store formats and the corresponding shopping frequency, as well as selected personal information such as age, gender, occupation, household income, and household composition. After deleting incomplete records, 1,010 respondents were included in the data analysis.

Table 1 displays the definition and measurement units of selected variables, as well as their mean and standard deviation. In the sample, 36.3 percent of the responding households report to buy food at open-air markets "more than once a week," 32.8 percent "once a week," 16.3 percent "every other week," 11.4 percent "once a month," respectively, and the remaining 3.3 percent "almost never" purchase food there. In terms of outlet type and applying the above mentioned frequency categories, the proportions of households buying food in supermarkets, are 7.3, 9.8, 9.4, 25, and 48.5 percent, respectively; finally, households that "shop food from hawkers" given the five frequency categories account for 16.5, 9.9, 11.9, 10.8, and 51 percent, respectively.

The typical respondents are 39.2 years old and have 3.5 members in their households. In addition, 38.3 percent of the respondents have a secondary education, while 13.5 percent have a college education. Among the surveyed households, 64.2 percent of them are self-employed, and 24.3 percent work in government or civil department. The average household income in the month preceding the survey is about 646 Ghanaian cedi.

4 Model and estimation

Three equations examine the determinants of household food shopping frequency in supermarkets, at open-air markets, and from hawkers (i.e., one equation for one food retail format). The dependent variable in each equation is the corresponding shopping frequency, which is measured on a scale from one to five (i.e., 1=almost never, 2=once a month, 3=every other week, 4=once a week, 5=more than once a week). The higher number indicates more frequent patronizing a certain outlet type. Moreover, the

explanatory variables include socio-demographic characteristics and location (i.e., household income; respondent's education, occupation, age, marital status; household composition, and regional location).

First, the multivariate ordered probit regression is applied to investigate the socio-demographic factors' effect on an urban household's food shopping frequency at each food outlet, considering the potential correlations of shopping decision in different food outlets. To capture the potential cross equation correlation, a multivariate version of ordered probit model was employed in the current research. The model framework of multivariate order probit regression was depicted in Equation 5 and 6, where Y^* is the latent variable behind the food shopping frequency, X denotes the selective explanatory variable vector, β is the coefficient vector, and ε is the error term which is assumed to follow multivariate normal distribution with zero mean. In the variance covariance matrix of error terms, $\rho_{mn}{}'s$ are the correlation coefficients between ε_m and ε_n.

$$\begin{aligned} Y_1^* &= X\beta + \varepsilon_1 \\ Y_2^* &= X\beta + \varepsilon_2 \\ Y_3^* &= X\beta + \varepsilon_3 \end{aligned} \tag{5}$$

$$\begin{aligned} &\varepsilon = \begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \end{pmatrix} \text{ follows } \mathrm{N}(\mu, \Sigma) \\ &\text{where } \mu = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}, \Sigma = \begin{pmatrix} 1 & \rho_{12} & \rho_{13} \\ \rho_{12} & 1 & \rho_{23} \\ \rho_{13} & \rho_{23} & 1 \end{pmatrix} \end{aligned} \tag{6}$$

The relation between the latent variable Y^* and the dependent variable Y is defined in Equation 7. When the latent variable falls between particular cut points, the dependent variable equals to certain ordinal level, where $Cut'{}s$ are parameters to be estimated assuming $Cut_{i-1} < Cut_i$ (because of convenience in model expression, Cut_0 and Cut_5 are used to denote the negative infinite and infinite) (Sajaia, 2008). The joint probability of

food shopping frequency can be expressed as the triple integral of Probability Density Function of multivariate normal distribution (Equation 8). The likelihood function of the empirical model is the product of all possible joint probabilities with the indicator variable *d* as corresponding power, and N is the total sample size.

$$Y = i, \text{ if } Cut_{i-1} < Y^* < Cut_i, \text{ where i} = 1, 2, 3, 4, 5 \tag{7}$$

$$\begin{aligned} &\Pr ob(Y_1 = i, Y_2 = j, Y_3 = k) \quad \text{i, j, k} = 1,2,3,4,5 \\ &= \text{Prob}(Cut^1{}_{i-1} < Y_1^* < Cut^1{}_i, Cut^2{}_{j-1} < Y_2^* < Cut^2{}_j, Cut^3{}_{k-1} < Y_3^* < Cut^3{}_k) \\ &= \text{Prob}(Cut^1{}_{i-1} - \text{X}\beta_1 < e_1 < Cut^1{}_i - \text{X}\beta_1, Cut^2{}_{j-1} - \text{X}\beta_2 < e_2 < Cut^2{}_j - \text{X}\beta_2, Cut^3{}_{k-1} - \text{X}\beta_3 < e_3 < Cut^3{}_k - \text{X}\beta_3) \\ &= \int_{Cut^1{}_{i-1} - \text{X}\beta}^{Cut^1{}_i - \text{X}\beta} \int_{Cut^2{}_{j-1} - \text{X}\beta_2}^{Cut^2{}_j - \text{X}\beta_2} \int_{Cut^3{}_{k-1} - \text{X}\beta_3}^{Cut^3{}_k - \text{X}\beta_3} \phi_3(e_1, e_2, e_3) de_1 de_2 de_3 \end{aligned} \tag{8}$$

$$Likelihood = \prod_l \prod_i \prod_j \prod_k \Pr ob(Y_1 = i, Y_2 = j, Y_3 = k)^{d(Y_1 = i, Y_2 = j, Y_3 = k)} \tag{9}$$

where l = 1,2, ...N; d = 1 if $Y_1 = i, Y_2 = j, Y_3 = k$; d = 0 otherwise.

Second, the predicted joint distribution and conditional distribution are further computed to quantify consumer food shopping behavior in-depth. The distributions reveal the comprehensive knowledge about consumer food shopping habits. Specifically, for example, joint distribution provides information about how likely is a household visit to supermarket once a week, while, at the same time, shopping food from hawkers once a month. Although the interpretation of joint and conditional distribution seems similar, they are different. For instance, results of conditional distribution indicate how likely is a household to visit supermarket once a week given the same household purchases food from hawkers once a month.

5 Results

Based on the estimation results from multivariate ordered probit model, the following is discussed in this section. First, the correlations between three food retail formats are examined. Second, significant variables determining food shopping frequency in supermarkets, open-air market, and hawkers are identified, in terms of the corresponding

coefficients and standard deviations. Third, the joint and conditional distribution of food shopping frequency are computed and showed. Because marginal effects of marginal distribution in each food retail outlet are similar to the previous study (Meng et al., 2014), therefore, rather than focusing on marginal distribution, the current study pays more attention to the joint and conditional distribution of food shopping frequency in the considered food retail formats.

Correlation of food shopping frequency between different food outlets

Multivariate ordered probit model assumes that the error term vector follows multivariate normal distribution, and the cross equation correlation can be captured. Results indicate that the correlation between food shopping frequency in supermarket and from hawkers is significantly positive, where ρ_{13} is about 0.18. It indicates that households buying their food in supermarkets are likely to patronize hawkers frequently. Or, the opposite is true, i.e., if a household visits supermarket less often, then such household is likely to purchase food from hawkers less often. Supermarket is usually far away from consumers' home in urban Ghana, therefore, on the way to supermarkets, consumers often meet several hawkers at the intersections and buy some food. Therefore, it is understandable why food-shopping frequencies in these two food outlets are positively correlated.

However, food-shopping frequency in open-air markets is not significantly correlated with food purchases at supermarkets and from hawkers, respectively. At the current stage of Ghana's development, open-air market still rules in the food supply system, and households often buy their food products there, from fresh vegetables to meat. Thus, shopping frequency in other retail food formats such as supermarkets and hawkers are less likely to affect the food shopping decision in open-air markets.

Because only the correlation between food shopping frequency in supermarkets and hawkers are significant, the trivariate ordered probit model can be simplified. A single ordered probit is use to model food shopping frequency in open-air markets. While a bivariable ordered probit model is specified for supermarkets and hawkers. The following discussion based on the results displayed in Table 2.

Significant determinants of food shopping frequency

As shown in Table 2, household size (i.e., the number of adult members), household income, education level, and regional factors are found to be significant in affecting consumer's food shopping frequency in supermarkets. While in open-air market equation, the statistically significant factors include marital status, age, the number of both small children and adult members, occupation, college education, and regional dummy variable. In addition, household composition, income, college education, and regional factors are of significant importance in determining the food shopping frequency from hawkers.

Considering food shopping frequency in each food retail format separately is called marginal distribution, while analyzing the food shopping frequencies of at least two retail formats jointly is called joint distribution. Similar to the joint distribution, if treat the food shopping frequency in one food outlet as given, it is called conditional distribution. Because the marginal distribution results as well as their corresponding marginal effects are quite similar to those reported previously (Meng et al., 2014), we skip thier discussion. Therefore, the current study attaches particular importance to the joint distribution and conditional distribution.

Predicted joint distribution

According to the results, food-shopping frequency in supermarket is positively correlated to food shopping frequency with hawkers. Five categories, namely, "almost never", "once a month", "every other week", "once a week", and "more than one a week" measure shopping frequency in each food retail outlet type. The probabilities of 25 joint situations are displayed in Table 3. By comparing those joint probabilities, the situation of "almost never" shopping in both supermarket and hawkers has the highest probability of 25 percent. Results also suggest there is a big chance that a household shops in supermarket "once a month" and "almost never" shops from hawkers, with a probability of 13 percent.

In the joint situation of almost never shopping in supermarket and from hawkers, the marginal effect of household size has a negative effect of 2.4 percent. Secondary education has a significant negative effect on this shopping combination, also both Tamale and Takoradi households are less likely to be in that situation. While for the situation where household almost never shop for their food from hawkers but patronize supermarket once a month, the number of children under 3 years old has a negative effect, both income and education have positive effects, while Tamale households have lower probability being in this situation than households in Accra.

Predicted conditional distribution

The predicted probabilities of shopping for food from hawkers conditioned on supermarkets are displayed in Table 4. The reverse situation, i.e., the predicted probabilities of shopping for food in supermarkets conditioned on hawkers are displayed in Table 5.

In Table 4, given shopping in supermarket "almost never", the probabilities of purchasing food from hawkers "almost never" "once a month" "every other week" "once a week" and "more than one a week", are 55.6 percent, 11.1 percent, 11.1 percent, 8.9 percent, and 13.3 percent, respectively. It suggested that given a household almost never using supermarkets for food shopping, there is more than 50 percent of probability that this households almost never patronize hawkers for food. In addition, it is worth noting that given a household shopping food in supermarkets "more than once a week", more than a fifth of them purchase food from hawkers. Table 4 displays the positive correlation of food shopping frequency in supermarkets and hawkers in details.

Similarly, Table 5 shows the predicted probability of food shopping in supermarkets given the food shopping frequency in hawkers. Given shopping food from hawkers happens "almost never", the probabilities of purchasing food in supermarket "almost never" "once a month" "every other week" "once a week" and "more than one a week", are 48.1 percent, 25 percent, 9.6 percent, 9.6 percent, and 7.7 percent, respectively.

Results indicate 12.5 percent of households, shopping food from hawkers more often than weekly, given they visit supermarkets for food shopping “more than once a week”.

6 Discussions

Results of the study provide a comprehensive picture of the determinants of the food shopping frequency in open-air markets, from hawkers, and in supermarkets in urban households of Ghana, a West African country. The present study contributes to the food supply system examination by developing the multivariate version of the estimation method. The multivariate ordered probit regression model allows the present study to examine the correlation between food shopping decision in different food retail formats. Because it is quite common to purchase food from several food retailers simultaneously. Therefore, instead of investigating the food shopping frequency in any food outlet types separately, it is of particular relevance to consider the correlation between food purchases in various outlets and, furthermore, research the joint distribution and conditional distribution of food shopping frequency in different outlets.

Results provide insights about the structure of food retail system in Ghana. Clearly, the traditional food retail outlets such as open-air markets play the major role in food supply in the urban households of Ghana. Therefore, monitoring food supply and food price stability in the traditional outlet types such as open-air markets remains essential to assure food security in the urban households of Ghana. While other food retail formats such as supermarkets and hawkers are also integral sectors in the food supply system. Food shopping frequencies in supermarkets and from hawkers are found to be significantly positively correlated. In other words, supermarkets and hawkers display a complementary relationship. Because on the way to supermarkets, consumers have opportunities to purchase some food from hawkers, usually located at the intersection of major roads. Thus, in order to develop modern food retailing industry, local governments need to recognize that it is critically important to enhance the infrastructure and the accessibility of public transportation in urban areas.

Results from the joint distribution and conditional distribution of food shopping frequency in supermarkets and hawkers provide in-depth information about consumer food shopping habits. The study contributes to the examination of consumer food shopping behavior focusing especially on West Africa, a region that has received little attention. The gained insights assist in establishing factors that affect a household's choice among food outlet types, and describe the client profile of these main food retail outlets yielding invaluable information for food retailers. For example, supermarket operators are suggested to focus food promotion among the high-income, well-educated, and large households in relatively more developed urban areas of the country. However, to strength its competitive position in food retail system, open-air market retailers need to increase the quality and diversity of their food products to attract well-educated households. Furthermore, hawkers attract their customs mostly by their convenience. Hawkers fill the niche in Ghana and to remain competitive need to focus on on-site/on-the-go consumption and convenient food products.

Furthermore, the multivariate version of estimation methods can be applied to a wide range of other studies, especially if there is potential correlation between the modeled events. Results of the joint distribution and conditional distribution provide more comprehensive information than solely marginal distribution.

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Table 1. Descriptive statistics of variables included in the empirical model

Variable name	Variable description / units of measurement	Mean	Std dev
Dependent variable:			
Freq_market	How often do you buy food products in the market? Almost never=1; once a month=2; every other week=3; once a week=4; more than once a week=5	3.870	1.100
Freq_super	How often do you buy food products in the supermarket? Almost never=1; Once a month=2; Every other week=3; Once a week=4; More than once a week=5	2.056	1.292
Freq_hawker	How often do you buy food products from the hawkers? Almost never=1; once a month=2; every other week=3; once a week=4; more than once a week=5	2.272	1.538
Independent variables:			
	Demographic factors		
Married	=1 if a respondent is married	0.753	0.431
Age	Actual age in years	39.222	10.656
Age_3	Number of household members 3 years old or younger	0.363	0.645
Age_12	Number of household members between 4-12 years old	0.945	1.067
Age_18	Number of household members between 13-18 years old	0.983	1.205
Age_60	Number of household members between 19-60 years old	2.087	1.751
Age_61	The squared number of household members 61 years old or older	0.153	0.505
	Socioeconomic factors		
Income	Household income in the month preceding the survey / in Ghanaian cedis	646.070	785.081
Employ_self	=1 if a respondent is self-employed	0.642	0.480
Employ_gov	=1 if a respondent is gov/civil employee	0.243	0.429
Educ_sec	=1 if a respondent has a secondary education (including Senior high/GCE O-A level, Vocational school, Technical school, or Teacher training)	0.382	0.486
Educ_col	=1 if a respondent has a college education (including university postgraduate)	0.134	0.340
	Location		
Tamale	=1 if a household is in Tamale	0.186	0.389
Takoradi	=1 if a household is in Takoradi	0.208	0.406

Table 2. Estimation results of the food purchase frequency by three outlet types in urban households of Ghana, 2011.

Variable name	Supermarket	Open-air market	Hawkers
	Demographic Factors		
Married	.1254	-.1380*	.0394
	(.0874)	(.0833)	(.0886)
Age	-.0030	-.0075**	.0049
	(.0038)	(.0036)	(.0038)
Age_3	-.0109	.1026*	.1365 **
	(.0593)	(.0612)	(.0620)
Age_12	-.0338	.0459	.0174
	(.0364)	(.0347)	(.0360)
Age_18	-.0313	.0376	-.0083
	(.0328)	(.0313)	(.0323)
Age_60	.0541**	.0536**	.0674***
	(.0225)	(.0218)	(.0225)
Age_61	-.0434	.0187	.0645
	(.0768)	(.0727)	(.0777)
	Socio-economic Factors		
Income	.0128**	-.0038	-.0234***
	(.0051)	(.0049)	(.0069)
Employ_self	-.0141	-.2337**	-.0073
	(.1174)	(.1146)	(.1184)
Employ_gov	.1531	-.2104	-.0838
	(.1360)	(.1340)	(.1417)
Educ_sec	.4745***	-.0892	-.1300
	(.0850)	(.0813)	(.0865)
Educ_col	.3889***	-.4806***	-.2599*
	(.1180)	(.1167)	(.1363)
	Location		
Tamale	.0267	.0727	.6428***
	(.1071)	(.1020)	(.1054)
Takoradi	.4310***	-.1668*	.3176 ***
	(.0947)	(.0917)	(.0981)
Cut1	.4419	-2.4872	.3793
	(.2101)	(.2184)	(.2147)
Cut2	1.1873	-1.6403	.6915
	(.2123)	(.2082)	(.2154)
Cut3	1.5421	-1.0388	1.0734
	(.2142)	(.2060)	(.2165)
Cut4	2.0662	-.1296	1.4491
	(.2180)	(.2039)	(.2178)
Rol13	.1896***		
	(.0403)		

Note: *, ** and *** denote significant at 10%, 5%, and 1% levels, respectively. Standard errors are in parentheses.

Table 3: Predicted joint probability of shopping for food in supermarkets and hawkers

Supermarket\Hawkers	Almost never	Once a month	Every other week	Once a week	More than once a week
Almost never	.25 (.0991)	.05 (.0218)	.05 (.0268)	.04 (.0251)	.06 (.0643)
Once a month	.13 (.0503)	.03 (.0060)	.03 (.0078)	.03 (.0085)	.04 (.0286)
Every other week	.05 (.0281)	.01 (.0037)	.01 (.0041)	.01 (.0036)	.02 (.0102)
Once a week	.05 (.0373)	.01 (.0054)	.01 (.0059)	.01 (.0048)	.02 (.0110)
More than once a week	.04 (.0481)	.01 (.0075)	.01 (.0082)	.01 (.0129)	.02 (.0129)

Note: Standard deviances are in parentheses.

Table 4: Predicted probability of shopping for food from hawkers condition in supermarkets

Supermarket(condition)\Hawkers	Almost never	Once a month	Every other week	Once a week	More than once a week
Almost never	0.556	0.111	0.111	0.089	0.133
Once a month	0.500	0.115	0.115	0.115	0.154
Every other week	0.500	0.100	0.100	0.100	0.200
Once a week	0.500	0.100	0.100	0.100	0.200
More than once a week	0.444	0.111	0.111	0.111	0.222

Table 5: Predicted probability of shopping for food in supermarkets condition on hawkers

Supermarket\Hawkers(condition)	Almost never	Once a month	Every other week	Once a week	More than once a week
Almost never	0.481	0.455	0.455	0.400	0.375
Once a month	0.250	0.273	0.273	0.300	0.250
Every other week	0.096	0.091	0.091	0.100	0.125
Once a week	0.096	0.091	0.091	0.100	0.125
More than once a week	0.077	0.091	0.091	0.100	0.125