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Chinese Consumers' Preferences for Livestock Products[1]

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Abstract

This research surveyed over 784 Chinese consumers in Shanghai and Nanjing in 2001 and 2002, evaluating their preferences for livestock product attributes using ordered-probit models and factor analyses. Empirical results confirm the heterogeneity of Chinese livestock retail markets and suggest that livestock distributors should focus on Chinese female consumers and young consumers considering cooking convenience as a key attribute. Chinese consumers with higher incomes placed less importance on product price and shopping environment and more importance on product quality and brand name. Highly-educated Chinese consumers placed more importance on the brand name attribute. Our findings also indicate that it is crucial for U.S. livestock exporters to create an excellent external product image such as brand name, packaging, cooking convenience and shopping environment. Marketing strategies to consider include building a brand name for livestock products, designing attractive packaging with suitable size, making products easy to cook and creating a comfortable shopping environment.

Keywords: China, factor analysis, livestock products, ordered-probit model

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Introduction

China's food systems incurred rapid development over the past two decades. From the consumption side, Chinese consumers gradually shifted from basic food staples to protein-rich livestock products (Qin, et al., 2002; Peng, 2002). From the production side, the quantity of food available is no longer in short supply for most Chinese consumers, especially urban residents. From the marketing side, a profound transformation of China's livestock product retail markets has taken place. Chinese consumers have more freedom to make consumption choices in terms of their own preferences (Marchant and Tuan, 2002; Zhong, Marchant, Ding, and Lu., 2002). This research examines these preferences, focusing on China's livestock products.

Even in the early 1990s, dominant retail outlets in China consisted of wet markets[1] and non-staple food stores. However, in recent years the introduction of supermarkets and convenience store chains fundamentally changed the Chinese market outlet structure (Moustakerski, 2001). Supermarkets are now common throughout China. According to China's Chain Store Association (Bean, et al., 2002), as of 2001 there were 91 retail chain store companies in China with total sales revenue of 116 billion Yuan in RMB[2]. "The total number of stores equaled 7,953, of which there were 3,328 supermarkets, 271 hypermarkets, 3,342 convenience stores and 60 warehouse stores. Over half of China's convenience stores were located in Shanghai" (Bean, et al. 2002).

The above transition of China's retail marketing system promises great sales potential for frozen and chilled livestock products including U.S. exporters, especially as refrigerator ownership increases in China. The proportion of Chinese households that purchase frozen foods grew from 13% in 1994 to 38% in 1998 (Lyon and Durham, 1999). In urban areas, frozen food purchases are even higher. Twenty percent of Chinese consumers purchase livestock products from supermarkets and food stores (Reynolds, 1998). This 20% represents a growing market since these consumers are new entrants into the middle class who are willing to pay more for quality products and convenience.

Livestock products sold in Chinese supermarkets and food stores command a 10%-plus price premium compared to products sold in traditional Chinese wet markets. This price premium stems from special product attributes (e.g., clear labeling, customized cuts, and packaging) that wet market products do not possess. It is crucial for U.S. exporters to know how and why these attributes are evaluated by

[1] Wet markets are open-air stalls where Chinese consumers have traditionally shopped for fresh vegetables, meat and seafood. Wet markets sell locally grown produce almost exclusively.
[2] The exchange rate equaled 8.27 Yuan in RMB = 1 U.S. dollar.

Chinese consumers since most U.S. meat exports to China are chilled or frozen, and sold in supermarkets and food stores (Lyon and Durham, 1999).

However, existing literature does not extensively discuss Chinese consumers' evaluation of frozen and/or chilled livestock product attributes. Previous studies found that socioeconomic, geographic and demographic variables can be important factors in determining consumers' preferences toward meat consumption (Senauer, et al., 1992; Cui, 1997). Hui et al., (1995) suggested a study of consumer preferences by examining the relationship between consumers' importance ratings of meat attributes and variables representing their socioeconomic, geographic and demographic backgrounds.

The overall objective of this research is to evaluate Chinese consumers' preferences for livestock products which can ultimately help livestock distributors, including U.S. livestock exporters, better understand the Chinese livestock market. To obtain this overall objective, the following two specific objectives are included:

1. to assess the determinants of Chinese consumers' preferences for livestock product attributes by estimating a series of ordered-probit models, and

2. to detect the interrelationship between initially selected product attributes using the factor analysis methodology.

This paper is organized as follows: following our discussion of ordered-probit model methodology, we than describe our Chinese consumers' preference survey. The survey data provides information on consumers' importance ratings of seven selected livestock product attributes as well as consumers' socioeconomic, geographic and demographic background. Next, we report empirical modeling results for ordered-probit models and factor analyses. Finally, we present implications from our empirical results for livestock distributors, focusing on U.S. exporters of livestock products.

Research Methodologies

This consumer preference analysis stems from microeconomic theory and Lancaster's characteristics methodology where consumption utility is derived directly from a well-defined set of characteristics or attributes of goods and indirectly from consumed goods (Lancaster, 1991; Nicholson, 2001). With respect to Chinese consumers' livestock product consumption behavior, this methodology enables us to analyze Chinese consumers' preferences on selected livestock product attributes, which shape consumers' shopping behavior.

An individual consumer's utility function or preference ordering is hypothesized to be represented by our consumer's importance ratings R (R = 1–not important at all,

R = 2–not very important, R = 3–somewhat important, R = 4–important, R = 5–extremely important) on livestock product attributes (e.g., price, product quality, labeling, packaging, brand name, cooking convenience and shopping environment). Ratings (Rs) are determined by a 1×1 vector (X) consisting of *1* socioeconomic, geographic and demographic factors of our representative consumer. These variables include *household income*, *year*, *region*, *age*, *household size*, *gender*, *education*, and *marital status.* The vector R comprises responses from each survey participant and is expressed as an ordinal importance rating based on that consumer's utility function.

There is a clear ranking among the importance rating categories, but the differences between adjacent categories are not treated as the same. Ordinary linear regression is inappropriate due to the non-interval nature of the dependent variable. On the other hand, multinomial logit models or ordinary binary probit models would fail to account for the ordinal nature of the dependent variable. Ordered probit models have been widely used for analyzing such categorical data (Chen, et al., 2002; Maddala, 1983; McKelvey and Zavoina, 1975). For a detailed discussion on ordered probit models refer to Appendix 1.

Consumer Preference Survey

Two Chinese consumer preference surveys were conducted in Nanjing and Shanghai in 2001 and 2002. Nanjing is the provincial capital of China's Jiangsu Province, which is a main livestock producing province, and Shanghai is the commercial center of China. We randomly chose participants to ensure the survey was a fair representation of the population. First, we selected eight supermarkets in each city based on their geographic location. In particular, two supermarkets were chosen randomly from the Eastern, Southern, Western and Northern areas in each city. Then twenty five survey participants were chosen randomly in each supermarket.

The total usable observations analyzed in this research equaled 784, among which 384 observations (218 from Shanghai and 166 from Nanjing) were from 2001 and 400 observations (200 from each city) were from 2002. In survey design, consumers' perception of selected livestock product attributes was assumed to be elicited by their importance ratings of each selected attribute, using a scale from 1 to 5 (1 being not important at all and 5 being extremely important) as described above. The selected attributes associated with frozen/chilled livestock products purchased from supermarkets and food stores were (1) *product quality,* (2) *labeling,* (3) *price,* (4) *packaging,* (5) *brand name* (6) *cooking convenience and* (7) *the shopping environment.*

Table 1 lists respondents' background information. As shown in the table, about 75% of respondents come from small-sized households with 3 or fewer persons. This

Table 1: Background Information of Chinese Respondents

	2001				2002				Total	
	Nanjing		Shanghai		Nanjing		Shanghai			
	Number	%	Number	%	Number	%	Number	%	Number	%
Gender										
Male	72	43.11	92	42.20	57	28.50	65	32.50	286	36.43
Female	95	56.89	126	57.80	143	71.50	135	67.50	499	63.57
Total	167		218		200		200		785	
Age										
25&Less	34	20.36	32	14.68	15	7.50	18	9.00	99	12.61
25-39	75	44.91	82	37.61	78	39.00	69	34.50	304	38.73
40-49	26	15.57	68	31.19	45	22.50	55	27.50	194	24.71
50-65	30	17.96	32	14.68	49	24.50	49	24.50	160	20.38
Above65	2	1.20	4	1.83	13	6.50	9	4.50	28	3.57
Total	167		218		200		200		785	
Marital Status										
Single	43	25.75	52	23.85	23	11.50	31	15.50	149	18.98
Married	123	73.65	160	73.39	175	87.50	164	82.00	622	79.24
Widow/divorced/	1	0.6	6	2.75	2	1.00	5	2.50	14	1.80
Total	167				200		200		785	
Average Household Monthly Income (Yuan in RMB)										
Less than 800	7	4.19	15	6.88	15	7.50	4	2.00	41	5.22
800-1499	47	28.14	44	20.18	60	30.00	34	17.00	185	23.57
1500-2499	63	37.72	66	30.28	60	30.00	52	26.00	241	30.70
2500-3499	37	22.16	52	23.85	36	18.00	43	21.50	168	21.40
3500&Above	12	7.19	41	18.81	26	13.00	67	33.50	146	18.60
Total	166		218		197		200		784	
Education Level										
Below High school	28	16.77	51	23.39	35	17.50	38	19.00	152	19.36
High School	47	28.14	70	32.11	91	45.50	83	41.50	291	37.07
College	87	52.10	84	38.53	71	35.50	75	37.50	317	40.38
Master & Above	4	2.40	13	5.96	3	1.50	4	2.00	24	3.06
Total	166		218		200		200		784	
Household Size										
1	11	6.59	4	1.83	8	4.00	3	1.50	26	3.31
2	32	19.16	20	9.17	24	12.00	27	13.50	103	13.12
3	80	47.90	120	55.05	118	59.00	108	54.00	426	54.27
4	27	16.17	51	23.39	19	9.50	28	14.00	125	15.92
5	8	4.79	23	10.55	22	11.00	31	15.50	84	10.70
6	6	3.59	0	0	9	4.50	3	1.50	18	2.29
Total	164		218		200		200		782	

might result from China's strict "only one child" policy. Per capita incomes of Chinese consumers continue to grow over time (Fuller et al., 2001). Such data indicate that Chinese consumers, especially those in urban areas, have the potential to buy high valued frozen/chilled livestock products. This is consistent with findings from other studies that a large Chinese middle class population exists with high disposable income available for discretionary spending (Reynolds and Hatfield, 1996; *The Economist*, 1999). In China, shopping for the family household is traditionally conducted by women. This is reconfirmed by our survey results that more than 60% of respondents who were randomly selected in supermarkets were female.

The survey results indicate that an increasing number of consumers shop at supermarkets and food stores to buy livestock products in contrast to wet markets. About 53% of respondents in 2001 chose supermarkets as their main source for livestock products. In 2002, this number increased to 66%. Some respondents stated that supermarkets ensure higher hygienic standards for livestock products, and also provide a better shopping environment. During the summer, due to a shortage of cold storage facilities, meat in wet markets is easily spoiled. Therefore, consumers are more willing to pay a premium for higher quality livestock products. This signifies a great market potential for U.S. livestock products, which are generally considered high quality products by Chinese consumers.

Empirical Results from Ordered-Probit Models

As discussed above, socioeconomic, geographic and demographic factors are important variables in determining consumers' preferences for meat consumption (Senauer, et al., 1992; Cui, 1997). These become explanatory variables (X's) in our empirical model. The selected socioeconomic, geographic and demographic factors in our model include *household income*, *year*, *region*, *age*, *household size*, *gender*, *education*, and *marital status.* All explanatory variables are expressed as dummy variables with the exception of *household size*. The specification of our empirical model is described in Appendix 2.

Estimation results of the ordered-probit models of selected livestock product attributes are reported in Table 2. The log-likelihood test was applied to assess the overall significance of the independent variables in explaining the variations in the importance ratings for each model. Results indicate that all statistical tests reject the null hypotheses of $\beta = 0$ at the 5% confidence level except for the price attribute, at the 10% confidence level. This implies that our model can be used to explain the variation in Chinese consumers' importance ratings on selected livestock product attributes. Some selected coefficients and their signs are discussed below.

Table 2: Estimates of the Ordered Probit Model on the Importance Ratings on Selected Livestock Product Attributes

Explanatory Variables	Effects Importance Ratings on Livestock Product Attributes						
	Price	Labeling	Quality	Brand Name	Packaging	Cooking Convenience	Shopping Environment
YEAR	0.9770[a]** (134.4825)[b]	-0.7776** (84.2469)	0.3341** (8.6946)	0.1605** (4.1572)	0.1969** (6.1438)	0.4392** (30.3693)	-0.1122 (2.0436)
REGION	-0.2992** (13.7058)	-0.0726 (0.7697)	0.1671 (2.2185)	-0.4074** (26.2099)	-0.3483** (18.8584)	-0.2074** (6.8360)	-0.1364* (2.9924)
GENDER	-0.1014 (1.5057)	-0.1044 (1.5270)	-0.1699* (2.2347)	-0.0361 (0.1991)	-0.0326 (0.1595)	-0.1291 (2.5285)	-0.1990** (6.0569)
YAGE	0.1249 (1.4411)	-0.1942* (3.2534)	-0.1610 (1.3339)	-0.1315 (1.6597)	-0.1074 (1.0856)	-0.2481** (5.8689)	-0.1334 (1.7181)
MAGE	0.0504 (0.1960)	-0.0179 (0.0237)	-0.3290** (4.3971)	-0.1369 (1.5138)	0.0737 (0.4288)	-0.1996* (3.2042)	-0.1053 (0.9027)
MARRIED	-0.0587 (0.3072)	-0.1723 (2.5318)	-0.1688 (1.3725)	-0.3118** (8.9652)	0.1885* (3.2662)	0.0350 (0.1128)	0.2018* (3.7544)
LINCOME	-0.3382* (3.1313)	0.0261 (0.0188)	-0.3218 (1.6545)	0.2261 (1.5207)	0.0427 (0.0532)	-0.2659 (2.0660)	-0.3673** (3.9604)
MINCOME	-0.1141 (1.6303)	0.0832 (0.8217)	0.2992** (5.4891)	0.1505* (2.9499)	0.0593 (0.4518)	-0.0710 (0.6528)	-0.0645 (0.5445)
LEDUC	0.2286 (0.9209)	0.4595* (3.4821)	0.5003 (1.3878)	0.6538** (7.8404)	0.3147 (1.8882)	0.3185 (1.8953)	0.3289 (2.0558)
MEDUC	0.3286 (2.0064)	0.3482 (2.1079)	0.3229 (0.5941)	0.3706* (2.6626)	0.0909 (1.669)	0.1575 (0.4893)	0.00954 (0.0018)
HOMESIZE	-0.0729* (3.5008)	-0.0472 (1.3857)	-0.0593 (1.2217)	-0.0147 (0.1484)	-0.0495 (1.6533)	-0.0668* (3.0460)	0.00342 (0.0080)
Model Chi-Square	56.6292*	96.4146**	60.6339**	79.2756**	84.6860**	49.8457**	93.7056**

Note: a Coefficient estimates
b Chi-Squared value for the variables
* indicates significance at 10% level
** indicates significance at 5% level

Using chi-squared tests on the estimated coefficients for the two dummy variables, *YEAR* and *REGION*, we examined the time trend and regional differences underlying Chinese consumers' preferences. The estimated coefficients for *YEAR* are statistically significant at the 5% level in all models except for the s*hopping environment* model. Compared to 2001, Chinese survey participants in 2002 were less sensitive to livestock attributes of *quality, price, brand name, packaging and cooking convenience* and more sensitive to *labeling* attributes. This may result from the further implementation of the Chinese government's labeling regulations on food products, especially on imported products, which affects U.S. exports.

The estimated coefficients for *REGION* are statistically significant at the 5% level in models of the following attributes: *price, brand name, packaging* and *cooking convenience* and at the 10% level for the *shopping environment* model. The negative coefficient[3] on 6 of 7 attributes indicate that, on average, Shanghai consumers are more likely to give higher importance ratings on these product attributes and thus place a higher value on them compared to Nanjing consumers. The insignificant coefficients for the *quality* and *labeling* attributes imply that Shanghai and Nanjing consumers have similar preferences, whereby Nanjing is considered the base region.

The variable *GENDER* is significant only in the *quality* and *shopping environment* models, which implies that there are no preference differences between males and females on *labeling*, *price*, *brand name*, *packaging* and *cooking convenience*. The negative estimated coefficients related to g*ender* for the *quality* and *shopping environment* models imply that male consumers pay more attention to product quality and the shopping environment than female consumers.

The variable *YAGE* is statistically significant at the 5% level in the *cooking convenience* model and at the 10% level in the *labeling* model. The negative signs indicate that young Chinese consumers are more concerned with cooking convenience and labeling. The reason for these differences may be that the proportion of young Chinese consumers who are full time workers is higher than that of other age groups. Therefore, on average, young Chinese consumers are more time-constrained shoppers and are more concerned with labeling.

The variable *MAGE* is statistically significant at the 5% level in the *Quality* model and at the 10% level in the *Cooking Convenience* model. The negative signs indicate that *middle-aged consumers* are more concerned about product quality and cooking convenience compared to the referenced *old-aged* consumers. A possible reason may be that family cooking responsibilities are assumed by mothers and/or fathers, who

[3] Comparing equations (4) and (5) in the appendices, we see that the estimated coefficients are –β' instead of β' if no data transformation is conducted. Then we conclude that an estimated coefficient with a negative sign indicates that, on average, consumers will achieve a greater utility level and therefore are more likely to give a higher importance rating (R) on the product attribute with the increased level of x_i, holding other variables constant.

are primarily middle-aged. To ensure reasonable nutrient intake for their children, they may pay more attention to product quality. Thus, as the age of Chinese consumers increases, they place less importance on the cooking convenience and labeling, but place more importance on the quality attribute of livestock products.

The variable *LINCOME* is statistically significant at the 5% level in the *shopping environment* model and at 10% level in the *price* model. The negative sign indicates that *low-income consumers* give high importance ratings to the shopping environment and price compared with higher income consumer groups. The variable *MINCOME* is statistically significant for *quality* with a positive sign at the 5% level and *brand name* at the 10% level. This implies that, on average, *middle-income consumers* are less likely to give high importance ratings for product quality and brand name compared to the reference category of high-income consumer groups. Thus, as incomes increase, Chinese consumers place greater importance on quality and brand name and less importance on price and shopping environment.

The *LEDUC* variable is statistically significant at the 5% level in the *brand name* model and at the 10% level in the *labeling* model. These positive signs in both models imply that less educated consumers place less importance on brand name and labeling attributes. Thus, as education level increases, more-educated Chinese consumers place greater importance on brand name.

The HOMESIZE variable is statistically significant at the 10% level in the *price* and *cooking convenience* models. The negative signs suggest that the larger Chinese households in China place more importance on price and cooking convenience, as expected.

Interrelationship among Importance Ratings on Each Attribute

In addition to assessing the determinants of Chinese consumers' importance ratings for each livestock product attribute as conducted above, we used the factor analysis method[4] to detect the interrelationships for consumers' ratings on each attribute. The factor analysis method can identify latent factors underlying importance ratings (R) on the set of Chinese livestock product attributes and explain the structure of importance ratings (R) on these selected product attributes using the reduced number of latent factors. We used a SAS factor analysis procedure (PROC FACTOR) to detect the structure of the relationships between the seven selected

[4] Theoretically, factor analysis assumes that observed variables $Y=(y_1, y_2, \ldots, y_p)^T$ are related to a set of unobserved latent variables $Z=(z_1, z_2, \ldots, z_q)^T$ called "factors". The relationship between vectors Y and Z is stochastic and may be expressed by a conditional probability function $\pi(Y \mid Z)$. A crucial assumption with factor analysis is that of conditional independence, where the observed dependence among the Y vector is wholly explained by its dependence on the Z vector. Thus, the observed variables (Y) are explained in terms of a smaller number of unobserved latent factors (Z). (Bartholomew, 1980).

product attributes (e.g., *price, product quality, labeling, packaging, brand name, cooking convenience* and *the shopping environment*). Results indicate that we can retain three latent factors since their corresponding eigenvalues are positive[5]. Table 3 reports the factor pattern matrix. The values in this matrix are standardized regression coefficients, which map a variable to a specific factor, holding other factors constant (see below).

Table 3: Rotated Factor Pattern Matrix (Standardized Regression Coefficients)

	External Image	Intrinsic Value	Quality
Quality	-0.0357	0.0300	**0.2872**
Label	0.2484	**-0.3458**	0.0372
Price	0.1463	**0.3618**	0.1100
Brand Name	**0.5471**	0.0163	0.0159
Packaging	**0.6195**	-0.0114	-0.0493
Cooking Convenience	**0.4228**	0.1064	-0.0124
Shopping Environment	**0.4413**	-0.1372	0.0606

Notes: Values in bold indicate attribute loads on factor (loading > 0.25 criteria)

The product attributes significantly loaded on the first factor are *brand name*, *packaging*, *cooking convenience* and *the shopping environment*. The common characteristic among these product attributes is that each captures the external elements for livestock products. Before consumers actually consider shopping for any specific livestock product, these product attributes may attract their attention or interest first. Therefore, we name the first factor as "External Image."
The second factor identifies the product attributes for *labeling* and *price*. The attribute *labeling* provides detailed important information such as nutrient content, production location, expiration date, which reflects the intrinsic value of the livestock product. The attribute *price* informs the consumer of the product's value. Therefore, we name the second factor as "Intrinsic Value." The third factor identifies only *quality*.

The eigenvalue for the first factor (1.2985) is much greater than that for the second factor (0.3147), which implies that the first factor is the dominant global factor (Johnson et al., 2002) [6]. From Table 3 we can see that the dominant factor for

[5] To obtain the eigenvalues (or latent roots), we first calculated the correlation between the original variables and the factors. We then derived the eigenvalues by summing the column of squared loadings for each factor. It is common to retain factors with an eigenvalue greater than 1.0 in principal component analysis. However, in our common factor analysis, we adjusted the eigenvalue criterion, retaining three factors with positive eigenvalues.
[6] The eigenvalue indicates the amount of estimated common variance explained by each factor. The relative importance of each factor can be measured in terms of the share of its eigenvalue over the sum of all the eigenvalues. The dominant global factor explains most of the estimated common variance.

Chinese consumers' importance ratings of livestock product attributes is the external image (*brand name*, *packaging, cooking convenience and shopping environment*) instead of the intrinsic value (*label* and *price*) or *quality*.

Limitation of This Analysis

Rather than focus on strict demand elasticity, our research captures the general impacts of Chinese consumers' socioeconomic, demographic and geographic background (including gender, age, income, education, etc.) on their livestock product shopping behaviors. Regardless of the rapidly changing market situation in China, these socioeconomic, demographic and geographic factors will continue to play an important role in shaping Chinese consumers' shopping behaviors. Therefore, our research findings provide practical implications for U.S. livestock exporters in the future even under a rapidly changing market environment. However, because our sample only covered two major eastern Chinese cities, U.S. livestock exporters should be cautious in using our research results if their strategic market targets relatively less wealthy inland or western Chinese cities.

Implications and Conclusions

China has become an important emerging livestock importing country in the world, which presents a significant potential market for international livestock exporters including those from the United States. To better understand China's livestock international trade potential, this research investigates Chinese consumers' shopping preferences for livestock products which ultimately determine China's livestock international trade demand.

In addition to the changes in China's livestock supply and demand situation, there have been fundamental transformations in China's livestock retailing sector during recent years. Supermarkets and food store chains have become dominant retail outlets for frozen/chilled livestock products, especially in large and mid-size cities like Shanghai and Nanjing. Our research surveyed 784 Chinese consumers who shopped at supermarkets and food stores Shanghai and Nanjing and confirmed the heterogeneity of Chinese livestock retail markets. It is necessary for a successful marketing strategy to segment Chinese consumers into different categories by examining socioeconomic, demographic and geographic factors (e.g. region, gender, income, age, education, etc.).

Our findings suggest that U.S. livestock exporters should target young Chinese consumers and consider cooking convenience as a key attribute in marketing U.S. livestock products. Young Chinese consumers are more concerned with labeling issues and cooking convenience, while middle-aged Chinese consumers are more concerned with product quality. These young Chinese consumers tend to have high incomes and thus are more likely to purchase high-quality livestock products

imported from the United States. Chinese consumers with higher incomes place less importance on product price and shopping environment and more importance on product quality and brand name. Highly-educated Chinese consumers tend to place more importance on both labeling and brand name attributes. Thus, developing brand loyalty is also a key marketing strategy for U.S. exporters. Since many Chinese women shop for their families, livestock distributors should also focus on Chinese female consumers as a marketing strategy.

Our factor analysis results imply that traditional marketing strategies which focus solely on price and quality competition may no longer be successful in today's Chinese livestock markets. Our findings indicate that it is crucial for U.S. livestock exporters to create an excellent external livestock product image (such as brand name, packaging, cooking convenience and shopping environment). Marketing strategies to consider include building a brand name for the livestock product, designing attractive packaging with suitable size, making products easy to cook and creating a comfortable shopping environment.

Appendix 1: Theoretical Ordered Probit Model

For a representative consumer i giving his/her importance ratings on the jth product attribute, the utility model can be specified as

1) $$U_{ij} = \beta' X_{ij} + \varepsilon_{ij},\ \varepsilon_{ij} \sim N(0,1).$$

where U_{ij} is unobservable utility and X is defined above. The error term, ε_{ij}, is assumed to have standard normal distribution across observations. However, the importance ratings (R) of livestock product attributes are observable as

2) $$\begin{aligned} R &= 1 \text{ if } U_{ij} \le \mu_1, \\ &= 2 \text{ if } \mu_1 < U_{ij} \le \mu_2, \\ &\quad \cdots \\ &= m \text{ if } \mu_{m-1} \le U_{ij}, \quad (m = 1, 2, \ldots, 5) \end{aligned}$$

The μ_m's, also called utility threshold coefficients that provide rating alternatives, are unknown parameters to be estimated along with the βs. The following probabilities can then be observed:

3) $$\begin{aligned} P_1 &= \Phi(\mu_1 - \beta' X) \\ P_2 &= \Phi(\mu_2 - \beta' X) - \Phi(\mu_1 - \beta' X), \\ &\quad \cdots \\ P_m &= 1 - \Phi(\mu_{m-1} - \beta' X), \end{aligned}$$

where P_m is the probability that our importance rating R = m (where m = 1, 2, …, 5, as defined above). Additionally, $\Phi(.)$ is the cumulative probability function of a

normal distribution over the range of utility for our representative consumer. Typically, the first utility threshold parameter μ_1 is normalized to zero providing one less parameter to estimate. Therefore, we estimate

$$
\begin{aligned}
4) \qquad & \Phi^{-1}(P_1) = -\beta' X, \\
& \Phi^{-1}(P_1+P_2) = \mu_2 - \beta' X, \\
& \ldots \\
& \Phi^{-1}(P_1+\ldots+P_{m-1}) = \mu_{m-1} - \beta' X, \\
& \text{and } P_1 + P_2 + \ldots + P_m = 1,
\end{aligned}
$$

where Φ^{-1} is the inverse of the cumulative standard normal distribution function.

Appendix 2: Empirical Ordered Probit Model

Using the theoretical model specified in equation (4) in appendix 1, we insert our explanatory variables (Xs) and write our econometric model of the Chinese consumers' importance ratings for each specific livestock product attribute described below. Since we have seven selected product attributes, we estimate seven unique models.

$$
\begin{aligned}
5) \quad \Phi^{-1}(P_1) = {} & u_{10} + u_{11}\text{YEAR} + u_{12}\,\text{REGION} + u_{13}\text{GENDER} + u_{14}\text{YAGE} + u_{15}\text{MAGE} \\
& + u_{16}\text{MARRIED} + u_{17}\text{LINCOME} + u_{18}\text{MINCOME} + u_{19}\text{LEDUC} \\
& + u_{110}\text{MEDUC} + u_{111}\text{HOMESIZE}
\end{aligned}
$$

$$
\begin{aligned}
\Phi^{-1}(P_1+P_2) = {} & u_{20} + u_{21}\text{YEAR} + u_{22}\,\text{REGION} + u_{23}\text{GENDER} + u_{24}\text{YAGE} \\
& + u_{25}\text{MAGE} + u_{26}\text{MARRIED} + u_{27}\text{LINCOME} + u_{28}\text{MINCOME} \\
& + u_{29}\text{LEDUC} + u_{210}\text{MEDUC} + u_{211}\text{HOMESIZE}
\end{aligned}
$$

$$
\begin{aligned}
\Phi^{-1}(P_1+P_2+P_3) = {} & u_{30} + u_{31}\text{YEAR} + u_{32}\,\text{REGION} + u_{33}\text{GENDER} + u_{34}\text{YAGE} \\
& + u_{35}\text{MAGE} + u_{36}\text{MARRIED} + u_{37}\text{LINCOME} + u_{38}\text{MINCOME} \\
& + u_{39}\text{LEDUC} + u_{310}\text{MEDUC} + u_{311}\text{HOMESIZE}
\end{aligned}
$$

$$
\begin{aligned}
\Phi^{-1}(P_1+P_2+P_3+P_4) = {} & u_{40} + u_{41}\text{YEAR} + u_{42}\,\text{REGION} + u_{43}\text{GENDER} + {}_{44}\text{YAGE} \\
& + u_{45}\text{MAGE} + u_{46}\text{MARRIED} + u_{47}\text{LINCOME} + u_{48}\text{MINCOME} \\
& + u_{49}\text{LEDUC} + u_{410}\text{MEDUC} + u_{411}\text{HOMESIZE}
\end{aligned}
$$

and $P_1 + P_2 + P_3 + P_4 + P_5 = 1$, where P_m is defined in equation (3) above and

YEAR: Year variable, 2002 = 1 and 2001 = 0
REGION: Regional dummy variable, Shanghai = 1 and Nanjing = 0
GENDER: Gender of respondents, Male = 1, Female = 0
YAGE: Young age category, 39 and Less = 1, otherwise = 0
MAGE: Middle age category, 39 to 49 = 1, otherwise = 0
MARRIED: Marital status, Married = 1, otherwise = 0

LINCOME: Low income category, Less than 800 Yuan = 1, otherwise = 0
MINCOME: Middle income category, 800 to 2499 Yuan = 1, otherwise = 0
LEDUC: Low education category, high school and less = 1, otherwise = 0
MEDUC: Middle education category, College = 1, otherwise = 0
HOMESIZE: Household size, continuous variable.
u: coefficients to be estimated.

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