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Relative Importance Rankings for Pork Attributes by Asian-Origin Consumers in California: Applying an Ordered Probit Model to a Choice-Based Sample

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ABSTRACT

This paper reports on a study examining the ranking of selected attributes of fresh pork by Asian-origin consumers in San Francisco, California. Freshness is ranked as the most important attribute, followed by the attributes of the color of meat, lowness in fat, and the whiteness of fat. The attributes of price, freedom from chemicals, and being USDA labelled were also ranked to be of importance. Empirical results from an ordered probit model, postulated to explain respondents' importance rankings of attributes, suggested that particular demographic and socio-economic characteristics of Asian-origin consumers influenced the importance rankings of selected pork attributes. The findings suggest that Asian-origin consumers should not be treated as a single homogenous niche group in marketing, since there are identifiable sub-groups of these consumers with specific attitudes and preferences.

Background

California is a large market for many food products, including pork. The fact that most pork consumed in California must be shipped into the state makes this a market of particular interest to pork suppliers in other regions. Recognition of increasing ethnic diversity among California consumers, as in many other North American food markets, raises interest in identifying preferences of particular ethnic origin groups for particular foods (Senauer, Asp and Kinsey, 1992). Among the various ethnic-origin subgroups that have distinct food preferences, the ethnic Asian-origin sub-market is of particular interest to pork suppliers. For example, the ethnic Asian-origin population in the Pacific Northwest has been identified as a potential niche market for western Canadian fresh pork (Kuperis et al., 1999). Urban niche markets for fresh pork in northern California may also be of potential interest to suppliers from this region. However, to this point relatively little information is available that assesses consumers' preferences in this ethnic market segment.

A number of factors contribute to interest in identifying information on the preferences of Asian-origin fresh pork consumers in San Francisco. First, pork is the primary meat consumed by many Asian-origin consumers.

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For example, although per-capita meat consumption in Hong Kong and Taiwan is lower than in North America, consumption of pork is much higher in these countries than in North America. Specifically, USDA data for 1997 indicate that per-capita consumption of pork was some 11 kg more in Taiwan than in the United States, while people in Hong Kong consumed about 24 kg more pork than their American counterparts (USDA, 1999). A large proportion of America's Asian-origin population resides in California and this population segment is growing (State of California, 2000, 1998b). Much of America's Asian-origin population is concentrated in the large urban centers in the west (USDC, 1995). Demographic projections suggest rapid future growth of this ethnic group, due to immigration (Beale, 2000). It has also been documented that different approaches and methods apply to merchandising and retailing fresh pork for the Asian-origin market segment than to other population segments (Kuperis et al., 1999). One reflection of these differences is that more than half of Asian-origin consumers in San Francisco purchase their fresh pork in Asian stores (Le, 1999). Ethnic Asian retail food stores carry different varieties of pork cuts and parts than is typically the case for conventional supermarkets.

To meet the requirements for effective marketing to a segment of ethnic consumers, marketers need to identify and understand both the nature of the pork attributes that are most valued by ethnic-origin consumers and the factors that determine these preferences. Such knowledge should enable suppliers to determine more effective marketing strategies to penetrate this market segment. Ethnic Asian/Pacific Islanders comprised 34 percent of the population of San Francisco County in July 1998, an increase from the 28 percent of the total population reported in the 1990 census (State of California, 2000). This study focuses on identifying preferences for fresh pork by Asian-origin consumers in San Francisco, California.

Many studies have investigated consumers' attitudes towards meat purchases and meat consumption (Hui et al. 1995; Capps and Schmitz 1991; Jordan and Elnagheeb 1991; Frazao and Cleveland 1994; Menkhaus et al. 1985; Smallwood et al. 1994; Senauer et al. 1992; Tippett and Goldman 1994; Wohlgenant et al. 1985). One finding of these studies is that geographic, demographic, and socioeconomic factors can be important factors in determining consumers' preferences and meat consumption. Most of these studies focused on aggregate consumption of individual meats, aggregate meat consumption, and selected attributes of meats. There has been little research focus on preferences of Asian-origin consumers for meat.

This paper examines how Asian-origin consumers rank a variety of selected attributes of fresh pork and evaluates the simultaneous effects of demographic and socioeconomic factors of Asian consumers on their preferences for these pork attributes. The data applied in this study are from a survey of Asian-origin consumers conducted in San Francisco, California in 1998. A total of 173 Asian consumers were intercepted at small Asian stores, large Asian stores, American-style Asian supermarkets, and Asian butcher shops. The sample that resulted is store based and thus is a choice-based sample. Non-parametric approaches were applied to assess the importance of the various attributes. An ordered probit model, which is amenable to the choice-based sampling procedure, is applied to the survey data to investigate the effects of demographic and socioeconomic factors of the sampled Asian-origin consumers on their preferences for fresh pork attributes.

Survey Design and Data Collection

The data applied in this study are from a survey of Asian-origin shoppers conducted in San Francisco, California in 1998. Rather than using telephone and mail survey methods to contact respondents, a mall intercept method was chosen because of its relatively low cost and flexibility. The survey instrument was designed in consultation with meat retailers and wholesalers catering to ethnic-Asian shoppers in the major Chinatown region of San Francisco. Pre-testing was conducted with Asian-

origin shoppers in San Francisco, following assessments of an earlier version of the survey in Edmonton, Alberta and in Vancouver, British Columbia.

To elicit information on consumers' perception of attributes of fresh pork in San Francisco, the self-explication approach outlined below was adopted in the survey. The advantage of this approach is that it is simple to use, particularly when large numbers of attributes are of interest as is the case in this study. Empirical results have suggested that this approach is likely to yield predictions that are generally comparable to those of traditional conjoint analysis (Green and Srinivasan 1990, p. 10).

The self-explication approach has several possible problems. For example, substantial inter-correlation may apply between attributes and this can make it difficult for the respondent to provide ratings for levels of an attribute, holding all else constant. Another potential problem is that the question "how important is an attribute" can be viewed to be ambiguous, in that the respondent may answer in terms of his/her own range of experience, rather than relative to the experimentally defined range of attribute levels (Green and Srinivasan 1990).

The nature of the self-explication procedure is that respondents were first asked to evaluate the importance rating of each selected attribute, using a scale from 1 to 5, with 1 representing "not important at all" and 5 representing "extremely important". Respondents were then asked to allocate a specific number of points (specified as from 1 to 6 in this survey, with 1 representing the least important attribute and 6 representing the most important attribute) across the attributes, to reflect their relative importance or ranking. The respondents' relative importance ranking for each attribute, termed the *part-worth of the attribute* in the marketing literature on attribute valuation (Green and Srinivasan 1990, p 9), is obtained by multiplying the importance rating for each attribute by its attribute ranking, giving part-worth values from 1 to 30.

A total of 173 of the Asian-origin consumers who were intercepted completed the interview-based survey. Interviews were conducted with respondents at small Asian stores, large Asian stores, American-style Asian supermarkets, and Asian butcher shops in the Chinatown regions of San Francisco from September to October, 1998. The criteria for individual shoppers to be included in the sample were that each individual must be a consumer of pork and be of Asian descent. The data collected from small Asian stores came from the "Main Chinatown" and the "New Chinatown" districts of San Francisco. The data for large Asian stores were collected from customers of the "99" Ranch Markets located in suburban areas of San Francisco. Customers of Asian origin shopping at American-style or conventional supermarkets were sought at Safeway, Andornico, and Cala Foods outlets in the Chinatown areas noted above. The data for customers of meat specialty stores were gathered in the Main Chinatown area.

Sixty-one percent of the survey interviews were conducted in English and 39 percent of the surveys were conducted in Chinese, with the assistance of a mandarin Chinese translator. The largest number of surveys was conducted on a Saturday (25 percent), while the least number of survey interviews was conducted on Mondays or Wednesdays (10 percent). On Sundays, Thursdays, Tuesdays, and Fridays the numbers of surveys conducted were 18 percent, 14 percent, 12 percent, and 11 percent, respectively. Sixty-five percent of the surveys were conducted from 2:00 p.m. to 5:00 p.m. Of the 173 eligible surveys, 35 percent were conducted at American-style supermarkets, 29 percent at meat specialty stores, 28 percent at large Asian grocery supermarkets and eight percent at small (independent) Asian grocery stores.

To assess the representativeness of the sample in terms of the demographic structure of the Asian-origin population of San Francisco, survey statistics on gender, ethnic background, and age structure are given in Table 1. The census-based demographic data also reported in Table 1 for the Asian-origin population of San Francisco includes Pacific Islanders. These two segments of the population were aggregated in all population censuses prior to

Table 1. Comparison of Sample Survey Characteristics and Census-based Demographic Data for San Francisco

Socioeconomic and Demographic Characteristics	Categories	Representation in the Survey Sample	Representation in San Francisco Statistics
Gender	Male	43.35%	48.15%
	Female	56.65%	51.85%
Ethnic Background	Vietnamese	4.05%	3.93%
	Filipino	9.83%	27.96%
	Chinese	71.10%	51.35%
	Korean	0.57%	3.29%
	Japanese	6.94%	7.48%
	Other	7.51%	5.99%
Age Category	≤24	8.67%	30.90%
	25–34	27.75%	16.96%
	35–44	30.10%	15.58%
	45–54	10.98%	11.86%
	55–64	2.98%	9.35%
	>65	19.65%	15.35%

Source: State of California (1998a) and this survey.

2000 (USDC, 2000). The survey sample has a slightly higher proportion of females than is the case for this population segment, as might be expected since females may be more likely to be grocery shoppers. Filipino and Korean shoppers are under represented in the survey, while Chinese-origin respondents are over represented. The lowest age category, less than or equal to 24 years, is under represented, as might be expected since the census data for San Francisco also include the non-shopping population, such as infants and young children. Age categories of 25–34 and 35–44 years are over represented in the survey. In general these age differences might be expected in terms of the sampled population of food shoppers.

Relative Importance Rankings by Asian-origin Consumers for Pork Attributes

The relative importance rankings (part-worths) for 13 selected pork attributes are summarized in Figure 1. These rankings take a minimum value of 1 and a maximum of 30. The higher the surveyed consumers value a specific attribute, the higher is the relative importance ranking for that attribute. On average, Asian-origin consumers value freshness most highly, the color of meat is ranked second, a low amount of fat is third, whiteness of fat is fourth, price is fifth, freedom from chemical residues is sixth, and having a USDA label is the seventh-ranked attribute. Seasoned and prepared pork was considered the least-important attribute.

To determine whether or not Asian-origin consumers differentiate between these various pork attributes, non-parametric tests—the Kruskal-Wallis test and Dunn's procedure (Berenson and Levine 1996)—were applied. The test results are presented in Table 2. The Kruskal-Wallis test is based on the sums of the relative importance ranks from the survey. It tests whether these importance rankings for the different attributes are equal using a Chi-Squared test. Dunn's procedure is a pair-wise multiple comparison test used to determine which attributes or groups of attributes differ in importance rankings. The Kruskal-Wallis test on the relative importance rankings rejects the null hypothesis that these rankings for the 13 pork attributes are identical. Asian-origin consumers differentiate between the importance of the pork attributes.

Application of Dunn's procedure reveals

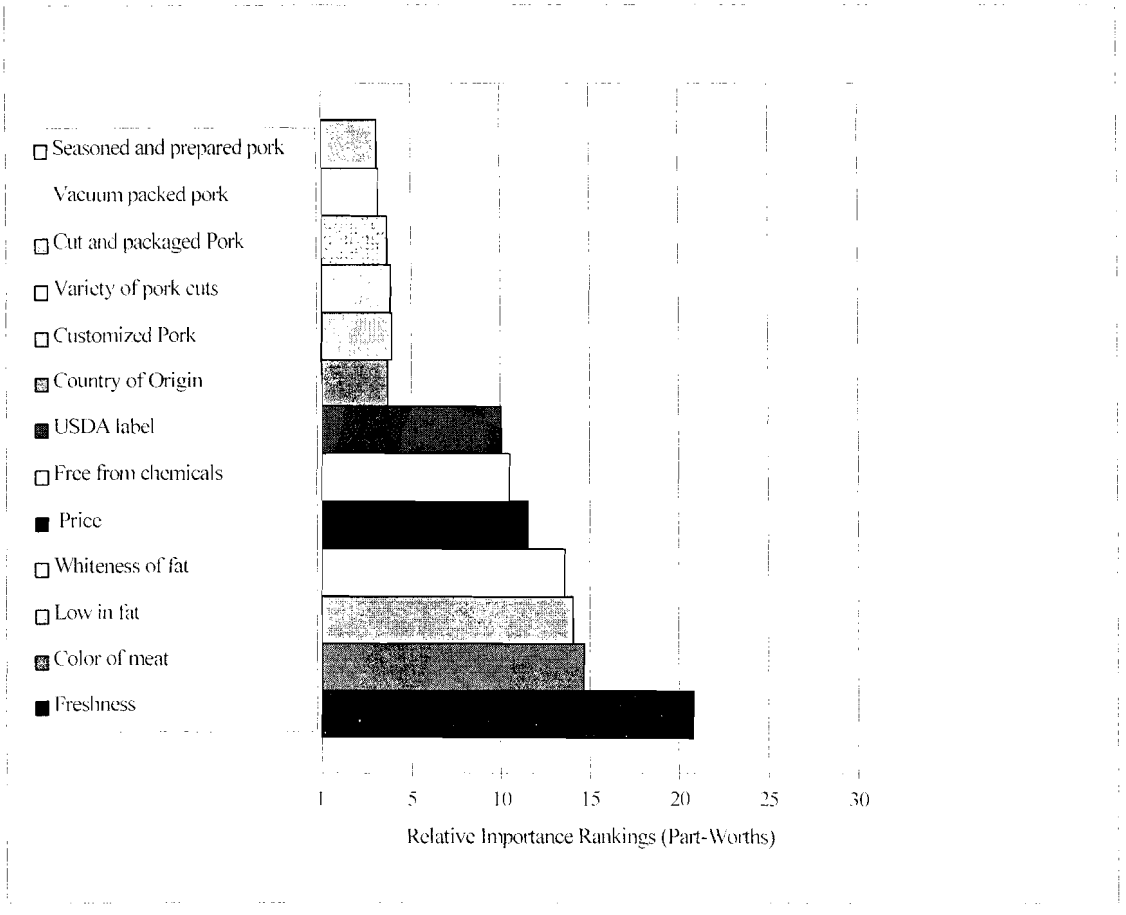

Figure 1. Asian-origin consumers' mean relative importance rankings for 13 selected fresh pork attributes

four categories of order of importance for the specified pork attributes (Table 2). Individual attributes in the same category are equally important to the surveyed Asian consumers. Freshness is the most important attribute these consumers consider when purchasing pork. The attributes of the color of meat, lack of fat, and the whiteness of fat are equally important to Asian consumers and comprise the second most important group of pork attributes. The group of attributes that is third in importance includes the price of pork, freedom from chemical residues, and being USDA labelled. The least-important attributes are knowing that pork comes from the United States, the availability of customized pork cuts, the variety of pork cuts, packaged pork, vacuum packed pork and seasoned and prepared pork.

The Conceptual and Empirical Model

Lancaster's conceptual framework of the demand for attributes provides the theoretical basis of the model of consumer preferences that is used in this study. Goods are not viewed as the direct objects of utility, rather it is the attributes of the goods from which utility is derived (Lancaster 1991). In this study a consumer's utility function associated with the purchase of pork is postulated in terms of relative importance rankings for selected pork attributes and it is hypothesised that these are determined by a vector (X) of the consumer's socio-economic and demographic factors. The utility function (U) is not observable, but is assumed to underlie the observed vector of importance rankings, R (where R = 0, 1, 2,

Table 2. Results of the Kruskal-Wallis Test and Dunn's Procedure for Multiple Comparisons of Relative Importance Rankings for Selected Fresh Pork Attributes

2a. The Kruskal-Wallis Test

H_0: the relative importance rankings of 13 selected fresh pork attributes are identical.

H_1: the relative importance rankings of 13 selected fresh pork attributes are not different.

Observed Chi-square = 1074.385 and critical Chi-square = 26.217 at 0.01-level of significance with 12 degrees of freedom. The null is rejected.

2b. Dunn's Procedure

Fresh Pork Attributes	Mean Ranks for Fresh Pork Attributes	Dunn's Procedure for Multiple Comparison of c Sample Mean Ranks	
Freshness	1942.269	A*	(1)**
color of meat	1594.381	B	(2)
low in fat	1544.642	B	(2)
whiteness of fat	1514.101	B	(2)
price of pork	1383.751	C	(3)
pork free from chemicals	1323.280	C	(3)
USDA label	1278.671	C	(3)
knowing that pork comes from USA	788.552	D	(4)
customized pork cuts	724.535	D	(4)
variety of pork cuts	706.983	D	(4)
cut and packaged pork	678.197	D	(4)
vacuum packed pork	580.422	D	(4)
seasoned and prepared pork	565.217	D	(4)

* Asian-origin consumer relative importance rankings on the attributes in the same category (A, B, C, or D) are not statistically different, while Asian-origin consumer relative importance rankings on the attributes in the different categories (A, B, C, or D) are statistically different.

** The numbers in the parentheses are the ranks of order of importance for fresh pork attributes from Dunn's procedure.

. . . , j). Since the vector R is expressed as an ordinal ranking, following Maddala (1983), an ordered probit model is applied to assess the impact of selected socio-economic determinants on the relative importance rankings of pork attributes for Asian-origin consumers. The model is specified as:

$$(1) \quad U = \beta X + \epsilon, \qquad \epsilon \sim N(0, 1) \quad \text{and}$$

$$(2) \quad R = \begin{cases} 0 & \text{if } U \leq 0 \\ 1 & \text{if } 0 < U \leq \mu_1 \\ 2 & \text{if } \mu_1 < U \leq \mu_2 \\ \vdots & \\ j & \text{if } U > \mu_{j-1} \end{cases}$$

where μ_j's are threshold variables or cut-off points of the relative importance rankings for each attributes and ϵ is the error term. The cut-off points vary with individuals. Individuals with similar tastes and backgrounds are expected to have similar cut-off points. Hence, from the central limit theorem, the threshold level is assumed to be normally distributed. There is no significance to the unit distance between the set of observed values of U since the μ_j's are free parameters and merely provide the ranking (Maddala 1983, p 46–49).

The probability of the consumer choosing a specific ranking is given as

$$(3) \quad p(R_i = 0) = \Phi(-\beta X)$$

$$p(R_i = 1) = \Phi(\mu_1 - \beta X) - \Phi(-\beta X)$$

$$p(R_i = 2) = \Phi(\mu_2 - \beta X) - \Phi(\mu_1 - \beta X)$$

$$\vdots$$

$$p(R_i = j) = 1 - \Phi(\mu_{j-1} - \beta X)$$

where $\Phi(\cdot)$ is the cumulative probability function of a normal distribution for the

Table 3. Variable Codes and Statistics for the Survey Data

Independent Variables	Definition & Codes	Mean	Standard Deviations
SASIANSTORE	small Asia store = 1, otherwise = 0;	0.231	0.423
LASIANSTORE	large Asian supermarket = 1, otherwise = 0;	0.168	0.375
ASUPERMKT	American style supermarkets = 1, otherwise = 0;	0.468	0.500
SSTORE	meat specialty store = 1, otherwise = 0.	0.133	0.341
GENDER	Male respondent = 1; female = 0	0.434	0.497
MEALMAKER	If the respondent is the main meal maker, yes = 1; no = 0	0.618	0.487
CHINESE	Chinese = 1, otherwise = 0.	0.711	0.455
USBIRTH	Born in U.S. = 1; other = 0.	0.243	0.443
USYEARS	Numbers of Years Lived in the States	21.625	16.498
HDSIZE	Number of family members in the household	2.983	1.395
LINCOME	under $29,999 = 1, otherwise = 0;	0.295	0.457
MINCOME	$30,000–44,999 = 1, otherwise = 0;	0.277	0.449
HINCOME	$45,000 and over = 1, otherwise = 0.	0.428	0.496
YOUNGAGE	Under 34 = 1, otherwise = 0;	0.364	0.483
MIDAGE	Between 35–44 = 1, otherwise = 0;	0.301	0.460
OLDAGE	45 and over = 1, otherwise = 0.	0.335	0.473
FULLEMPL	full time employment = 1, otherwise = 0.	0.572	0.496
HIGHSCHOOL	up to high school/technical school = 1, otherwise = 0;	0.364	0.483
COLLEGE	up to college = 1, otherwise = 0;	0.335	0.473
UNIVERSITY	University = 1, otherwise = 0.	0.301	0.460

range of consumers' utility. The log-likelihood function is

$$\ln L = \sum_i \ln L_i = \sum_i \ln P(R_i = j). \quad (4)$$

Estimation Results

The direct use of the relative importance rankings from 1 to 30 as a dependent variable is problematic as this creates too many ordinal ranking categories for the ordered probit model and the available survey data. To derive the dependent variable to be used in the ordered probit model, the relative importance rankings for each attribute are re-categorized into six groups of ranks—0, 1, 2, 3, 4, and 5. Rank 0 stands for the relative importance rankings from 1 to 5, Rank 1 from 6 to 10, Rank 2 from 11 to 15, Rank 3 from 16 to 20, Rank 4 from 21 to 25, and Rank 5 from 26 to 30. The frequency distributions of the relative importance rankings over these six ranks were checked for each attribute and each rank had one or more survey observations.

Several ordered probit models with different specifications of the independent variables were initially assessed. Collinearity was exhibited for several response variables that were initially postulated to be independent. Based on a priori considerations and trial and error estimation, the set of variables defined in Table 3 was chosen for the ordered probit models. The specified socioeconomic and demographic characteristics include age, gender, number of years living in the United States, ethnic background, education, employment status, and whether or not the respondent prepares most of the meals in the household. All but two explanatory variables are expressed as binary variables, 0 for nonoccurrence and 1 for occurrence. The exceptions are the number of years that the respondent has been living in the United States and the size of the household, both of which are continuous variables. The variables, their definitions, and the descriptive statistics for these are given in Table 3.

Separate models were estimated for all 13 fresh pork attributes using the ordered probit model. The dummy variables OLDAGE, HINCOME, and UNIVERSITY were dropped to avoid singularity problems in the respondent's

age-, income-, and education-related variables. As the sample is store-based, each stratum (i.e. each specific type of store) was allowed to have its own set of cutoff values. Consequently, 16 threshold coefficients were estimated.

The statistically significant ordered probit models are reported in Table 4. Log-likelihood tests were applied to assess the overall significance of the various independent variables in explaining the variations in the importance rankings (Table 4). The socio-economic and demographic variables in the equations for the attributes of freedom from chemicals, USDA labelled, low in fat, freshness, color of meat, whiteness of fat, and price of pork are relevant in explaining variations in Asian consumers' importance rankings for these important attributes. This suggests that Asian-origin consumers are not homogenous in their preferences for these attributes of fresh pork. However, log likelihood tests did not reject the null hypothesis, $\beta = 0$, at the 95 percent confidence level in the ordered probit models for the remaining group of attributes, These attributes are the variety of pork cuts, seasoned and prepared pork, packaged cuts, vacuum packaged pork, customized pork cuts, and knowing that the pork is from the United States. The results of the ordered probit models for these attributes (not reported here) imply that this group of socio-economic and demographic variables is not relevant in explaining variations in Asian-origin consumers' importance rankings for these attributes. The results of the ordered probit models corroborate the non-parametric test results reported in Table 2.

Table 5 presents the estimates of the threshold variables. These are interpreted as the numerical linkages between the utility function of each respondent and their preference ratings for attributes (Maddala, 1983). According to Maddala, the threshold coefficients should exhibit the relationship $\mu_{1j} \leq \mu_{2j} \leq \ldots \leq \mu_{j-1,j}$ and must be positive. Failure to exhibit these conditions would imply specification error in the model. The estimated threshold coefficients were all positive and ordered properly. Most threshold coefficients were statistically significant at either 99 percent or 95 percent confidence level. Highly significant, positive μ estimates indicate that the categories in the response variable are indeed ordered.

Estimated coefficients are tested using t-test statistics (Table 4). A positive sign on the statistically significant parameter estimates indicates the likelihood of the response increasing with the level or presence of x_k, holding other variables constant, and vice versa. For example, the coefficient of GENDER is significant at 95 percent in the equations for "low in fat" (Column labeled FAT, Table 4) and for "freshness" (Column labeled FRESH, Table 4), but GENDER is not significant in the rest of the attribute equations. The significantly positive coefficient on GENDER in equation for "low in fat" indicates that this attribute is more important for a respondent who is male rather than female. The significantly negative coefficient of GENDER in the equation for freshness indicates that the importance of this attribute decreases for a respondent who is male rather than female.

Estimated coefficients for store choice of shoppers at large Asian stores (LASIANSTORE) were positive and significant at the 95 percent level of confidence in the equations for freshness and price, but were not significant in the equations for other attributes. This suggests that Asian consumers who purchase most of their fresh pork at large Asian stores value freshness more and were more price sensitive than other Asian-origin consumers. Coefficient estimates on the ethnic origin variable "CHINESE" were negative and significant in the attribute equations for "free from chemical residues" and "USDA label", while the estimated coefficient on CHINESE was positive and significant in the price attribute equation. This suggests that the Chinese-origin consumers value food safety attributes less than do the other groups of Asian-origin consumers and that consumers of Chinese origin are more price sensitive than other Asian-origin groups. Coefficients on the variable signifying that the respondent's birth-place was the United States (BIRTHUS) were positive and significant in the equations for the attributes "free from chemical residues" and "USDA label". Asian-origin consumers who are born in the United States place more value on food safety

Table 4. Estimates of the Ordered Probit Models Postulated to Explain the Relative Importance Rankings for the Selected Fresh Pork Attributes

Dependent Variables	Relative Importance Rankings for Pork Attributes[a]						
Explanatory Variables[c]	CHEM	LABEL	FAT	FRESH	COLOR	WHITE	PRICE
Constant	1.531**[b]	1.963**	1.963**	1.742**	1.684*	1.455*	1.228*
GENDER	−0.070	−0.286	0.510*	−0.543*	0.387	0.498	0.261
MEALMAKER	0.264	0.060	0.272	−0.246	0.273	0.299	−0.088
SASIANSTORE	−0.100	−0.224	−0.480	0.190	−0.437	−0.482	−0.119
LASIANSTORE	−0.093	−0.507	−0.131	1.074*	−0.116	0.212	0.801*
ASUPERMKT	−0.176	−0.402	−0.101	0.406	−0.070	0.149	0.520
CHINESE	−0.740**	−0.857**	0.113	−0.279	−0.061	0.065	0.415*
USBIRTH	0.665*	0.803**	−0.577	−0.305	−0.426	−0.620	−0.146
USYEARS	−0.003	0.006	0.001	0.012	0.002	0.007	−0.021*
HDSIZE	0.065	0.036	−0.113	0.122	−0.058	−0.110	−0.009
LINCOME	−0.048	−0.068	0.059	0.385	0.220	−0.036	0.260
MINCOME	−0.254	−0.322	0.325	0.179	0.474	0.350	0.192
YOUNGAGE	0.840**	0.789*	−0.305	−0.112	−0.034	−0.051	−0.704*
MIDAGE	0.836**	0.881**	−0.003	−0.260	0.019	0.008	−0.451
FULLEMPL	−0.241	−0.210	−0.075	0.092	−0.050	−0.086	0.123
HIGHSCHOOL	−0.258	−0.478	−0.034	0.373	−0.021	0.116	0.484
COLLEGE	−0.171	−0.289	−0.605**	0.303	−0.618**	−0.628**	0.161
Model chi-squares	60.42**	78.60**	53.62**	37.71**	45.24**	49.13**	46.82**

[a] CHEM stands for Free from Chemical Residues, LABEL for USDA Label, FAT for Low in Fat, FRESH for Freshness, COLOR for Color of Meat, WHITE for Whiteness of Fat, and PRICE for Price of Pork.

[b] * statistically significant at the 0.05-level of significance, and ** at the 0.01-level.

[c] Dummy variables OLDAGE, HINCOME, and UNIVERSITY were dropped. All age variables, income variables and education variables are measured relative to the dropped categories.

Table 5. Major Statistical Properties of the Ordered Probit Models

The Model Threshold Variables	The Ordered Probit Models for[a]						
	CHEM	LABEL	FAT	FRESH	COLOR	WHITE	PRICE
μ_{11}	0.998**	1.028**	0.779**	0.857*	0.351	0.278	0.334**
μ_{21}	2.055**	2.091**	1.135**	1.193**	0.602**	1.344**	1.327**
μ_{31}	2.291**	2.304**	1.937**	1.626**	1.619**	1.806**	2.562**
μ_{41}	2.567**	2.558**	3.164**	2.903**	2.681**	2.887**	2.980**
μ_{12}	1.076**	1.010**	0.589**	0.482	0.131	0.459*	0.669**
μ_{22}	1.920**	1.733**	1.526**	0.726*	1.218**	1.359**	1.368**
μ_{32}	2.636**	2.480**	2.246**	1.838**	2.103**	2.095**	2.174**
μ_{42}	2.929**	2.869**	3.393**	2.719**	3.018**	3.366**	2.971**
μ_{13}	0.720**	0.874**	0.296**	0.310	0.364**	0.249**	0.600**
μ_{23}	1.820**	1.732**	0.972**	0.877**	0.815**	0.838**	1.517**
μ_{33}	2.547**	2.443**	1.792**	1.684**	1.809**	1.737**	2.456**
μ_{43}	3.224**	3.457**	2.437**	2.726**	2.535**	2.361**	2.870**
μ_{14}	1.056**	1.092**	0.631**	0.382**	0.684**	0.480**	0.783**
μ_{24}	1.696**	2.134**	1.219**	0.912**	1.097**	1.307**	1.414**
μ_{34}	2.381**	2.524**	2.279**	1.471**	2.135**	2.177**	2.530**
μ_{44}	2.705**	2.807**	3.243**	2.252**	3.231**	2.851**	3.706**

[a] CHEM stands for Free from Chemical Residues, LABEL for USDA Label, FAT for Low in Fat, FRESH for Freshness, COLOR for Color of Meat, WHITE for Whiteness of Fat, and PRICE for Price of Pork.
[b] * statistically significant at the 0.05-level and ** at the 0.01-level of significance.

attributes than other identified groups of Asian-origin consumers.

The number of years that Asian-origin consumers have lived in the U.S. significantly affects their importance rankings for the attribute of pork price. The negative coefficient estimate on the number of years respondents had lived in the United States (USYEARS), indicates that those Asian-origin consumers that have lived for longer periods in the U.S. are less price sensitive. Coefficient estimates for respondents who are 34 or under (YOUNGAGE) and who are between 35–44 (MIDAGE) were positive and significant at the 99-percent level of confidence in the attribute equations for "free from chemical residues" and "USDA label". Asian-origin consumers that are 44 years or less in age value food safety attributes more highly than do older Asian consumers. The estimated coefficient on YOUNGAGE was negative and significant at the 99-percent level of confidence in the price attribute equation. Asian-origin consumers of 35 or less years of age tend to be less price sensitive than is the case for older Asian-origin consumers.

Estimated coefficients for college-educated respondents (COLLEGE) were negative and significant at the 99-percent level of confidence in the equations for "low in fat", "color of meat", and "whiteness of fat". College-educated Asian-origin consumers rank fresh pork attributes such as low in fat, color of meat, and whiteness of fat lower than is the case for the university-educated Asian-origin consumers in the survey sample. However, the sampled high school graduates appear to have the same ranking of preferences for these attributes as the university graduates. Coefficients on the number of household members (HDSIZE), middle income (MINCOME), and low income (LINCOME) of respondents were insignificant in all the attribute equations. Household size was not a key determinant of the relative importance rankings for the specified fresh pork attributes and that differences in levels of income did not influence rankings.

Overall, the results of the ordered probit models indicate that younger shoppers are more concerned about food safety issues than older ones. Ethnic Chinese and those respondents not born in the United States are rela-

tively less concerned with this aspect of food quality, but ethnic Chinese respondents born in the United States tended to express the same attitudes about food safety as indicated by the ethnic Asian population respondents in general. The attributes of pork being "low in fat" and freshness also relate to food quality. The results indicate that Asian-origin male respondents place more importance on pork being low in fat, while women are more concerned with freshness of pork. The attributes of color of meat and whiteness of fat reflect visual appeal which seems to matter more to Asian-origin consumers without college-level education than to respondents with this education. Finally price appears to matter most to older, ethnic-origin Chinese who have lived in the United States for a relatively short time.

Marginal Effects on the Probability of Importance Rankings

The signs of parameter estimates and their statistical significance indicate the direction of the response associated with the presence or level of a particular variable. Interpretation is aided by computing how much a particular variable increases or decreases the likelihood of the ranking response. To aid interpretation of the results, the marginal effects of the independent variables on the probability of importance rankings for pork attributes are calculated. For the ordered probit model, the marginal effects can be computed, following Liao (1994, p 45), as

$$(5)\quad \frac{\partial P(R=j)}{\partial x_k} = \left[\Phi\left[\mu_{j-1} - \sum_{k=1}^{k} \beta_k x_k\right] - \Phi\left[\mu_j - \sum_{k=1}^{k} \beta_k x_k\right]\right]\beta_k$$

where $\partial P(\cdot)/\partial x_k$ is the partial derivative of probability with respect to x_k and all other notation is as before. All variables are held at their mean levels except for the variable being interpreted. The marginal effects are computed for all equations and independent variables using LIMDEP 7.0. The marginal effects for variables that are found to be statistically significant are reported in Table 6. A positive marginal effect of x_k indicates that the probability of a consumer choosing that particular ranking increases with x_k while a negative marginal effect indicates the opposite. The marginal effects should sum to zero by canceling one another out across the response categories. This holds true for the marginal effects summarized in Table 6.

The interpretation of the marginal effects is reasonably self-evident. Rank 5 represents the highest relative importance rankings and 0 is the lowest. For example, the marginal effect for CHINESE on the probability of choosing a particular importance ranking for "low in fat" shows that if the respondent is of Chinese origin, there is an increase of 9.38 percent in the probability of choosing Rank 0, an increase of 15.06 percent in the probability of choosing Rank 1, an increase of 2.03 percent in the probability of choosing Rank 2, a decrease of 9.30 percent in the probability of choosing Rank 3, a decrease of 6.89 percent in the probability of choosing Rank 4, and a decrease of 10.29 percent in the probability of choosing Rank 5, relative to the entire survey sample. Overall the marginal analysis supports the analysis of the model that is reported above. Younger survey participants are more sensitive to food safety issues related to chemical residues and USDA labeling. Males are more sensitive to "low in fat" but females are considerably more sensitive to changes in freshness.

Conclusions

This study reports on an investigation of how Asian-origin consumers of fresh pork in San Francisco, California ranked 13 attributes when purchasing this product. Non-parametric tests reveal four distinct categories. Freshness is the most important attribute that the sampled consumers consider when purchasing pork. The second most important category of pork attributes includes color of meat, lack of fat, and the whiteness of fat. The third category of importance of pork attributes includes the price of pork, its freedom from chemicals, and being USDA labelled. Consumer knowl-

Table 6. The Marginal Effects of Selected Factors on the Probabilities of Relative Importance Rankings for Pork Attributes

	Marginal Effect on the Probabilities of the Relative Importance Rankings for Fresh Pork Attributes*					
Attributes	*Prob (j = 0)*	*Prob (j = 1)*	*Prob (j = 2)*	*Prob (j = 3)*	*Prob (j = 4)*	*Prob (j = 5)*
Free from Chemical Residues						
CHINESE	0.0938	0.1506	0.0203	−0.093	−0.0689	−0.1029
USBORN	−0.0899	−0.1443	−0.0195	0.0891	0.066	0.0986
YOUNGAGE	−0.1118	−0.1795	−0.0242	0.1109	0.0821	0.1226
USDA Label						
CHINESE	0.1257	0.1929	−0.0005	−0.1136	−0.1008	−0.1036
USBORN	−0.113	−0.1734	0.0005	0.1022	0.0906	0.0931
YOUNGAGE	−0.1173	−0.1799	0.0005	0.106	0.094	0.0967
MIDAGE	−0.1302	−0.1999	0.0006	0.1178	0.1044	0.1074
Low in Fat						
GENDER	−0.0572	−0.055	−0.0577	0.0057	0.0925	0.0717
COLLEGE	0.0758	0.073	0.0765	−0.0075	−0.1227	−0.095
Freshness						
GENDER	0.0054	0.0093	0.0345	0.1034	0.0599	−0.2125
LASIANSTORE	−0.01	−0.0171	−0.0631	−0.1895	−0.1097	0.3894
Color of Meat						
COLLEGE	0.0771	0.055	0.0873	0.0167	−0.1197	−0.1164
Whiteness of Fat						
COLLEGE	0.0915	0.0533	0.0863	−0.0108	−0.1141	−0.1061
Price of Pork						
LASIANSTORE	−0.1359	−0.1409	−0.0897	0.1306	0.1367	0.0992
CHINESE	−0.0571	−0.0592	−0.0377	0.0548	0.0574	0.0417
USYEARS	0.0029	0.003	0.0019	−0.0028	−0.0029	−0.0021
YOUNGAGE	0.1009	0.1045	0.0666	−0.0969	−0.1015	−0.0736

* 5 represents the highest relative importance rankings and 0 represents the lowest.

edge that pork comes from the United States, customized pork cuts, the variety of pork cuts, packaged pork, vacuum packed pork and seasoned and prepared pork are each in the least-important category of attributes.

The empirical results from the ordered probit model suggest that Asian-origin consumers' demographic and socio-economic characteristics influence their ranking of importance for the pork attributes that were identified to be important. It appears that Asian-origin consumers should be viewed as a heterogeneous group for niche marketing purposes since there are identifiable sub-groups of these consumers. For example, the nutritional attribute of "pork that is low in fat" was valued more by highly educated males, and food safety attributes such as "free from chemical residues" were valued more by U.S. born younger Asian-origin Americans.

The results given here may be useful in helping determine effective marketing strategies targeted to Asian-origin consumers. Chinese-origin respondents are found to be much more price sensitive than other Asian-origin groups, suggesting that efforts to reduce production and marketing costs of pork could be of particular importance in marketing pork to the Chinese-origin segment of the Asian pork market. Freshness is considered a key quality

attribute and this must be incorporated in any marketing plan targeted to these sub-groups. Some groups of ethnic Asian consumers, particularly those that are younger or more educated, are particularly concerned with food safety issues. Marketing plans targeted at this group may focus on food safety and provide information on this at the point of sale, as through package labelling. Sourcing pork from outside the United States is not a key issue in marketing fresh pork to ethnic Asian-origin consumers.

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