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Ordered Probit Analysis of Consumers' Preferences for Milk and Meat Quality Attributes in the Emerging Cities of Southern India

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In order to assess consumer preferences for milk and meat quality attributes, a study was carried out in two Second-Tier cities of Tamil Nadu. Personal interviews were done to collect the data from 160 respondents chosen through a multistage sampling procedure in each of the two cities selected for this study. Ordered Probit model fitted for the attributes of milk showed that: family size had a significant positive preference towards texture, low fat and low price of milk, educated consumers paid greater attention to taste, safety, flavour, packaging and low fat attributes of milk and low income consumers paid less importance on most of the attributes of milk. Ordered Probit model for meat revealed that as the family size increased, the consumers were likely to give more importance to ageing and tenderness and less importance to leanness of meat. Male consumers paid greater attention to colour and females were none concerned with tenderness, cooking quality and price. As the education level increased, the consumers became more and more quality and price conscious. Households having children paid more importance to tenderness and taste attributes of meat, whereas the household having aged people opted for colour, taste, tenderness, cooking quality, leanness and price attributes. Low income consumers paid less importance to quality attributes and the respondents performing more physical activity paid lesser attention towards leanness and more importance to price of the meat. This suggests the need for enhancing the production of quality livestock products, together by developing a well-organized distribution system.

***Keywords**: milk attributes, meat attributes, consumer preferences, ordered probit, India, empirical study*

***JEL Classification**: M31*

1. Introduction

The Food basket in India is undergoing a significant shift, away from staple food, grains toward high-value food commodities, like fruits, vegetables, milk, meat, eggs and fish. The expenditure share of animal food products in total food expenditure over the past two decades had witnessed a marked increase. In the time frame of 1983-2004-05, the share of dairy products in urban food expenditure had risen from 15.7% to 18.6% per cent, and that of meat, eggs and fish from 6.1% to 6.4% (Birthal, 2008). Changes in the consumption of animal-related products are more conspicuous in quantity. Between 1983 and 1999-2000, the per capita consumption of milk, meat and fish increased by 71%, 30% and 42%, respectively. Contrasted with staple foods, the demand for high-value foods, including livestock products, is more receptive to income changes, particularly at the lower end of income distribution (Kumar and Birthal, 2004; Ravi and Roy, 2006), and with rise in income, the poor too tend to include more of high-value food products in their food basket.

The changes in consumption pattern were driven by sustained rise in per capita income, urbanization, changing lifestyles, increasing number of women in workforce, nuclearisation of families, improvements in transport infrastructure, rise of supermarkets and increasing use of credit cards (Pingali and Khwaja, 2004). Urbanisation is closely linked to the economic activities and consequent developments in both production and consumption of a particular area. Tamil Nadu ranks first in urbanisation among the fifteen major States of the country. According to the 2001 Census, Tamil Nadu has emerged as the State with the highest level of urbanisation (43.86 per cent) in the country, where 2.72 out of 6.21 crore of the total population of the State live in urban areas (State Environment Report, Govt. of Tamil Nadu, 2005). Also, more than 75 per cent of the male workforce was engaged in non-agricultural pursuits in all these urban corridors.

The demand for livestock products in Tamil Nadu has also undergone a perceptible change in the recent past, reflecting the growth in per capita income, urbanisation and their repercussions. Even spread of small, medium and major towns, migration of people from rural areas in search of employment and the presence of industrial estates in all districts contributed to speedy urbanisation of Tamil Nadu (The Hindu, 2015). With the rapid changes in socio economic environment, it becomes essential to study the consumption pattern and preferences for livestock products in Tamil Nadu. Because, quality characteristics are very important and even low income consumers are willing to pay premium for products that match their preferences as they are vigilant in identifying products that do not meet their desired standards (Langyintuo, et al., 2004).

Further, there have not been comprehensive studies available on consumers' preferences for livestock products in the Second-Tier cities of Tamil Nadu, where the population is currently bulging due to increased industrial growth, urbanisation and improved infrastructure in all spheres. Against this background, the present study was undertaken to assess the consumer preferences for milk and meat quality attributes in the emerging larger cities of Southern peninsular India, the Tamil Nadu.

2. Research Methodology

Among the five Second-Tier cities of Tamil Nadu, two corporation cities, viz., Coimbatore and Salem were selected randomly. Of these two cities, Coimbatore is the second largest city of Tamil Nadu, known for its textile and manufacturing factories, engineering firms and automobile parts manufacturers, while Salem is the fifth largest city of the State, sheltering largely cottage industries, besides a number of industries including Steel Authority of India Limited (SAIL) and an exclusive Electrical and Electronics Industrial Estate.

A multistage sampling procedure was adopted to select the respondents of the study. In the first stage, as stated above, two Second-Tier cities, viz., Coimbatore and Salem were selected randomly. In the second stage, eight zones, four from each of the two selected cities, were chosen and in the third stage, 16 wards, two from each chosen zone were selected using simple random sampling technique. In the fourth stage, 160 household respondents, 10 from each of the selected wards were chosen randomly. Thus, this study had the sample size of 160 household consumers comprising 80 from each of the cities. From the household consumers so selected, relevant data were collected through personal enquiry, by interviewing the sample respondent households with the help of a structured and pilot-tested interview schedule.

2.1. Ordered Probit Model

Ordered-response models recognize the indexed nature of different response factors; in this investigation, consumers' preferences towards milk and meat quality attributes were the ordered responses. Underlying indexing in such models is a latent, but continuous descriptor of the response. In an Ordered Probit Model, the random error associated with this continuous descriptor is assumed to follow a normal distribution.

In contrast to Ordered-response models, Multinomial Logit and Probit Models neglect the data's ordinal nature, require estimation of more parameters (on account of at least three choices, thus diminishing the degrees of freedom available for estimation), and are associated with undesirable properties, such as the independence of irrelevant alternatives in the case of a Multinomial Logit (Ben-Akiva and Lerman, 1985) or lack of a closed-form likelihood as in the case of a Multinomial Probit (Greene, 2000).

An individual consumers' utility function or preference ordering was hypothesized to be represented by consumers' importance ratings R (R=1-strongly no; R=2-no; R=3-slightly no; R=4-slightly yes; R=5-yes; and R=6-strongly yes) on different milk and meat quality attributes. Ratings (R's) are determined by a 1 x 1 vector (X) consisting of socio-economic, geographic and demographic factors of the representative household respondent (Table 1).

Table 1. Description of variables used in Ordered Probit analysis

Explanatory variables	Levels	Specification
Family size	Continuous	Consumption units in the household
Sex	Male; Female	1 – if male; 0 – otherwise
Hindu	Hindu; Non-Hindu	1 – if household is a Hindu; 0 – otherwise
Christian	Christian; Non-Christian	1 – if household is a Christian; 0 – otherwise
Education	Four	Educational level of the head of the household (0 – if Illiterate; 1 – if Primary; 2 – if Secondary; and 3 – if College)
Food habit	Non-Vegetarian; Vegetarian	1 – if Non-Vegetarian; 0 – otherwise
Region	Coimbatore; Salem	1 – if Coimbatore; 0 – otherwise
Child	Two	1 – if family had child(ren)-below 14 years; 0 – otherwise
Aged	Two	1 – if family had aged person(s)-above 60 years; 0 – otherwise
Low income	Two	1 – if household income is less than Rs.10000; 0 – otherwise
Middle income	Two	1 – if household income is Rs.10001-20000; 0 – otherwise
Physical exertion	Two	1 – if respondent does physical work; 0 – otherwise

The ordered probit models of this study were estimated using STATA 9.0® software packages. The following model specification was used here:

$$T_n^* = \beta' z_n + \varepsilon_n$$

Where,

T_n^* = latent and continuous measure of preference of the respondent n in the study,

z_n = a vector of explanatory variables describing the respondent,

β = a vector of parameters to be estimated, and

n = a random error term (assumed to follow a standard normal distribution).

The observed and coded discrete preference variable, T_n^* was determined from the model as below:

$$T_n = \begin{cases} 1 \, if -\infty \le T_n^* \le \mu_1 \,(strongly\,no) \\ 2 \, if - \mu_1 \le T_n^* \le \mu_2 \,(no) \\ 3 \, if - \mu_2 \le T_n^* \le \mu_3 \,(slightly\,no) \\ 4 \, if - \mu_3 \le T_n^* \le \mu_4 \,(slightly\,yes) \\ 5 \, if - \mu_4 \le T_n^* \le \mu_5 \,(yes) \\ 6 \, if - \mu_5 \le T_n^* \le \mu_6 \,(strongly\,yes) \end{cases}$$

Where $\mu_i s$ represent the thresholds to be estimated. The probabilities associated with the coded responses of an Ordered Probit Model are as follows: n is an individual, k is a response alternative, $\Pr(T_n = k)$

is the probability that the individual *n* responds in manner *k*, and $\Phi(.)$ is the standard normal cumulative distribution function.

The interpretation of this model's primary parameter set, *β*, is that positive signs indicate higher preference as the value of the associated variables increase, while negative signs suggest the converse.

3. Results and Discussion

3.1. Factors Influencing Consumers' Preferences for Milk and Meat Quality Attributes

Ordered Probit models were fitted for analysing the socio-economic, geographic and demographic factors determining the consumers' preference ratings of milk and meat quality attributes.

3.2. Factors Determining Consumers' Preferences for Attributes of Milk Quality

Estimation results of the seven separate Ordered Probit models fitted for the attributes of milk, viz., taste, texture, safety, flavour, packaging, fat and price are presented in Table 2. The log-likelihood ratios and Chi-Square test results indicated that all the seven models fitted were good fits.

The estimated coefficients for the dummy variables, family size was statistically significant at one per cent level in texture, fat and price. The family size did not affect the attributes such as taste, safety, flavour and packaging of milk. As the family size increased, consumers seemed to prefer milk with high texture, low fat and low price so as to satisfy the requirements with the available disposable income. Besides being low priced, the good texture of such milk could enable them to better distribute the same among the larger family.

The Probit coefficients for sex were statistically significant at five per cent level for the fat attribute, which implied that males were concerned with milk fat on health grounds. However, no significant differences could be found between males and females on taste, texture, safety, flavour, packaging and price attributes of milk.

The education level significantly influenced taste, safety, flavour, packaging and fat attributes at one per cent level. The positive sign of the coefficients in all the models indicated that as the level of education increased, the consumers' attitude tilted towards high quality milk. A high educated consumer preferred flavoured, tasty milk with low fat which is also safely packaged. The results implied that educated consumers were both quality and safety conscious.

The dummy for food habit (viz., vegetarian and non-vegetarian) showed significant influence towards low price at 10 per cent level. The negative sign of the co-efficient indicated that the vegetarians were much concerned about the milk price, as it was occupying a major chunk in their expenditure towards livestock products.

The variable - region was significant at five per cent level in models fitted for taste, texture and fat and at one per cent level in that of price. This implied that there was regional difference in the consumers' preferences for attributes of milk. The positive sign in taste, texture and fat attributes meant that the consumers of Coimbatore City paid greater attention towards these quality attributes and placed a higher value compared to the consumers in Salem City. The negative significance in price conveyed that Coimbatore City consumers were less likely to pay greater ratings on this attribute, as their standards of living were higher.

Table 2. Estimates of the Ordered Probit model on the important ratings of attributes of milk

Explanatory variables	Effects of important ratings on milk attributes						
	Taste	**Texture**	**Safety**	**Flavour**	**Packaging**	**Fat**	**Price**
Family size	0.1995 (0.1338)	0.2886*** (0.1122)	0.0146 (0.1357)	-0.0855 (0.1148)	0.0880 (0.1066)	0.2796*** (0.1079)	0.4470*** (0.1257)
Sex	-0.1013 (0.2265)	-0.2300 (0.2012)	0.3125 (0.2319)	-0.1294 (0.2084)	-0.1267 (0.1901)	0.4008** (0.1911)	-0.1754 (0.2121)
Hindu	-0.7685 (0.4955)	-0.5784 (0.3858)	-0.0500 (0.4513)	-0.6269 (0.4298)	-0.1484 (0.3588)	-0.2775 (0.3598)	0.0461 (0.3979)
Christian	-0.5426 (0.6508)	-0.6439 (0.5140)	-0.9434 (0.6303)	-0.6494 (0.5675)	0.0344 (0.5030)	0.4794 (0.5314)	0.5291 (0.5684)
Education	0.4982*** (0.1314)	0.1276 (0.1166)	0.7827*** (0.1400)	0.3103*** (0.1173)	0.4216*** (0.1098)	0.6806*** (0.1172)	0.1969 (0.1261)
Food habit	-0.1721 (0.3192)	-0.0980 (0.2821)	0.2196 (0.3338)	0.2232 (0.2957)	-0.3486 (0.2730)	0.1558 (0.2712)	-0.6145* (0.3454)
Region	0.4738** (0.2339)	0.5205** (0.2037)	0.3163 (0.2377)	0.0461 (0.2122)	0.0069 (0.1926)	0.3311** (0.1913)	-0.6418*** (0.2203)

Child	0.8529*** (0.2515)	0.0429 (0.1976)	0.7017*** (0.2476)	1.2207*** (0.2317)	0.7049*** (0.1925)	0.3875** (0.1894)	-0.0730 (0.2145)
Aged	-0.0185 (0.2104)	0.6620*** (0.2358)	0.2046 (0.2240)	0.0072 (0.1930)	0.1722 (0.1850)	0.8639*** (0.2116)	-0.0452 (0.2193)
Low income	-0.9366** (0.4218)	-0.1035 (0.2879)	-1.3993*** (0.4146)	-1.1225*** (0.3301)	-0.7507*** (0.2803)	-1.2562*** (0.2893)	0.7306** (0.2928)
Middle income	-0.8967** (0.4308)	0.1311 (0.2931)	-0.6878 (0.4277)	-0.3232 (0.3414)	-0.5060* (0.2870)	-1.1645*** (0.2947)	1.0659*** (0.3092)
Physical exertion	0.0395 (0.2243)	-0.0731 (0.1905)	-0.4335* (0.2341)	-0.2560 (0.2069)	-0.4199** (0.1866)	-0.2385 (0.1852)	-0.0923 (0.2106)
Log likelihood	-134.0936	-194.9475	-122.3553	-162.8353	-193.4128	-194.4253	-171.4407
Model Chi-Square	54.18***	24.79**	86.68***	73.61***	50.73***	93.44***	45.30***
Number of observations	160	160	160	160	160	160	160

Notes: Figures in parentheses indicate standard errors. Significance: * Significant (P ≤ 0.10); ** Significant (P ≤ 0.05); *** Significant (P ≤ 0.01).

The dummy variable for having children was significant at one per cent level in the models fitted for taste, safety, flavour, packaging and five per cent level in that of fat. The positive coefficients on five of seven attributes indicated that, on average, household having children below 14 years gave more importance ratings on these quality attributes and thus placed a higher value on them compared to the households without children.

The variable - aged was significant at one per cent level in the models fitted for texture and fat attribute. The positive sign of this variable pointed out that the aged people over 60 years were likely to bestow more importance to texture and low fat attributes as they were confronted with health problems due to ageing.

The low income dummy was significant at one per cent level in the functions fitted for safety, flavour, packaging and fat and at five per cent level in that of taste and price attributes. The negative sign in taste, safety, flavour, packaging and low fat indicated the less care attitude of them on these quality attributes, while the positive sign in low price attribute enlightened their economic concerns. Similarly, the middle income dummy was significant at one per cent level in fat and price models and at five per cent level in taste and at 10 per cent in packaging attributes.

The physical exertion variable included in the model earned significance at five per cent level for packaging and 10 per cent level for safety. Its negative sign pointed out that the respondents who performed more physical activity paid lesser attention towards safety and packaging attributes, due to their good physique and health. The religion dummies, the Hindu and Christian, included were not significant in any of the models, showing that the consumers of different religions were indifferent to their preferences towards attributes of milk.

3.3. Factors Determining Consumers' Preferences for Attributes of Meat Quality

As in case of milk, seven different Ordered Probit models were fitted for the attributes of meat, viz., ageing, colour, taste, tenderness, cookery property, leanness and price and the results are presented in Table 3. The log-likelihood ratios and Chi-Square test results indicated that all the seven models were good fits.

The variable - family size was significant at one per cent level in leanness and price models and five per cent level in ageing and tenderness models. The positive coefficients in ageing, tenderness and price showed that as the family size increased, the consumers were likely to give more importance to ageing and tenderness, as they were more price conscious. The negative sign in leanness showed that larger households attached lesser importance on leanness of meat, which would otherwise cost them more.

The explanatory variable - sex was significant at five per cent level in tenderness and price functions and one per cent level in colour and cookery property functions. The positive sign in colour attribute indicated that male consumers, who used to shop, paid greater attention to colour, while the negative sign in tenderness, cookery property and price exhibited that compared to males, females were more likely to bother on these attributes, as they were making decisions for the whole family.

The religion dummy - Hindu was significant at five per cent level in price attribute model. The negative coefficient indicated that they attached lesser importance to the low price attribute which could be due to the lower quantity of meat they consumed. However, the other religion dummy, Christian was significantly positive at 10 per cent level for price attribute, indicating their concern for price, as they consumed more meat compared to Hindus.

The educational level was significant at one per cent level in the models of taste, tenderness, cookery property and leanness, at five per cent level in ageing and at 10 per cent level in low price attribute. The significant positive coefficients in six out of seven attributes vividly exhibited that as the education level increased, the consumers became more and more quality and price conscious.

The variable - region was significant at one per cent level in leanness, at five per cent level in ageing and at 10 per cent level in tenderness models. The positive coefficient in ageing implied that the consumers of Coimbatore City gave more importance to ageing, which is the visible attribute, while the negative sign for tenderness and leanness implied that Salem City consumers gave higher ratings on tenderness and leanness than the consumers of Coimbatore City.

The dummy variable for having children was significant at five per cent level in tenderness and one per cent level in taste. The positive coefficients in these two models exhibited that the households having children below 14 years paid more importance to tenderness and taste attributes of meat compared to those who did not, so as to satisfy the craving of their children.

Table 3. Estimates of the Ordered Probit model on the important ratings of attributes of meat

Explanatory variables	Effects of important ratings on meat product attributes						
	Ageing	Colour	Taste	Tenderness	Cookery property	Leanness	Price
Family size	0.3142** (0.1251)	0.0605 (0.1092)	0.1494 (0.1682)	0.3117** (0.1553)	0.0172 (0.1324)	-0.3347*** (0.1285)	0.6258*** (0.1393)
Sex	0.3546 (0.2245)	0.5548*** (0.1966)	-0.4165 (0.2969)	-0.6345** (0.2631)	-1.3317*** (0.2668)	0.1396 (0.2229)	-0.5358** (0.2444)
Hindu	-0.2443 (0.3934)	0.0586 (0.3452)	-0.1607 (0.4930)	0.5152 (0.4107)	-0.3188 (0.4177)	0.3753 (0.3679)	-2.0003** (0.8301)
Christian	-0.3208 (0.5625)	-0.8566* (0.4899)	0.1500 (0.8338)	0.1929 (0.6225)	0.1748 (0.6229)	0.1949 (0.5365)	1.7494* (0.9148)
Education	0.2796** (0.1272)	-0.1782 (0.1126)	1.7754*** (0.2182)	0.8265*** (0.1594)	0.5799*** (0.1358)	0.4136*** (0.1285)	0.2493* (0.1313)
Region	0.5092** (0.2193)	0.2683 (0.1951)	-0.2486 (0.2937)	-0.4803* (0.2582)	-0.2900 (0.2338)	-0.9824*** (0.2287)	0.3262 (0.2282)
Child	0.0124 (0.2061)	-0.0739 (0.1877)	0.7183*** (0.2791)	0.5769** (0.2387)	-0.0862 (0.2199)	-0.0020 (0.2040)	0.3107 (0.2286)
Aged	-0.5232* (0.2981)	0.5913** (0.2545)	1.0626*** (0.3706)	2.3981*** (0.4403)	0.7203** (0.3114)	1.2619*** (0.3292)	0.6104** (0.3052)
Low income	-0.3217 (0.2893)	-0.6374** (0.2768)	0.2203 (0.4156)	-0.9721*** (0.3452)	-0.9213*** (0.3365)	-0.4204 (0.3064)	0.5924* (0.3230)
Middle income	-0.8700*** (0.2894)	-0.0294 (0.2683)	0.0538 (0.4115)	-0.2397 (0.3511)	-0.1097 (0.3378)	-0.1520 (0.3045)	0.2636 (0.2998)
Physical exertion	-0.0474 (0.2137)	-0.0909 (0.1887)	0.2225 (0.2731)	-0.0672 (0.2346)	0.2744 (0.2186)	-0.7063*** (0.2146)	0.4838** (0.2351)
Log likelihood	-194.9475	-225.6910	-97.2231	-123.1377	-157.3560	-163.8990	-148.2481
Model Chi-Square	54.18***	33.44***	112.50***	94.60***	66.95***	57.24***	52.77***
Number of observations	140	140	140	140	140	140	140

Notes: Figures in parentheses indicate standard errors. Significance: * Significant ($P \leq 0.10$); ** Significant ($P \leq 0.05$); *** Significant ($P \leq 0.01$).

The variable - aged was significant at five per cent level in colour, cookery property and price, at one per cent level in taste, tenderness and leanness and 10 per cent level in aging. The positive sign in colour, taste, tenderness, cookery property, leanness and price indicated that the household having aged people above 60 years offered greater importance ratings to these attributes. Obviously, as the age advanced, they tended to become choosy and more price concerned. Similar observations were also made by Peng, et al. (2005), while evaluating the Chinese consumers' preferences for meat quality attributes.

The independent dummy variable representing low income category was significant at five per cent level in colour, one per cent level in tenderness and cookery property and 10 per cent level in price. The negative sign in colour, tenderness and cookery property indicated their less care attitude on these quality attributes, while the positive sign in low price attribute was informative of their economic concerns. However,

the middle income dummy was negatively significant at one per cent level in ageing attribute alone, which in turn showed the importance attached by higher income group on this external appearance attribute.

The physical exertion variable was significant and negative at one per cent level in leanness, while positively influencing the low price at five per cent level. Its negative sign pointed out that the respondents performing more physical activity paid lesser attention towards leanness and its positive sign in low price indicated their high calorie requirements.

4. Conclusion

Ordered Probit model fitted for the attributes of milk and meat showed that various socio-economic factors had significant effect on the preference towards these livestock products. Hence, the future demand for livestock products will be based on the achievement of options. This implies the need for enhancing the production of quality livestock products, together by developing a well-organized distribution system. Since livestock products are the highly perishable commodities, there would arise a need for well evolved livestock products processing system to meet the ever growing demand for processed and packaged livestock products.

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