Public Perceptions of Food Safety

by

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Abstract

The results of a 1986 nationwide survey concerning public perceptions of agriculture are presented. Specifically, the paper reports on those questions having to do with food safety, nutrition, taste, and freshness, as well as the use of antibiotics in animal feed. An ordered probit model is used to analyze the socioeconomic factors that influenced the perceptions of respondents from the Southern region. While most respondents found food to be safer, more nutritious, and fresher than in previous times, most did not think food was better tasting. A majority were concerned about the health effects of antibiotics in animal feed.

Statement of Problem

From Chilean grapes to Alar on apples, issues surrounding food safety have exploded on the American landscape. A survey conducted by the Food Marketing Institute in 1988 revealed that 83 percent of the respondents considered product safety to be an important factor in the selection of their food. The cases of Alar and Chilean grapes resulted in a reported 14 percentage point decrease in shoppers who were completely or mostly confident about the safety of supermarket food from 81 percent to 67 percent in early 1989 (Kiplinger Agriculture Letter). In a 1989 Georgia survey, 89 percent of the respondents thought that it was important to test and certify fresh produce as free of pesticide residues (Huang et al.). A consumer survey of the Atlanta Metropolitan Area revealed that 48 percent of the respondents said that the use of food additives and antibiotics in animal feed increased the risk of human illness (Florkowski et al.).

Public perceptions of food safety will continue to be an important factor influencing the food industry. Product attributes related to food safety will affect the purchasing behavior of consumers (McGuirk et al.). The perception of these attributes is also an element in the formulation of policies about food in general and food safety in particular. Therefore, an understanding of the different factors that influence public perceptions of food safety is needed in order to formulate effective food policies.

Objectives

The aim of this paper is to provide an analysis of the factors that influence public perceptions of food. This includes food safety, nutrition, taste, and freshness, as well as the use of antibiotics in animal feed. The paper will present the results of a nationwide survey which included questions about these areas. The sociodemographic factors that affected these perceptions for those respondents in the southern region will be examined.

Methodology

This study uses data from a nationwide mail survey conducted in 1986 to determine public views of changes taking place in the structure of U.S. agriculture. Auburn University coordinated and conducted the survey for the S-198 Regional Project "Sociodemographic Dimensions of Agricultural Change, Natural Resource Use and Agricultural Structure." The details of the survey including development and administration of the questionnaire, data processing and statistical weighing procedures to correct for disproportionate sampling are described in Molnar.

The questionnaires were pretested and mailed to a stratified sample of 9,250 persons representing the U.S. population. The survey contained over 150 questions including those on food safety and standardized questions to obtain socioeconomic background data. Of the 9,250 questionnaires sent, 2,268 were either refused, went to addresses where the occupant had recently died, or were incorrect addresses. Of the questionnaires that went to correct addresses (6,982), 3,212 were usable returned questionnaires for a return rate of 46 percent. The sample population was drawn from a computer-merged list of residential telephone subscribers and automobile owners which included most households in the United States. The seven states represented on the regional committee were over sampled and were appropriately weighted in the analysis. The questionnaire was mailed three times, with three reminder postcards.

Respondents were requested to register the intensity of their perceptions on a five-category Likert scale ranging from strongly agree to strongly disagree. In order to analyze the effects of socioeconomic and demographic factors on public perceptions an ordered probit model (OPM) was employed (see appendix). The OPM is a generalization of the probit model to handle ordered categories as dependent variables (Maddala). However, the Likert scale in this study included a category of "undecided" or "don't know" which lacks any logical order. The "undecided" respondents were, therefore, dropped from the estimation procedure. A model estimation excluding those respondents may lead to a sample selection bias if the selected subsample is not random. Selection bias was tested for, following Greene (1988, see also Heckman). The selectivity bias hypothesis was rejected at the ten percent significance level for all equations. This result is also confirmed by the small variation in the average of the explanatory variables before and after sample selection (Table 1). Therefore, the selected subsample remains random and the analysis of the socioeconomic and demographic factors was based on this subsample.

For the selected subsample, numerical values were assigned to the responses in order to use the OPM. Three was assigned to strongly agree, two to agree, one to disagree, and zero to strongly disagree. Hence, agreement with any statement increases along this scale.

The OPM can be expressed mathematically as

$$U_{hj} = X \beta_h + e_{hj} \qquad (1)$$

$$h = 1, 2, \ldots, 5; \; j = 0, 1, 2, 3$$

where U_{hj} represents the utility derived by making the j^{th} choice from the h^{th} statement and e_{hj} is assumed to be identically normally distributed with a zero mean and a unit variance.

Table 1. Variable Definition and Description of the Explanatory Variables

Variable name	Definition	Mean: Before selection	Mean: After selection
Income			
INC	Mid-points of nine income categories ranging from less than $4,999 to $60,000 or more expressed in thousands[a]	30.989[b]	31.138
FMINC	1 if respondent's family has positive income from farming; 0 otherwise	0.143	0.150
Education (excluded category: high school or less)			
SOMECOLL	1 if had some college; 0 otherwise	0.292	0.293
COLLGRAD	1 if college graduate; 0 otherwise	0.228	0.228
POSTGRAD	1 if completed post-graduate degree; 0 otherwise	0.125	0.129
Knowledge of agriculture			
AGEDN	1 if respondent took a high technical, or college course in agriculture; 0 otherwise	0.256	0.255
Race			
Black	1 if black; 0 otherwise	0.058	0.062
Sex			
Female	1 if female; 0 otherwise	0.293	0.290
Age			
AGE	Age in years	46.49	47.03

[a]Values for the lower and upper open-ended categories were calculated using the range between mid-points of succeeding and preceding categories respectively. For the first seven categories, the ranges were uniformly $4,999. For example, category 1 was 0 to $4,999, category 2, $5,000 to $9,999, etc. Category 8 was $40,000 to $59,999 and category 9 was $60,000 or more. For each category the assumption was of a normal distribution around the midpoint. Violation of this assumption would result in slightly biased estimates.

[b]Standard deviations for income are 16.8 and 16.9 and for age, 15.67 and 15.65 before and after selection, respectively.

Table 2. Public Perceptions of Food Safety: Nationwide Responses to the 1986 Survey

Statement	Percent[a]		
	Agree	Undecided	Disagree
1. Today's food is safer than it ever has been	40	24	36
2. Today's food is fresher than it ever has been	59	17	24
3. Today's food is more nutritious than it ever has been	46	24	30
4. Today's food is better tasting than it ever has been	32	29	38
5. Use of antibiotics in animals' feed is a threat to humans	44	38	18

[a]Totals may not add to 100 percent due to rounding.

Results and Conclusions

Five questions or statements on the survey dealt directly with issues surrounding food safety. The responses from the nationwide sample are shown in Table 2. For ease of presentation, the categories strongly agree and strongly disagree were combined with agree and disagree, respectively, to produce the three categories shown.

Table 2 shows that 40 percent of the respondents agreed with the statement that "today's (1986) food is safer than it ever has been." The comparison time of "today" was not defined in the questionnaire. However, 36 percent disagreed with the statement and 24 percent were undecided. More respondents (59 percent) agreed that food was fresher than it ever had been, while 25 percent disagreed and 17 percent were undecided. Less than half of the respondents perceived today's food as more nutritious than it ever had been. Although a large proportion of the respondents agreed that food was fresher and more nutritious, only 32 percent agreed that food was better tasting than it had been. The majority, 38 percent, felt food was not better tasting than in the past and 29 percent were undecided.

A majority of the respondents (44 percent) agreed with the statement that the use of antibiotics in animal feed is a threat to human health. However, there was uncertainty here since 38 percent were undecided. This is consistent with the findings of Florkowski et al. where 48 percent of the respondents said that the use of antibiotics and food additives increased the risk of human illness and nearly the same percentage were undecided.

The analysis of the effects of the socioeconomic and demographic factors on responses was applied to the Southern Region. Table 3 presents the maximum likelihood estimates of the β-parameters in the ordered probit model (equation 1) along with their asymptotic t-ratios. The β-coefficients were standardized by dividing by the standard deviation of the error term. Due to lack of theoretical foundation, no a priori hypotheses were formulated about the signs (or magnitudes) of the coefficients. Regarding food safety, Table 3 shows that all variables, except race (BLACK) and AGEDN, were statistically significant determinants of variations in perceptions of food safety. Females were more likely to have a negative perception of food safety than males. Thus, females were more likely to have higher food risk perceptions than males. The coefficients on the measures of education (SOMECOLL, COLLGRAD, and POSTGRAD) were statistically significant at the ten percent level. The interpretation of all education variables is relative to the excluded categories of some high school or less.

Table 3. Results of the Ordered Probit Model of Factors Affecting Responses: Southern Region[a]

Explanatory variables	Dependent Variable[b] Safer β_1	t-value[c]	Fresher β_2	t-value	More nutritious β_3	t-value	Better tasting β_4	t-value	Antibiotics β_5	t-value
Intercept	0.48384***	3.305	1.17177***	8.059	0.87770***	5.725	0.76512***	5.092	1.62931***	9.879
AGEDN	0.01115	0.143	0.08275	1.044	0.05557	0.706	0.00642	0.079	-0.24108***	-2.799
FEMALE	-0.29635***	-4.168	-0.18613***	-2.625	-0.17316**	-2.359	-0.06663	-0.870	0.30535***	3.839
SOMECOLL	0.13607*	1.678	0.04741	0.587	0.11331	1.371	0.05680	0.669	-0.09588	-1.085
COLLGRAD	0.22595**	2.469	0.07334	0.805	0.09136	1.031	0.19218**	2.046	-0.22379**	-2.261
POSTGRAD	0.34349***	2.997	0.29807***	2.757	0.24985**	2.236	0.29746***	2.591	-0.35880***	-3.009
INC	0.00496**	2.353	0.00031	0.148	0.00371*	1.756	0.00728***	3.316	0.00022	0.100
FMINC	0.16771*	1.877	0.05742	0.670	0.09220	1.055	0.12022	1.342	-0.31006***	-3.197
AGE	0.01497***	6.586	0.01495***	6.954	0.01451***	6.477	0.00871***	3.979	0.00789***	3.394
BLACK	-0.10879	-0.836	-0.50086***	-4.291	-0.16544	-1.320	-0.25594*	-1.923	-0.19601	-1.412
μ_1	1.32592***	24.482	1.27961***	19.033	1.43366***	22.344	1.55900***	26.011	1.40494***	17.434
μ_2	2.93712***	40.786	3.18591***	40.160	3.11645***	40.053	3.02626	38.666	2.66219***	29.949
$\chi^2(9)$[d]	96.896***		87.490***		69.682***		55.004***		70.569***	

a. The southern region included Alabama, Arkansas, Georgia, Louisiana, Kentucky, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia, District of columbia, and Florida.

b. The descriptions safer, more nutritious, better tasting, fresher, and antibiotics correspond to the statements from Table 2.

c. t-values are asymptotic t-values. *, **, and *** indicates significance at the 10, 5, and 1 percent level, respectively.

d. For the chi-square statistic there were 9 degrees of freedom.

The coefficients on these education variables indicate that the more highly educated the respondent the more likely he/she would agree that today's food is safer. Assuming that education provides more information about food safety, this result supports claims that lack of information has contributed to faulty public perceptions about food safety. The coefficient on income was statistically significant at the 5 percent level. It also carried a positive sign showing that the probability to agree with the food safety statement increased as did income. Hence, those with higher incomes have lower food risk perception than those with lower incomes. The response to the safety statement is believed to be influenced by the quality of food a respondent buys. Thus, the positive sign on the income coefficient may result from the fact that respondents with higher income have access to better quality food. With respect to age, the probability to agree with the food safety statement increased with age. Also, blacks were more likely to disagree with the statement.

A variable for farm income was included to determine whether those involved directly in agriculture perceived food safety differently than did those who do not derive any income from a farm. The farm income (FMINC) variable, although significant in only one of the first four equations (food safety), carried a positive sign in all four equations. However, the t-ratio is higher than 1 in two of the other three equations. The positive sign on FMINC shows that the probability to agree with any of the four statements was higher for respondents with positive farm income than for those who do not earn farm income.

A striking result is that all coefficients on the explanatory variables carried the same signs in the first four equations--although they differed in their magnitude. Hence, the same arguments as those for food safety can be made about the other three equations (freshness, nutrition, and taste). Females and blacks were more likely to disagree with the four (food-quality) statements than males and other races, while those with higher levels of education and income and older respondents were more likely to agree with the statements.

Regarding the use of antibiotics in animal feed, Table 3 shows that six out of nine variables carried significant coefficients with opposite signs to their counterparts in the food-quality equations. Females were more likely than males to agree with the statement "use of antibiotics in animals feed is a threat to humans." Education (AGEDN, COLLGRAD, and POSTGRAD) was a significant determinant of the perception of hazard from use of antibiotics in animal feed. The trend of the education coefficients shows that as the level of education increased, the probability to disagree with the statement increased. The coefficient on farm income (FMINC) was statistically significant at the one percent level and carried a negative sign. This says that those who had positive farm income are more likely to disagree with the statement than those who had no farm income.

Table 4 presents the observed proportions (probabilities) of choosing each category as well as the probabilities predicted by the model. The predicted probabilities were obtained by evaluating the probability equation (appendix equation 4) at the sample means. Results show that observed and predicted probabilities largely agree. Table 5 presents the probabilities of choosing one response-category rather than another for four groups of respondents: female/black, male/black, female/nonblack, and male/nonblack. Table 5 indicates that, other things equal, the probability to agree with any of the food-quality statements is higher for males than females and for nonblacks than blacks. Nonblack males are most likely to agree with any of the food-quality statements and least likely to disagree with these statements. Both black and nonblack women exhibited strong disagreement concerning food being safer than ever. Since the coefficient on sex (FEMALE) was not significant in the food-taste equation, the predicted probabilities did not significantly differ between sexes, holding race constant. For men, strong disagreement concerning food taste was followed by food safety. Food safety ranked second after food taste with respect to the negative public perception of food-quality characteristics. The effects of race (BLACK) and sex (FEMALES) on perception of food nutrition were about equal. The results in Table 4 are closest to those for the male/nonblack group (Table 5) because the majority of respondents were nonblack (see Table 1).

Table 4. Observed and Predicted Probabilities for the Selected Subsample

Statement	Percent[a]			
	Strongly agree	Agree	Disagree	Strongly disagree
1. Today's food is safer than it ever has been	7 (6)[b]	46 (46)	38 (40)	9 (9)
2. Today's food is fresher than it ever has been	11 (9)	62 (62)	24 (25)	4 (3)
3. Today's food is more nutritious than it ever has been	9 (8)	52 (52)	34 (36)	5 (5)
4. Today's food is better tasting than it ever has been	7 (6)	40 (40)	45 (47)	7 (7)
5. Use of antibiotics in animals' feed is a threat to humans.	22 (21)	45 (46)	29 (29)	4 (3)

a. Row totals may not add to 100 percent due to rounding.

b. Numbers in parentheses are the predicted probabilities; others are the observed probabilities.

Table 5 also shows that females were more likely to agree with the statement, "use of antibiotics in animals' feed is a threat to humans," than males. The coefficient on the variable BLACK carries a negative sign in the antibiotics equation. This indicates that blacks are more likely to disagree with the statement than nonblacks. However, that coefficient is not significant at the ten percent level. This result is reflected in Table 5 since the probabilities for the male/black and male/nonblack are comparable. The same is true for the other two groups. Again the responses in Table 4 were closest to those for the male/nonblack groups because the majority of respondents were nonblack males.

Implications

Since this survey was conducted in 1986, the responses were not affected by the massive publicity surrounding Alar and tainted imports, both of which occurred in 1989. Since current public preferences concerning food safety may still be influenced by those occurrences, the responses to this survey may better reflect basic public opinion. Although the data from this survey is five years old, it can be used as a baseline case and can be compared with other surveys conducted since the 1989 twin food safety occurrences. The results of this study can add to the growing knowledge of how consumers respond to perceived changes in the food distribution system. In fact, some of the recent studies on food safety have found similar relationships. For example, Misra and Huang's results for female, income and age variables agree with the results in this study. Also, Halbrendt et al. have found that respondents with high levels of education are significantly less concerned about the use of growth promotants in livestock and poultry production.

As the food industry seeks to address public concerns about food, the results of this survey may provide decision makers with some guides including:

- Most of the respondents to the survey believed that the food they bought was safer, more nutritious, and fresher than in previous times. The largest majority was in the area of freshness. It appears that grocery store emphasis during the 1980s on produce sections has made an impression on consumers.

Table 5. Predicted Probabilities for Four Different Groups of Respondents[a]

	Female/Black	Male/Black	Female/ Nonblack	Male/ Nonblack
1. Today's food is safer than it ever has been				
Strongly agree	0.03[b]	0.06	0.04	0.07
Agree	0.36	0.45	0.40	0.48
Disagree	0.46	0.40	0.44	0.37
Strongly disagree	0.14	0.09	0.12	0.07
2. Today's food is more nutritious than it ever has been				
Strongly agree	0.04	0.06	0.06	0.09
Agree	0.45	0.50	0.50	0.54
Disagree	0.43	0.38	0.38	0.34
Strongly disagree	0.08	0.06	0.06	0.04
3. Today's food is better tasting than it ever has been				
Strongly agree	0.03	0.04	0.05	0.06
Agree	0.32	0.34	0.39	0.41
Disagree	0.53	0.52	0.48	0.46
Strongly disagree	0.12	0.11	0.08	0.07
4. Today's food is fresher than it ever has been				
Strongly agree	0.03	0.04	0.08	0.11
Agree	0.47	0.53	0.61	0.64
Disagree	0.40	0.36	0.28	0.23
Strongly disagree	0.10	0.07	0.04	0.03
5. Use of antibiotics in animals' feed is a threat to humans				
Strongly agree	0.22	0.14	0.28	0.19
Agree	0.47	0.43	0.47	0.46
Disagree	0.28	0.37	0.23	0.31
Strongly disagree	0.03	0.06	0.02	0.04

a. $Pr(Z=j) = \Phi(\mu_j - \hat{\beta}'X) - \Phi(\mu_{j-1} - \hat{\beta}'X)$ $j = 0, 1, 2, 3$ $\mu_{-1} = -\infty$, $\mu_0 = 0$, $\mu_3 = \infty$, while μ_1, $\mu 2$ and $\hat{\beta}$ are given in Table 3. The $\hat{\beta}'X$ are calculated by fixing all variables, except FEMALE and BLACK, at their sample means. FEMALE and BLACK are set to zero or one to give the four groups.

b. Column totals may not add to 1 due to rounding.

- Most of the respondents nationwide, however, did not think food was better tasting than in some previous period. One implication of this finding may be a contradiction between what must be done to produce fresher food, and taste. This may be particularly important when taste is affected by appearance.

- A majority of the respondents were concerned about the health effects of antibiotics in animal feed. However, there was a large portion who were undecided on this issue. The food industry has an opportunity to provide educational information on this issue.

- The sociodemographic characteristics that affect how people responded to the survey were sex, education, income, age, and race.

- Women and blacks were most likely to exhibit negative impressions concerning food safety and other issues than males and other races.

- Those with higher education levels have positive impressions about food. Thus, food industry concerns about media stories may be countered with educational programs.

- As income increases, so does the confidence in the food system. This may result from an ability to buy better and more customized food products.

- Older consumers responded more positively about the food system than younger ones.

While most consumers have a positive impression of the system, there is much concern and indecision. However, it is also clear that information by the food industry can influence opinions. By providing accurate information and educational programs, the food industry can retrieve favorable public opinion. Given the above results, however, these educational programs and efforts should be directed towards the poor, less educated, and minorities.

Appendix

Facing a set of J (j = 1,2,..., J) ordered alternatives, the respondent is assumed to select that alternative which maximizes his or her utility. Following Trost and Lee, a well behaved preference function, U, is assumed to exist. Moreover, the maximum utility, $U_{ji,}$ attainable is represented by the following relationship:

$$U_{ji} = X_i' \beta + e_{ji} \qquad (1)$$

where X_i is a kx1 vector of characteristics for individual i, β is a kx1 vector of unknown parameters to be estimated, $X_i' \beta$ is the deterministic component, and e_{ji} is the random component which is assumed to be identically normally distributed with a zero mean and a unit variance. The unit variance implies normalization of the β-coefficients by dividing by the variance of the error term and helps identify the model. The respondent will compare U_{ji} for j = 1,2,...J and select the alternative that gives the highest utility. The respondent will choose that alternative for which the probability that the utility derived from that alternative (U_{ki}) exceeds the utility from any other alternative ($U_{ji}, \forall j \neq k$) is highest. Stated formally,

$$P_{ki} = Pr\,[U_{ki} > \max\,(U_{1i}, U_{2i},..., U_{k-1i}, U_{k+1i},...,U_{Ji})] \qquad (2)$$

where P_{ki} is the probability that alternative k will be chosen.

In reality U_{ji} is not observable but we can observe the outcome of the decision process (the selection of alternative k). Hence, we can know which of the J alternatives U_{ji} belongs to. Let Z be a categorical variable with J response categories $R_1, R_2, \ldots, R_J$, which arises from the unobserved variable, U_{ji}, as follows: we assume that there is a set of J + 1 real numbers (threshold values) $\mu_0, \mu_1, \ldots, \mu_J$, with $\mu_0 = -\infty$, $\mu_J = +\infty$ and with $\mu_0 \leq \mu_1 \leq \ldots, \leq \mu_J$, such that $Z_i \epsilon R_k <=> \mu_{k-1} < U_i \leq \mu_k$ for k = 1,...,J.

Further let

$$Z_{ji} = 1 \text{ if } Z_i \epsilon R_j \text{ ; 0 otherwise} \qquad (3)$$

Using the above equations and assumptions, McKelvey and Zavoina show that

$$Pr(Z_{ji}=1) = Pr(Z_i \epsilon R_j) = \Phi [\mu_j - \beta' X_i] - \Phi [\mu_{j-1} - \beta' X_i] \quad (4)$$

where $\Phi(t)$ represents the cumulative standard normal density function. To identify the model in equation 4, we assume, without loss of generality, that $\mu_1 = 0$ (McKelvey and Zavoina). Letting Q = k + J-2, the problem is to find estimators for the Q parameters: $\mu_2, \mu_3, \ldots, \mu_{J-1}$ and $\beta_1, \beta_2, \ldots, \beta_k$ where β_1 represents the intercept. The likelihood of Z can be written as

$$L(Z|\beta_1,\ldots,\beta_K,\mu_2,\ldots,\mu_{J-1}) = \prod_{i=1}^{N} \prod_{j=1}^{J} (\Phi_{j,i} - \Phi_{j-1,i})^{Z_{ji}} \quad (5)$$

where $\Phi_{j,i} = \Phi (\mu_j - \beta' X_i)$

$\Phi_{j-1,i} = \Phi (\mu_{j-1} - \beta' X_i)$

So, the log likelihood function, L*, is

$$L^* = \log(L) = \sum_{i=1}^{N} \sum_{j=1}^{J} Z_{ji} \log (\Phi_{j,i} - \Phi_{j-1,i}) \quad (6)$$

which is maximized over the Q parameters and subject to the constraint $\mu_1 \leq \mu_2 \leq \ldots \leq \mu_{J-1}$. The Q parameters $(\beta_1, \ldots, \beta_k; \mu_2, \ldots, \mu_{J-1})$ can be estimated using maximum likelihood methods. The maximum likelihood estimators are consistent, asymptotically efficient, and normally distributed.

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