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Characteristics of Consumers Demanding and Their Willingness to Pay for Certified Safer Pork

Gay Y. Miller and Laurian J. Unnevehr

A telephone survey of 609 Illinois households was conducted in spring 1999. Most consumers surveyed have concerns about pork safety. Concerns were greatest among households with children, lower incomes, older consumers, and Blacks. Lower consumption of pork was associated with higher concern. Consumers had more confidence in USDA certification of enhanced pork safety than in industry certification. Most consumers were willing to pay some price premium for a certified safer product. Those willing to pay more were more likely women, older consumers with incomes less than $70,000, who live in an urban household, and have concern about pork safety.

Key Words: certified safer pork, consumer demand, food safety, pork

Pork producers are developing mechanisms to enhance the safety of pork products. For example, good production practices have been identified and are being documented as part of a trichinae-free certification program in swine production [National Pork Producers Council (NPPC), 1998]. Recently, the U.S. Department of Agriculture/Agricultural Marketing Service (USDA/AMS) Quality Systems Certification Program (QSCP) certified a fully integrated pork producer/processor as producing under consistent procedures, some of which relate to food safety (Unnevehr, Miller, and Gomez, 1999). Some pork producers believe there is market advantage to be gained from enhanced pork safety (Unnevehr, Miller, and Gomez, 1999). Whether market demand will reward the development and certification of improved production practices to reduce the incidence of foodborne illness is an important question for pork producers.

One potential market for a certified safer pork label is among consumers who purchase for at-home consumption. There are many unanswered questions related to this market, including: What are the characteristics of consumers in this potential

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Gay Y. Miller is a professor in the Department of Veterinary Pathobiology, the Department of Veterinary Clinical Medicine, and the Department of Agricultural and Consumer Economics, University of Illinois, Urbana/Champaign. Laurian J. Unnevehr is a professor in the Department of Agricultural and Consumer Economics, University of Illinois, Urbana/Champaign.

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market? Will consumers pay more for product certified as produced so as to enhance pork safety? Will consumers increase their consumption of pork because of such certification? and What kind of certification will consumers trust?

The objective of our study is to examine the relationship between consumer characteristics and attitudes about pork safety and willingness to pay for enhanced pork safety. This research is a first step in determining the demand for certified safer pork. Our results can also help identify consumers who might represent niche markets for enhanced pork safety.

Background

Pork safety is enhanced by practices throughout the pork supply chain designed to decrease risk from both microbial pathogens and drug residues. Pork is a potential source of several economically important pathogens, including *Clostridium perfringens, Staphylococcus aureus, Listeria monocytogenes, Campylobacter jejuni,* and *Salmonella* (Jensen and Unnevehr, 2000). These biological hazards can occur at any point along the pork supply chain, from production through processing, and finally at the consumer end, either in the restaurant or at home.

Biological hazards can be prevented or reduced at any point in the food chain from the farm to the table (Doyle, 2000). In contrast, drug residue avoidance is primarily the responsibility of pork producers. Specific preventive practices by producers, such as avoiding the use of specific drugs, accurately recording the use of drugs, following appropriate drug-withdrawal times, and limiting or controlling the route of drug delivery, are the primary means for eliminating the drug residue hazard.

Avoiding or reducing risks has costs for producers, processors, and consumers. For consumers, avoiding biological risks requires time and care in preparation, as well as potentially reduced product quality because of cooking requirements. Thus, to avoid such costs, consumers may choose to purchase products that will either directly or indirectly decrease their biological risk or decrease the time necessary for preparing safe products. Furthermore, some consumers have higher risk of contracting foodborne illness, such as young children, the elderly, and immuno-compromised individuals. Households comprising such individuals have greater incentives to reduce pork and other food safety risks. If consumers are willing to pay more for enhanced pork safety, then the pork industry will have incentives to adopt practices to improve safety and to market safer products.[1]

Food safety perceptions and their impact on consumption patterns represent a relatively new area of research, particularly for microbial hazards in meats, poultry, and

[1] Producers are required by various federal and state regulations to provide products that meet a certain level of safety, but it is possible some informed consumers would pay for a higher level of safety. Producers will have incen-tive to exceed the required level of safety, even in the absence of price premia, when there is liability associated with unsafe products. Most meat sold at retail is unbranded, and many kinds of foodborne illness cannot be reliably traced to a particular food source. Thus, direct consumer demand for enhanced safety is likely to be more effective in bringing forth changes in meat production practices and product safety than the incentives provided by product liability.

fish. Such research frequently relies on nonmarket valuation methods (Caswell, 1995). Lin and Milon (1993) found that safety perceptions did not influence shellfish consumption decisions per se, but new health risk information was associated with reduced shellfish consumption. Hayes et al. (1995) used experimental auctions to elicit the value of reduced microbial pathogen risk in a meat sandwich. They concluded subjects were willing to pay more (between $0.42 and $0.82) per meal to reduce the normal risk of microbial pathogens down to a 1-in-1,000,000 risk. Their overall results suggested an average subject would pay about $0.70 more per meal for safer food.

Fox et al. (1998) and Shogren et al. (1999) found consumers were willing to pay more for irradiated meat products with reduced risk of microbial pathogens. Based on their survey of a subset of pork consumers in two major U.S. cities, Boland, Fox, and Mark (1999) reported that consumers might be willing to pay a substantial premium for pork certified as having reduced salmonella risk.

These studies demonstrate the potential importance of microbial food safety to consumers. Our study is the first to examine the characteristics of consumers who are concerned about pork safety or who might be willing to pay more for enhanced pork safety. Understanding how concern varies among consumers may be useful for placing valuation study results into a larger market context.

Model, Data, and Estimation Procedures

Data

A statewide telephone survey of 609 Illinois households was conducted by the University of Illinois (Chicago) Survey Research Laboratory during spring 1999. The sample was selected such that the respondents were reflective of the total population of Illinois residents with a small margin of error. The CASES software (version 3.7) developed by the Computer-Assisted Survey Methods Program (CSM) at the University of California-Berkeley was used to assist in conducting the interviews, capturing data real-time, and preventing data errors. Telephone interviews were conducted by professional interviewers, trained in establishing professional rapport, answering potential questions, and maintaining respondent cooperation. Pretesting was conducted in February 1999, field-testing was conducted in March 1999, and the surveys were completed entirely during the month of April 1999.

Interviewers asked questions about the frequency of fresh pork consumption, consumer concerns about pork products and their safety, consumer willingness to pay (WTP) for a certified safer pork product, and consumer confidence in certifying institutions.[2] In addition, the respondents provided socioeconomic and demographic data. Table 1 presents the demographic profile of our survey respondents.

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[2] Our five questions relating to pork and food safety were part of a much larger survey. Individual research projects purchase space on the survey from the Survey Research Laboratory, UIC, which maintains the ongoing sampling and demographic portions of the survey. Our questions were limited by the availability of funding for this research. The five survey questions are provided in the appendix.

Table 1. Demographic Profile of Illinois Survey Respondents

Demographic Variable	Frequency	Percent
Education:		
▸ Less than high school diploma	91	14.8
▸ High school diploma/GED	188	45.7
▸ Some college or bachelor's degree	258	42.4
▸ Education beyond bachelor's degree	62	10.2
Presence of Children in Household:		
▸ None	346	56.7
▸ One or more	260	42.7
Gender:		
▸ Male	245	40.2
▸ Female	308	50.6
Age:		
▸ Born prior to 1940 (approximately 60 years old)	113	19.8
▸ Born in 1940 or later	481	79.0
Ethnicity:		
▸ Black, not of Hispanic origin	81	13.4
▸ Other	69	11.3
▸ White, not of Hispanic origin	452	74.2
Residence Location:		
▸ Rural	88	14.4
▸ Small town, suburb, or city	518	85.5
Total Household Income:		
▸ Less than or equal $30,000	200	32.8
▸ Between $30,000 and $70,000	215	35.3
▸ Greater than $70,000	118	19.4

Notes: N = 609 households. Frequency is less than total number of respondents, and percentages do not total 100 because of refusals or missing data. These data are weighted to reflect the distribution of the population of Illinois; weighting calculations were provided by the Survey Research Laboratory, University of Illinois-Chicago. Weighted percentages typically differ by only a few percentage points from unweighted percentages.

Model and Hypotheses

A framework (illustrated in figure 1) was developed to describe hypothesized determinants of concern about pork safety and WTP per pound for safer pork. This framework is derived from household production theory, which describes the determinants of household demand for products and product characteristics (Senauer, Asp, and Kinsey, 1991, chapter 6). Sociodemographic variables influence household demand by altering the utility derived from goods and/or the costs of household production. In our framework, these sociodemographic variables influence concern about food safety, because they influence consumer knowledge and/or risks. Frequency of consumption has an undetermined effect on concern a priori, as greater consumption might lead to increased concern, or conversely, increased concern might reduce

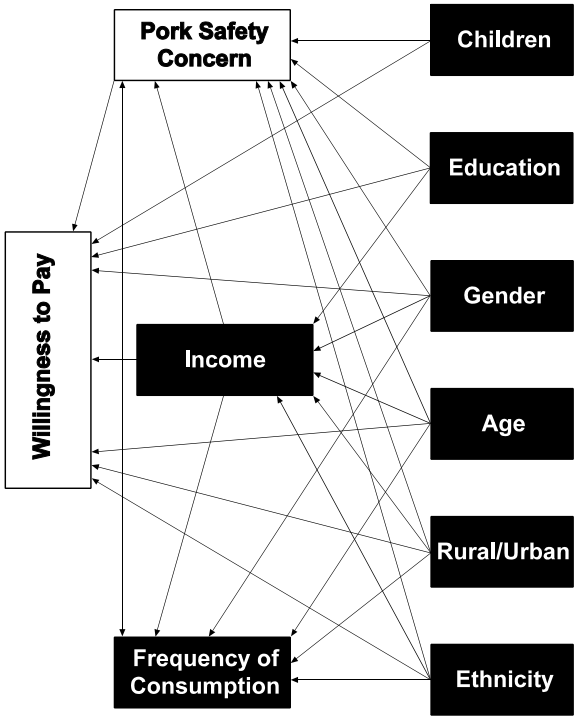

Figure 1. Conceptual relationships tested for models to explain pork safety concern and willingness to pay for a certified safer pork product

consumption. These variables also influence WTP for safety either directly, by influencing costs of avoiding illness, or indirectly, through their influence on concern. Income directly influences both frequency of consumption and WTP.

Using this framework, we developed and tested statistical models to estimate the importance of these determinants in explaining concern about pork safety and WTP for certified safer pork. Concern was modeled as a function of education level, gender of respondent, presence of children (under age 18) in the household, age of respondent, rural or urban location of residence, race/ethnicity of respondent, total household income, and frequency of consumption (see table 1). WTP was modeled as a function of these sociodemographic variables, and concern (which may not be explained entirely by demographics).

Our specific hypotheses were:

H1. *Consumer concern about pork safety is related to education, gender, presence of children in the household, age of respondent, income, and frequency of pork consumption.* Education has been found to be associated with greater nutrition knowledge (e.g., Ippolito and Mathios, 1991), so we hy-

pothesize education will also influence concern about pork safety. Women are more frequently the decision makers for at-home food purchases (Senauer, Asp, and Kinsey, 1991, p. 5), and thus may be more motivated to reduce costs of avoiding illness. Children and the elderly are at greater risk for foodborne illness, and we hypothesize this risk increases concern about safety. Other variables are included as basic demographic characteristics with no a priori hypotheses about their influence.

H2. *WTP per pound for a certified safe pork product is related to concern about pork safety and household income.* Greater concern will increase the value of safety to the consumer. Also, higher incomes will allow a consumer the flexibility of paying a price premium. WTP is also directly and indirectly related to demographic attributes (education, gender, presence of children, age, rural/urban, and ethnicity) which will influence concern, and income. The WTP question was framed with the background informational statement that the price of pork chops in the supermarket was about $2.20 per pound.

H3. *Consumers place greater confidence in third-party certification than they do in self-certification by industry.* We hypothesize that consumers prefer an independent source of verification for a label.

Statistical Estimation Procedures

Given the complexity of the framework in figure 1, it is useful to estimate the determinants of concern and of WTP with multivariate statistical models. Potential explanatory variables (respondent characteristics) include *Education* (a four-level variable: less than high school diploma, high school diploma/GED, some college or bachelor's degree, or education beyond bachelor's degree); *Gender* (two levels: male, female); *Presence of Children in Household* (two levels: yes or no); *Age of Respondent* (two levels: born prior to 1940 or not); *Residence Location* (two levels: rural or nonrural); *Ethnicity* (three levels: Black not Hispanic, White not Hispanic, or other); *Frequency of Pork Consumption* (five levels: none, less than once per month, 1–2 times per month, 3–4 times per month, or 5 or more times per month); and *Total Household Income* (three levels: less than $30,000, $30,000–$70,000, or $70,000 and over). Interaction terms are added to a logit model if there is an indirect influence of explanatory variables through another explanatory variable (e.g., *Frequency of Pork Consumption* $*$ *Total Household Income*). This feature of our logit specification is important, given the complexity of the hypothesized relationships in figure 1.

Logit models with concern about pork safety as the response variable were estimated (Fienberg, 1985, pp. 97–102). *Concern* was a dichotomous variable, categorized as those not concerned (responding as either not too concerned or not at all

concerned) versus those concerned (responding as either very concerned or somewhat concerned) about foodborne illness from pork.[3]

The full model for concern was estimated first, and the model was refined by backward elimination of nonsignificant explanatory variables. Removal of variables was evaluated by model to step-down model comparisons using differences in the residual χ^2 and degrees of freedom between the models. Variable elimination continued as long as there were independent variables with $P > 0.10$ and model to step-down model differences were nonsignificant. Elimination of variables was stopped when the residual χ^2 assessing goodness of fit was still adequate (Fienberg,1985, pp. 40–43) while keeping the model parsimonious.

Logit models with *WTP* for a certified enhanced safer pork product as the response variable were estimated in two ways. The first method paralleled that used for estimating concern. Given the hypothesized relationships outlined in figure 1, we can make an integrated interpretation of both concern and the first WTP model, including the indirect effects of *Concern* on *WTP*. There was adequate sample size to investigate indirect effects of *Concern* on *WTP*. Here, *WTP* was a four-level variable: \$1.00, \$0.50, \$0.10 or 0.25, and \$0.00.

There is an inherent bias in the ladder-style question we used to solicit WTP, as demonstrated by Herriges and Shogren (1996). To correct for the influence of this bias, our second model for estimating determinants of WTP adopts the approach of Shogren et al. (1999), and Hanemann, Loomis, and Kanninen (1991). Using their approach, we can't allow for the evaluation of interactions because of implicit sample size limitations. Thus, our second estimation of WTP provides less information about demographic determinants of WTP. However, this second method of estimation serves as a point of comparison that can validate or refute our first model estimating WTP. The *WTP* response variable in this second model was a four-level variable: at least \$1.00, \$0.50 to <\$1.00, \$0.10 to <\$0.50, and <\$0.10. Using dummy variables, we coded the observed WTP choices as follows:

$$(1)\qquad \begin{Bmatrix} d_i^{y} \\ d_i^{ny} \\ d_i^{nny} \\ d_i^{nnn} \end{Bmatrix} = \begin{Bmatrix} 1 & \text{if } \$1.00 \le WTP \\ 1 & \text{if } \$0.50 \le WTP < \$1.00 \\ 1 & \text{if } \$0.10 \le WTP < \$0.50 \\ 1 & \text{if } WTP < \$0.10 \end{Bmatrix}.$$

The log-likelihood function was specified as:

$$(2)\qquad \ln L(\alpha, \gamma, \beta) = \sum_{i=1}^{N} \left[d_i^{y} \ln(\pi^{y}) + d_i^{ny} \ln(\pi^{ny}) + d_i^{nny} \ln(\pi^{nny}) + d_i^{nnn} \ln(\pi^{nnn}) \right],$$

[3] If small cell numbers existed for categorical variables, then categories were combined to eliminate problems associated with small cell numbers while still adequately describing the combined categories.

where the superscripts refer to the series of yes and no sequences in the ladder-style questions related to WTP, and N is the number of people who responded to the survey, with the function $\pi(\cdot)$ as the likelihood of observing WTP. A superscript of y simply means the respondent answered yes to the question indicating a WTP of \$1.00 per pound; a superscript of ny means the respondent answered no to WTP of \$1.00 per pound, but yes to WTP of \$0.50 per pound; and so forth. The function $\pi(\cdot)$ takes the following form:

$$(3) \qquad \begin{Bmatrix} \pi^{y} \\ \pi^{ny} \\ \pi^{nny} \\ \pi^{nnn} \end{Bmatrix} = \begin{Bmatrix} 1 - G(\$1.00;\ \alpha, \gamma, \beta) \\ G(\$1.00;\ \alpha, \gamma, \beta) - G(\$0.50;\ \alpha, \gamma, \beta) \\ G(\$0.50;\ \alpha, \gamma, \beta) - G(\$0.10;\ \alpha, \gamma, \beta) \\ G(\$0.10;\ \alpha, \gamma, \beta) \end{Bmatrix}.$$

The logistic specification of the likelihood function was that each $G(\cdot)$ takes the form:

$$(4) \qquad G(B;\ \alpha, \gamma, \beta) = \frac{e^{\alpha+\gamma\mathbf{Z}-\beta B}}{1 + e^{\alpha+\gamma\mathbf{Z}-\beta B}},$$

where $\mathbf{Z}$ is the vector of respondent characteristics that enter the estimation; α, γ, and β are the parameters to be estimated; and B represents the bid values implied by the WTP values (following the approach used by Shogren et al., 1999). The model was considered adequate if $P < 0.01$ for the likelihood-ratio statistic and individual P-values were approximately 0.10 or less.

The CATMOD procedure in SAS was used for logit model estimations. All statistics presented were calculated using SAS (SAS Institute, Inc., 1998). Frequency data reported in tables 3 and 4 are weighted to reflect the distribution of the population in Illinois. Unweighted and weighted data typically differed by only 1 to 2 percentage points.

Results

Illinois consumers were concerned about foodborne illness from microorganisms in pork (table 2). Consumers were asked: "When you buy and prepare pork, how concerned are you about the possibility of foodborne illness from microorganisms such as *Salmonella*, *E. coli*, and toxoplasmosis? Would you say you are very concerned, somewhat concerned, not too concerned, or not at all concerned?" Approximately one-third (33.2%) of consumers said they were very concerned, 27.1% said they were somewhat concerned, 20.6% indicated they were not too concerned, and 14.4% reported they were not at all concerned. The remainder of those surveyed either did not respond, or had no opinion.

As seen from table 2, the vast majority of Illinois consumers eat pork. Consumers were asked: "How often do you eat pork products such as pork chops, bacon, sausage, or ham at home?" Only a small percentage (7.6%) of respondents either did not eat meat, or did not eat pork but did eat other meats. About a quarter (27.8%) of

Table 2. Survey Respondents' Pork Consumption, Pork Safety Concern, and Willingness to Pay for Enhanced Pork Safety

Variable	Frequency	Percent
Frequency of Consumption:		
▸ Never (or do not eat meat or pork)	46	7.6
▸ Less than once per month	49	8.0
▸ 1–2 times per month	170	27.8
▸ 3–4 times per month	158	25.9
▸ 5 or more times per month	186	30.5
Concern about Foodborne Illness from Pork:		
▸ Very or somewhat concerned	367	60.3
▸ Not too or not at all concerned	213	35.0
WTP for a Certified Enhanced Safety Pork Product:		
▸ $1.00/pound	156	25.6
▸ $0.50/pound	138	22.7
▸ $0.25 or $0.10/pound	158	25.9
▸ $0.00/pound	114	18.6
If Certified Pork Products Were Free, Would You:		
▸ Eat more	46	7.5
▸ Eat less	28	4.7
▸ Eat the same amount as you do now	509	83.5
Greater Confidence in Safety Label Certified by:		
▸ USDA	379	62.3
▸ Pork industry	97	15.9
▸ Either group	35	5.7
▸ Neither group	58	9.5

Notes: $N = 609$ households. Frequency is less than total number of respondents, and percentages do not total 100 because of refusals or missing data. These data are weighted to reflect the distribution of the population of Illinois; weighting calculations were provided by the Survey Research Laboratory, University of Illinois-Chicago. Weighted percentages typically differ by only a few percentage points from unweighted percentages. (A complete listing of the survey questions related to table 2 is provided in the appendix.)

respondents ate pork 1–2 times per month, another quarter of respondents (25.9%) ate pork 3–4 times per month, and another 30.5% of respondents ate pork 5 or more times per month.

Illinois consumers are willing to pay more for enhanced pork safety (table 2). Consumers were told: "Currently, the average price of pork chops in the supermarket is about $2.20 per pound." They were then asked: "How much additional money per pound would you be willing to pay for a certified enhanced safety pork product? Would you be willing to pay an additional $1.00 per pound?" The question was asked as a ladder-style question, with those unwilling to pay the highest level of $1.00 given subsequent WTP choices of 50 cents per pound, 25 cents per pound, and 10 cents per pound. Approximately a quarter (25.6%) of respondents would be willing to pay $1.00 more per pound for a certified enhanced safety pork product. Approximately another quarter (22.7%) of respondents would be willing to pay $0.50 more per pound. A third quarter (25.9%) indicated they would be willing to

pay either \$0.25 or \$0.10 more per pound. However, 18.6% of those surveyed were not willing to pay anything for a safer pork product.[4]

Most consumers are unlikely to increase the quantity of pork consumed even if safety were enhanced (table 2). Consumers were asked: "If certified pork products such as pork chops, bacon, sausage, or ham were available at no additional cost, do you think you would eat more, less, or the same amount as you do now?" A large majority (83.5%) of consumers would not eat more pork even if the certified product were available at no increase in price. Only 7.5% of consumers would increase their consumption of pork if there were a certified product available at no increase in price.

Consumers had more confidence in a food safety label for pork if the product were certified by the USDA than if the product were certified by the pork industry (table 2). Consumers were asked to consider the following and then respond: "Suppose a fresh pork product were available that was certified as being produced to ensure consistent product, using procedures to enhance food safety. If this label appeared on the product, would you have greater confidence in the safety of a pork product if it were certified by the U.S. Department of Agriculture or by the pork industry?" Most (62.3%) responded they would have more confidence in a USDA label, while 15.9% would have more confidence in a pork industry label. However, 9.5% indicated they would not have greater confidence in pork product safety with either group providing certification.

Concern about pork safety was related (residual goodness-of-fit $\chi^2 = 253.15$, $P = 0.141$, df = 230) to *Presence of Children in Household*, *Ethnicity*, *Frequency of Pork Consumption*, *Total Household Income*, and the interaction term *Age* $*$ *Total Household Income*. Households with children were more likely to be concerned about pork safety (negative coefficient with no children). Households that consumed pork, but consumed pork less than once per month, were more likely to be concerned about pork safety than households consuming pork more than four times per month (positive coefficient with lower consumption levels). Individuals from the lower two income categories (less than \$30,000 and \$30,000–\$70,000 household incomes) were more concerned than those with the highest (greater than \$70,000) household income (positive coefficients with lower incomes). Black respondents were more concerned with pork safety than were White respondents. Last, older (born prior to 1940, or roughly over 60 years of age) respondents who were in the two lower income categories were more likely to have concern about pork safety (positive estimated coefficients). The other variables in the final logit model for concern improve goodness of fit, but they are not statistically significant.

[4] Due to funding limitations, we were only able to purchase five questions. Therefore, our willingness-to-pay question was limited to one starting value. It would have been more appropriate to vary the starting values for the ladder-style question randomly to obtain a more robust estimate of willingness to pay. Due to this limitation of our survey, the willingness-to-pay results are used as a general indicator of potential market response, in order to explore relationships among consumer characteristics, concern, and potential market behavior.

Table 3. ANOVA Table for Final Logit Model, with Dependent Variable = *Concern about Pork Safety* (dichotomous variable, concerned or not concerned)

Source Variable	Degrees of Freedom (df)	Chi Square (χ^2)	Probability (*P*)
Intercept	1	5.47	0.019
Age	1	1.51	0.219
Presence of Children in Household	1	4.96	0.026
Ethnicity	2	13.88	0.001
Frequency of Pork Consumption	4	9.02	0.061
Total Household Income	2	10.72	0.005
Age∗Total Household Income	2	8.54	0.014
Total Household Income∗Rural	2	3.32	0.190
Frequency of Pork Consumption∗Total Household Income	8	12.51	0.130
Age∗Ethnicity∗Total Household Income∗Education	12	15.89	0.196
Age∗Total Household Income∗Education∗Gender	6	8.52	0.203
Ethnicity∗Total Household Income∗Rural∗Education∗Gender	12	16.47	0.171

Notes: Residual goodness-of-fit $\chi^2 = 253.15$, $P = 0.141$, and df = 230. Effective sample size = 496; don't know or refusals for variables were excluded from the analysis.

Table 4. Parameter Estimates from Logit Model, with Dependent Variable = *Concern about Pork Safety* (dichotomous variable, concerned or not concerned)

Effect Variable		Parameter Estimate	Chi Square (χ^2)	Probability (*P*)
Intercept		0.863	5.47	0.019
Age:	Older ▸	−0.324	1.51	0.219
Presence of Children in Household:	None ▸	−0.272	4.96	0.026
Ethnicity:	Black ▸	0.801	4.19	0.041
	Other ▸	0.265	0.42	0.519
Frequency of Pork Consumption:	Never ▸	−0.888	4.27	0.039
	Less than once per month ▸	0.588	3.38	0.066
	1–2 times per month ▸	0.296	1.79	0.181
	3–4 times per month ▸	0.243	1.14	0.286
Total Household Income:	Less than $30,000 ▸	0.826	5.06	0.024
	$30,000 to $70,000 ▸	0.942	7.30	0.007
Age∗Total Household Income:	Older and lowest income ▸	0.821	7.68	0.006
	Older and middle income ▸	0.596	3.06	0.080

Notes: Residual goodness-of-fit $\chi^2 = 253.15$, $P = 0.141$, and df = 230. Effective sample size = 496; don't know or refusals for variables were excluded from the analysis. Only one interaction term is presented because the others were not statistically significant.

From our first estimation procedure for WTP for an enhanced pork safety product, we observe that WTP was related (residual goodness-of-fit $\chi^2 = 424.19$, $P = 0.214$, df = 402) to *Gender*, *Ethnicity*, *Residence Location*, *Total Household Income*, *Concern about Pork Safety*, and the interaction terms, *Concern*∗*Education*, and *Concern*∗*Age* (tables 5 and 6). The three rows in table 6 under each effect variable correspond to the parameter estimates for each of the top three WTP levels beginning with $1.00. Thus, the zero level for WTP is the base comparison and has no parameter listed. Female respondents were more likely to have higher WTP for safer pork products than were males (parameter estimates for males are all negative). Individuals whose race/ethnicity was other than White (primarily Hispanics) were more likely (positive estimated parameter) to be willing to pay $1.00 per pound more for certified safer pork products. Blacks were more likely to be unwilling to pay any amount for safer pork products (negative estimated parameters). Rural residents were more likely to be unwilling to pay more for certified safer pork (negative estimated parameters). Individuals with the lowest household income (less than $30,000) were more likely to be willing to pay for safer pork. Individuals who have concern about pork safety were more likely to be willing to pay either $1.00 or $0.50 per pound for safer pork. Our interpretations are based on the signs of the estimated parameters and their significance.

The results from our second estimation for WTP provide us with a similar set of consumer characteristics related to WTP (table 7), with the exception that the relationship with ethnicity we observed previously does not remain in the model. Additionally, because of sample size limitations, no interaction terms can be evaluated. As seen from table 7, WTP was related (likelihood-ratio χ^2 statistic = 104.51 with df = 66, and $P > \chi^2 = 0.0018$) to *Gender*, *Residence Location*, *Total Household Income*, and, marginally ($P = 0.109$), to *Concern about Pork Safety*. Again, we find the following: women are more likely to be willing to pay more for enhanced pork safety (positive coefficient), households with higher incomes are less willing to pay more for enhanced safety (negative coefficient), rural households from rural settings are less willing to pay more for enhanced pork safety (negative coefficient), and individuals with concern are more likely to pay for enhanced pork safety (positive coefficient). Thus, after employing a methodology that allows for adjustment for the potential bias created by the starting bid values, our identified consumer characteristics related to WTP are very similar to those found in our first estimation approach.

Discussion

Our results indicate there is potential demand for certified safer pork products within the U.S. market for at-home consumption. Illinois is representative of the U.S. in terms of median household income, levels of education, and rural/urban distribution of the population (U.S. Bureau of the Census, 1998). Roughly one-fourth of Illinois household consumers would be willing to pay an additional $1.00 per pound for a certified safer pork product. This is an increase in retail price of approximately 50%. Only about a fifth of consumers are not willing to pay an increase of even $0.10.

Table 5. ANOVA Table for Final Logit Model, with Dependent Variable = *Willingness to Pay for a Certified Safer Pork Product* (4-level categorical variable: $1.00, $0.50, $0.10 or $0.25, and $0.00)

Source Variable	Degrees of Freedom (df)	Chi Square (χ^2)	Probability (P)
Intercept	3	1.95	0.583
Gender	3	17.81	0.001
Ethnicity	6	13.83	0.032
Rural Residence Location	3	8.90	0.031
Total Household Income	6	17.01	0.009
Concern	3	11.23	0.011
Concern∗*Education*	9	18.71	0.028
Concern∗*Age*	3	8.24	0.041

Notes: Residual goodness-of-fit $\chi^2 = 424.19$, $P = 0.214$, and df = 402. Effective sample size = 463; don't know or refusals for variables were excluded from the analysis.

When using the first approach for estimating WTP, our findings show the price premium for safer pork is high, although it is in the range found by Hayes et al. (1995) in their experimental auctions and less than the premium estimated by Boland, Fox, and Mark (1999) from a survey of predominantly high-income consumers. However, our second approach to estimating WTP does identify an upward bias in WTP (estimated coefficient of the bid value is negative). While it was not our intent to provide a specific estimate for the WTP for certified safer pork, there is an inherent bias in the approach which has been well recognized by Herriges and Shogren (1996), and Shogren et al. (1999).

Although most consumers would pay a price premium for certified safer pork, very few would increase their consumption. A high percentage of household consumers would not increase their consumption of pork even if certified pork were available at no extra cost. Many studies have found that pork has inelastic demand (e.g., Eales and Unnevehr, 1993), which may explain the consumption results. Most consumers do not want to vary the amount they consume very much in response to price shifts. Our results suggest there are market segments with highly inelastic demand that are willing to pay more for safer pork. Those who are most concerned about pork safety were willing to pay more for enhanced safety. Our study helps identify characteristics of consumers who are willing to pay more and also who have concern about pork safety. Identifying and marketing to this niche market for a certified safer product will help the industry to capture value from improved pork safety.

Our hypotheses regarding the influence of risk status or food preparation responsibility on concern were confirmed. Food safety concern was greater among women, certain categories of older respondents, and in households where children were present. WTP was related to concern about food safety, as hypothesized. In addition to the variance in WTP explained by concern alone, women and older consumers had greater WTP. Concerned older consumers, however, were more likely to be

Table 6. Parameter Estimates from Final Logit Model, with Dependent Variable = *Willingness to Pay for a Certified Safer Pork Product* (4-level categorical variable: $1.00, $0.50, $0.10 or $0.25, and $0.00)

Effect Variable		Parameter Estimate	Chi Square (χ^2)	Probability (P)
Gender:	Male ▸	−0.574	13.59	0.000
	▸	−0.433	8.16	0.004
	▸	−0.150	1.11	0.292
Ethnicity:	Black ▸	−0.770	3.81	0.051
	▸	−0.349	0.80	0.372
	▸	−0.842	3.87	0.049
	Other ▸	1.290	5.72	0.017
	▸	0.828	2.22	0.136
	▸	0.737	1.69	0.193
Residence Location:	Rural ▸	−0.372	3.01	0.083
	▸	−0.229	1.33	0.249
	▸	−0.599	8.46	0.004
Total Household Income:	< $30,000 ▸	0.434	3.97	0.046
	▸	0.479	4.73	0.030
	▸	−0.068	0.10	0.749
	$30,000 to $70,000 ▸	−0.154	0.54	0.461
	▸	0.283	1.93	0.165
	▸	0.134	0.52	0.473
Concern about Pork Safety:	▸	0.551	5.79	0.016
	▸	0.701	10.00	0.002
	▸	0.293	1.91	0.167
Concern ⋆Education:	Concerned and no HS diploma ▸	0.562	1.55	0.213
	▸	0.145	0.11	0.736
	▸	0.617	1.96	0.161
	Concerned and HS diploma ▸	−0.090	0.10	0.749
	▸	−0.600	4.55	0.033
	▸	0.101	0.14	0.704
	Concerned and some college or bachelor's degree ▸	−0.407	2.51	0.113
	▸	−0.394	2.49	0.115
	▸	−0.363	2.34	0.126
Concern ⋆Age:	Concerned and over 60 ▸	0.044	0.05	0.824
	▸	0.413	4.59	0.032
	▸	−0.032	0.03	0.863

Notes: Residual goodness-of-fit $\chi^2 = 424.19$, $P = 0.214$, and df = 402. Effective sample size = 463; don't know or refusals for variables were excluded from the analysis. The intercept is not presented because it was not statistically significant. The three rows under each effect variable correspond to the parameter estimates for each of the top three WTP levels: $1.00, $0.50, and $0.10 or $0.25. The $0.00 level for WTP is the base comparison and has no parameter listed.

Table 7. Multiple-Bounded Logistic Regression Estimation Results, with Dependent Variable = *Willingness to Pay for a Certified Safer Pork Product* (4-level categorical variable: at least $1.00, $0.50 to <$1.00, $0.10 to <$0.50, and <$0.10)

Variable	Definition	Coefficient	$P > \chi^2$
Intercept		0.099	0.641
Gender	0 = male; 1 = female	0.578	0.018
Residence Location	0 = nonrural; 1 = rural	−0.799	0.011
Total Household Income	−1 = < $30,000; 0 = $30,000 to $70,000; +1 = above $70,000	−0.291	0.068
Concern	0 = not concerned; 1 = concerned	0.387	0.109
B	Bid value	−0.324	0.022

Notes: Likelihood-ratio $\chi^2 = 104.51$, df = 66, and $P > \chi^2 = 0.0018$.

willing to pay up to $0.50 per pound more for certified safer pork, and were not as likely to be among those willing to pay $1.00.

We had no a priori expectations about how race/ethnicity or location of residence might influence concern and WTP. However, the results from the first estimation procedure for WTP show WTP was higher when race/ethnicity was Other (primarily Hispanic respondents), and was higher when respondents were from nonrural areas. Blacks had greater concern about food safety, but were not willing to pay more for a certified safer product. The cultural reasons for these differences are areas for further exploration. Ethnicity was not a significant direct variable in the second estimation of WTP.

Concern over pork safety was inversely related to frequency of pork consumption, as long as there was some pork consumption. Individuals who ate more pork were less concerned or vice versa. The direction of causality in this relationship is complex. It could be that individuals who believe pork is safe are willing to consume pork more often. It could also be that as people consume pork more often, and fail to experience any negative effects associated with foodborne illness, their concern about pork safety decreases. These data suggest concern about pork safety may influence some individuals to consume less pork. The relationship between safety concerns and frequency of consumption, and response of these variables to new information about pork safety is an area for further study.

Some variables did not relate to concern and WTP as hypothesized. Education was not a significant determinant of pork safety concern for this product. Contrary to expectations, those with lower incomes had greater concern and WTP. One explanation may be that lower income individuals feel they have less control and access to information; therefore they would prefer greater intervention on their behalf. Our findings provide an interesting contrast to Boland, Fox, and Mark (1999), who

specifically selected high frequency pork consumers with relatively high incomes and demonstrated demand for organic products. They assumed such consumers would be more likely to pay for reductions in salmonella; our results suggest an entirely different market segment might be amenable to certification of improved pork safety. Also, age, the presence of children, and education did not directly influence WTP. The influence of these variables is only indirectly expressed through concern about pork safety.

The results regarding what entity or group should guarantee a certified label confirm there is a role for the USDA in fostering a market for certified safer pork products. Current activities are preparing the path for certification with regard to trichinae status. This is being approached as a shared role among pork producers, accredited veterinarians, and the USDA. The actual certification process will require the input of each of these segments to document production practices influencing risk. However, the label placed on a pork product will be viewed with greater confidence by consumers if the label carries assurances from the USDA, rather than assurances from the pork industry.

The impact of producing a safer pork product on pork producers, and others in the supply chain, will depend on many factors including the costs associated with production of a certified product. The potential benefit to be gained depends on the portion of the production chain able to capture this enhanced value. Wohlgenant (1993) reported that an outward shift in the demand curve returned about $0.33 to pork producers for every additional $1.00 of demand. Furthermore, how production organization must be modified to produce a safer product will influence who gains from any increase in retail value. Producers with closely aligned relationships or contracts with particular packers might capture benefits, because these producers might find it easier to certify their production processes as providing a safer product.

A specific limitation of this study should be noted. These data relate to only a portion of the market for enhanced safety pork products. First, the small but growing export market demands a high degree of safety for product shipment over long distances and for meeting the competition from other pork-exporting nations (e.g., Denmark) that have stringent food safety regulations. This market provides incentives for improving safety by paying a premium price, and contracts for specific quantities with particular attributes (Sevebrant, 1999). Second, within the U.S., the at-home market is declining relative to the away-from-home market. A large potential market for certified pork products might exist through institutional outlets. Data from this survey of household consumers cannot be used to assess this potential market. Institutional markets, in particular hospitals, and retirement homes or other locations with people who might be at increased risk for foodborne illness, might represent a large part of the demand for certified product and could have an even more important role in the demand for certified product than household consumers.

Another weakness of this study (which is true of all surveys) is the uncertain ability of a survey to identify the true actions of consumers in the marketplace.

Although Shogren et al. (1999) provide encouragement regarding the comparability of results between surveys and market behavior, experiments and surveys nonetheless can fail to identify the actual response of consumers in the marketplace. In particular for our study, consumers with lower incomes may find it more difficult to be able to follow through with their desire and willingness to pay more for an enhanced pork safety product.

The large proportion of consumers who expressed concern and positive WTP reflects the importance of food safety in the marketplace, and the potential for preserving or enhancing product marketability through improved food safety. Many pork-producing countries have developed voluntary and mandatory programs to improve food safety throughout the pork chain (Unnevehr, Miller, and Gomez, 1999). To be competitive at home and abroad, U.S. pork producers and other groups in the pork production chain need to be involved in research, setting standards, and developing certification programs designed to move the pork-producing industry forward in enhancing the safety of pork products and communicating that safety to consumers.

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Appendix: Survey Questions

Transition statement that began the foods section which contained our questions:

Now, I would like to change the subject a bit and ask you some questions about food products and safety.

Q. How often do you eat pork products such as pork chops, bacon, sausage, or ham at home? Would you say . . .

(1) Never?
(2) Less than once a month?
(3) 1–2 times per month?
(4) 3–4 times per month?
(5) 5 or more times per month?
(6) R DOES NOT EAT MEAT
(7) R DOES NOT EAT PORK, BUT DOES EAT OTHER MEATS
(97) NO CODED RESPONSE APPLICABLE
(98) DON'T KNOW
(99) REFUSED

Q. When you buy and prepare pork, how concerned are you about the possibility of foodborne illness from microorganisms such as Salmonella, E. coli, or toxoplasmosis? Would you say . . .

(1) Very concerned?
(2) Somewhat concerned?
(3) Not too concerned?
(4) Not at all concerned?
(7) NO CODED RESPONSE APPLICABLE
(8) DON'T KNOW
(9) REFUSED

Q. Suppose a fresh pork product were available that was certified as being "produced to ensure consistent product, using procedures to enhance food safety." If this label appeared on the product, would you have greater confidence in the safety of a pork product if it were certified by the U.S. Department of Agriculture or by the pork industry?

(1) USDA
(2) Pork industry
(3) Either
(4) Neither
(7) NO CODED RESPONSE APPLICABLE
(8) DON'T KNOW
(9) REFUSED

Q. Currently, the average price of pork chops in the supermarket is about $2.20 per pound. How much additional money ***per pound*** *would you be willing to pay for a certified enhanced safety pork product?*

(a) *Would you be willing to pay an additional $1.00 per pound?*

(1) Yes
(2) No
(7) NO CODED RESPONSE APPLICABLE
(8) DON'T KNOW
(9) REFUSED

(b) *Would you be willing to pay an additional 50 cents per pound?*

(1) Yes
(2) No
(7) NO CODED RESPONSE APPLICABLE
(8) DON'T KNOW
(9) REFUSED

(c) *Would you be willing to pay an additional 25 cents per pound?*

(1) Yes
(2) No
(7) NO CODED RESPONSE APPLICABLE
(8) DON'T KNOW
(9) REFUSED

(d) *Would you be willing to pay an additional 10 cents per pound?*

(1) Yes
(2) No
(7) NO CODED RESPONSE APPLICABLE
(8) DON'T KNOW
(9) REFUSED

Q. If certified pork products such as pork chops, bacon, sausage, or ham were available at no additional cost, do you think you would eat . . .

(1) More?
(2) Less?
(3) The same amount as you do now?
(7) NO CODED RESPONSE APPLICABLE
(8) DON'T KNOW
(9) REFUSED