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ABSTRACT

There are huge gaps from the farm to the processing plants. No one knows where the cows are coming from. . . Trace forward from the processing plant is supposed to be accurate, but no one knows for sure. – Caroline Smith DeWaal.

This article reports the results from a series of laboratory auction markets in which consumers bid on meat characteristics. The characteristics examined include meat traceability (i.e., the ability to trace the retail meat back to the farm or animal or origin), transparency (e.g., knowing that the meat was produced without growth hormones, or knowing the animal was humanely treated), and assurances (e.g., extra meat safety assurances). This laboratory study provides non-hypothetical bid data on U.S. consumer preferences for traceability, transparency, and assurances (TTA) in red meat at a time when the U.S. currently lags other countries in development of TTA meat systems. Our results suggest that U.S. consumers would be willing to pay for such TTA meat characteristics, and the magnitude of the consumer bids suggest a likely profitable market for development of U.S. TTA systems.
MEAT TRACEABILITY: ARE U.S. CONSUMERS WILLING TO PAY FOR IT?

Introduction

Recent research suggests the U.S. red meat system is falling behind many of its major competitors and trading partners in terms of traceability, transparency, and enhanced assurances (TTA) (Liddell and Bailey (2001), Capmany et al. (2000)). In fact, the U.S. pork system ranks last, according to Liddell and Bailey, when compared against the United Kingdom (UK), Denmark, Canada, Japan, and Australia/New Zealand for TTA. Traceability is sometimes also called identity preservation and is defined in Liddell and Bailey as the ability to track the identification of red meat products backward from retail through the various stages of production. Transparency is the availability of information to consumers regarding the processes used during each phase of an individual red meat product’s creation, and assurance is the processes involved in monitoring the food chain for safety through product tests and process audits. Enhances assurances are guarantees of the existence of characteristics in meat products beyond typical government inspections. Such characteristics could include enhanced assurances about food safety, animal welfare, or environmental preservation.

TTA is different than the typical quality assurances and standardization in the domestic U.S. market and in international trade, such as ISO standards. It evolved initially in response to the perceived regulatory failure of European Union (EU) governments to provide adequate information to consumers during the EU BSE crisis. As a result, the EU has developed systems that enhance the credence nature of attributes such as animal welfare and even food safety issues such as BSE by filling the perceived information void inherent in standard government grading practices with TTA.
This article presents initial evidence on U.S. consumers willingness-to-pay (WTP) for TTA characteristics in beef and pork. We report the results from a series of controlled laboratory experiments in which consumers bid in a (theoretically) demand-revealing auction on meat sandwich upgrades. These WTP auctions, utilized first in Shogren et al. (1994b), generate nonhypothetical data on consumer valuation of TTA attributes in meat and are a first step towards identifying the potential U.S. market(s) for meat produced through a TTA system. We find that consumers are willing to pay significant amounts of money to upgrade a sandwich to an otherwise identical sandwich containing TTA attribute(s) meat. Furthermore, our results suggest that the market for TTA beef may be broader than the market for TTA pork, as auction market valuation of the latter is more sensitive to the specific demographic characteristics of the consumers.

Background on TTA

TTA is obtained through a system of records and certifications that allow a product to be traced and certified back to different points in the food chain. Currently, most U.S. red meat is traceable from retail back to the processor but not to the farm or animal level. Establishing TTA prior to processing would require a system that is currently not generally in place in the United States. While the United States has been slow to adopt TTA standards and certifications, some countries in the EU have developed comprehensive TTA systems.

Red meat producers and processors in the United States should be concerned that the U.S. system is lagging other countries in terms of TTA for at least two reasons. First, consumers have become increasingly concerned about the processes (inputs and methods) used to produce food. Second, if competitors are able to differentiate their red meat products as being superior to U.S. red meat products in terms of TTA, the United States may lose market share in its red meat
export markets. For example, recent food safety concerns in Japan, including the possible discovery of *bovine spongiform encephalopathy* (BSE\(^1\)), could potentially lead to heightened import restrictions and regulations. Japan is the United States’ principal export market for red meat and such concerns could eventually lead to a loss of U.S. market share if competitors such as Canada, Australia/New Zealand, and Denmark are successful in convincing Japanese buyers that their products are “safer” than U.S. products because their system provides more TTA than the U.S. system.

While TTA has not been a central issue in red meat markets in the United States, it has in the EU and other countries during the past five years. As a result, the EU systems have evolved at a faster rate than the U.S. system. The consequences in the United States may not be felt immediately, but the potential of the United States losing market share in red meat markets in the future exists if competitors can successfully differentiate their products based on real or perceived food safety and quality assurance characteristics that can be certified and traced (Bailey and Hayes).

Dr. John Wiemers, the chairman of the U.S. Department of Agriculture’s, Food Safety and Inspection Service Interagency Committee on Animal Identification, has stated that red-meat traceability systems will only be implemented in the United States if consumers are found to be willing to pay for the additional costs to produce traceable products. This suggests that evidence of consumer willingness to pay for TTA products is essential if TTA systems are to be developed in the United States.

An examination of differences in worldwide consumer attitudes about TTA and the market value they place on TTA certifiable characteristics will eventually be essential to

\(^1\)Also known as “mad-cow” disease.
identifying the optimal approach to improving TTA in the U.S. red meat system since U.S. red meat is traded not only domestically but also internationally. However, in this study we focus on the United States to ascertain if domestic consumers are willing to pay for TTA and other meat characteristics that could be certifiable through TTA. If significant changes are made in the U.S. red meat system to address TTA concerns, large investments will be needed to do so. Recapturing these investments will require capturing a significant market share of the red meat market for products featuring TTA characteristics. This will probably require a significant penetration of domestic red meat markets as well as foreign ones. The controlled experiments we use in this study generate nonhypothetical bid data on consumer willingness-to-pay (WTP) for TTA, and this information is vital towards assessing whether the U.S. red meat system should consider implementing TTA. A large-scale field experiment would be an effective but prohibitively costly way of conducting such research. As an alternative, the small-scale controlled laboratory experiments described in the next section offer a cost effective way of generate initial data on domestic consumer attitudes about WTP for TTA.

**Experiments**

We use the laboratory market approach for eliciting individuals' WTP for food traceability and related characteristics. Our experiments follow the basic design utilized in Shogren et al. (1994b) for eliciting bids to “upgrade” a meat sandwich. Subjects in the experiments are given a free lunch, which includes a meat sandwich, along with $15 cash at the beginning of the one-hour experiment. Subjects in the experiment are allowed to bid on what they would be willing to pay to exchange or upgrade their existing sandwich for a sandwich with the meat described as having one or more extra verifiable attributes. The upgrades we consider are based are: (1) extra assurance or information relating to the processes used to produce meat
including animal treatment (humane treatment procedures and lack of growth hormones used in production of the meat),\(^2\) (2) extra assurance of food safety (extra tests for \textit{e coli} or \textit{salmonella} for beef or pork, respectively),\(^3\) (3) the ability to trace the meat back to the farm of origin,\(^4\) and (4) all three upgrades combined. The respective auction sandwiches are numbered as Sandwich 1, Sandwich 2, Sandwich 3, and Sandwich 4.

Subjects were recruited from four different demographic cohorts for the experiments. The subjects were informed that either beef or pork would be consumed as part of the free lunch. Each experimental group consisted of 13-14 individuals on average. Eight total experiments were conducted, four experiments using ham sandwiches and four using roast beef sandwiches. Experimental groups were recruited for the ham and beef experiments such that students were one experimental group, faculty were a group, professional staff (e.g., accountants, administrative personnel, etc.) another group, and classified staff (e.g., maintenance workers, buildings and grounds keepers, etc.) as the fourth distinct demographic group. We chose to conduct experiments in groups of similar individuals for two reasons. First, it is often the case that individuals of similar sociodemographic populations shop in similar locations, and so this approach may help engage subjects in the auction process to the largest extent possible.\(^5\) Secondly, \textit{ex post} controls for the experimental group can help uncover the potential importance of consumer demographics in estimating the market potential for traceable food products.

Once the experimental subjects arrived, they were seated with the free lunch in front of

\(^2\) This relates to the transparency or knowledge of the processes used to produce red meat.
\(^3\) This relates to the assurance part of TTA since actual tests and guarantees are made.
\(^4\) This is the traceability portion of TTA.
\(^5\) Subject engagement in the auction was one reason behind the use of the random \textit{n}th-price auction in Shogren et al. (2001).
them, given the $15 cash up front, and told to await instruction before unwrapping the lunch sandwich. Subjects had hardcopy instructions of the experiment, the instructions were also explained orally, and all clarification questions were answered prior to commencement of the experiment. The auction format was such that subjects would place a bid to upgrade their existing sandwich to one of the four auction sandwiches, and the auction rules were for a (theoretically demand-revealing) second-price sealed-bid auction. There were no differences in appearance of any the sandwiches, which were visually inspected by each subject prior to bidding, and the instructions clearly explained the different verifiable meat attributes in each auction sandwich (see the Appendix for the text of the instructions). Unlike the auctions in Shogren et al. (1994b), subject bids are not truncated at zero, although we expect that individuals would place positive value on the attributes we study in this article.

Bids from each subject were taken in turn for each auction sandwich, and this constituted one round of the auction. Ten total rounds were conducted to allow for bid stabilization (see Hayes et al. (1995), and Shogren et al. (1994b)), and market price information (i.e., the second highest bid) for each sandwich was presented prior to eliciting the next round’s bid for that sandwich. Subjects were aware that a random draw at the end of the 10th round would determine which of the four simultaneous auctions would be binding—no subject would end up consuming

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6Shogren et al. (1994a) examine second-price, random nth price, and combinatorial auction rules and find that average bids in such food auction experiments are insensitive to the auction format.

7The experiments involved no deceit as the auction sandwiches were truly and verifiably different in the meat they contained. Imported ham from Denmark was used for the traceable (and related characteristics) ham, and one of the Utah State University farms was used to trace the roast beef (as well as to conduct extra safety tests and verify humane animal treatment).

8While it is highly unlikely that negative bid possibilities would significantly affect the average willingness-to-pay data for items generally viewed as upgrades from a baseline product, this is not to say that negative bids might be much more likely for other food attributes that are not necessarily considered “goods” (e.g., radiated meat). In our experiments, only a small minority of the subjects every submitted negative bids, and these subjects often did this only in the early auction rounds.
more than one sandwich in the experiment. A second random draw determined which of the 10 rounds would be binding. Subjects were fully aware prior to starting the first auction round that there was a uniform chance that any round for any auction sandwich might be the binding auction, and the subjects reported no confusion over the understanding of these procedures.

After this second random draw, the appropriate auction was consummated by the winning subject paying the second highest bid amount to exchange his/her original sandwich for the auction sandwich. Note that only one auction winner per experimental group consumes an auction sandwich. All subjects were then allowed/required to consume their sandwiches prior to leaving the experiment with their experiment cash.

Results

The main results of average bid behavior for beef and pork are highlighted in Figures 1 and 2, respectively. While the magnitudes of the average bids are important, our main discussion will involve comparisons of bids for different attributes of the same type of meat and for the same attribute for different types of meat. As do Hayes et al. (1995), we consider the magnitudes of the average bids more as an upper bound on bids due to the nature of the one-day experiment. Nonetheless, it is apparent that the average subject is willing to pay nontrivial amounts of money to upgrade the meat in a sandwich valued at approximately $3.00. Average willingness to pay (averaged across all subjects and all rounds) to upgrade the roast beef sandwich is $0.23 to add basic traceability, $0.50 to add assurances on animal treatment, $0.63 to add extra assurances of food safety, and $1.06 to upgrade the sandwich to one in which the roast beef contains all three

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9 While some may find elicitation of bids on four products at once cumbersome and/or confusing for the subjects, Melton et al. (1996) elicit simultaneous bids on eight different pork chops after noting that consumers regularly evaluate from six to eight packages of a particular cut of meat on display at once.
upgrades. For pork, the same respective upgrades were valued on average at $0.50, $0.53, $0.59, and $1.14.

From Figure 1 we see that, while traceability for beef products itself may be valued, consumers place an even larger value on specific verifiable information that might be captured along with a traceable meat system. Bids for beef traceability are statistically significantly lower than bids for animal treatment assurances and bids for increased food safety (p < .01 for the two-tailed nonparametric Mann-Whitney U-test of means using average bids in each round as the observation of interest).10 Similarly, among the specific attributes of food safety and animal treatment, bids for food safety are higher than those for animal treatment (p < .05). Subjects are also willing to pay significantly more for beef that combines all three of these meat attributes in a single product (p < .01 for each comparison), although the average bid for the “everything” sandwich is less than the sum of the bids for individual meat attributes. That is, subjects display a decreasing marginal willingness-to-pay for additional attributes. Similar results are to be found by analyzing market price data, which is descriptive of the subjects’ highest willingness-to-pay for comparative valuations of the food attributes.

Figure 2 shows the comparable aggregate bidding data for the ham sandwich upgrade. The bid data for each auction sandwich are not as neatly ordered for ham as they are for beef, but subjects are still willing to pay significantly more for food safety than for animal treatment assurances (p < .10 for the two-tailed test) or basic traceability (p < .05). We find no significant difference, however, in the average willingness-to-pay for animal treatment assurances and basic traceability for ham (p > .10). As before, subjects are willing to pay significantly more for all

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10 The Mann-Whitney nonparametric test of means places no distribution assumptions on the subject bids, although it does assume that average subject bids are independent across rounds for each sandwich auction. The basic results are, however, consistent with the parametric regression results shown in Table 1 in which we use each subject’s average bid across the final five auction rounds as the dependent variable.
attributes together in the sandwich meat (p < .01 for each comparison), but the average bid for the “everything” sandwich upgrade is less than the sum of the individual meat attributes.

Interestingly, similar analysis of the market price data for the ham experiments show that the market price for the animal treatment upgrade is significantly higher than the market price for basic traceability (p < .01). These results are due to some subjects’ extra high willingness to pay for basic traceability in ham, which generates high market prices but is tempered more in the overall average bid data.

In comparing average willingness to pay for a meat attribute in beef and pork, there is no significant difference in subjects’ average bids for animal treatment in beef versus pork (p > .10 for the two-tailed Mann-Whitney test) and food safety in beef versus pork (p > .10). Subjects are willing to pay significantly more for basic traceability, however, in pork than in beef (p < .01), which contributes to a higher average bid for a ham sandwich with all three attributes than a roast beef sandwich with all three attributes (p < .10). Figures 3 and 4 show the average bid frequencies for beef and ham, respectively. While the average subject is willing to pay significant amounts of money for meat with these attributes, Figures 3 and 4 highlight that a significant number of subjects—anywhere from 15% (food safety) to 55% (basic traceability) in beef and from 21% (food safety) to 40% (basic traceability) in pork—place a zero value on some of the individual food attributes. As such the conditional mean willingness-to-pay for these quality attributes in meat is even higher for the relevant segment of the market that positively values these attributes. The parametric regression results reported next will help highlight whether the positive willingness-to-pay of certain consumers is general across the demographic groups we used as experiment subjects or specific to one or more demographic group.
Table 1 reports the results of a basic treatment effects regression on average bids for ham and beef attributes. The regression results include group-specific controls, and each group represents a different demographic market type. The results demonstrate that specific demographic characteristics affect the bids for both beef and ham. Students and faculty made significantly lower bids for ham than professional staff while classified employees bid higher for ham than professional staff. For beef, each of the other three demographic groups placed higher average bids than the classified employees group (Table 1). These results could be explained by either meat preferences or educational differences. Education (students and faculty) probably affects the level of awareness of issues related to TTA such as BSE, a potential problem with beef, resulting in a premium being on enhanced beef characteristics relative to pork. Another potential explanation for students and faculty having lower average bids for ham than classified employees but higher average bids for beef that classified employees is that different preferences exist between the groups for beef to pork. In either case, this suggests that significant demographic effects exist implying that marketing strategies for TTA characteristics would need to be targeted based on demographics and/or other characteristics and not the general market.

Subjects in the ham sandwich experiment would pay the same for the three sandwiches with individual characteristics (Sandwich 1, 2, or 3) but would pay more for a sandwich with the combined characteristics (Sandwich 4) than they would for a sandwich with only traceability (Sandwich 3) (Table 1 and Figure 2). Conversely, subjects in the roast beef sandwich experiment would pay more animal welfare (Sandwich 1), food safety (Sandwich 2), and the combined characteristics (Sandwich 4) than for traceability alone (Sandwich 3) (Table 1 and Figure 2).

While the average bids of students, faculty, and professional staff were statistically above those of classified employees for beef, the premium above classified employees is statistically equal for the three groups (i.e., a test of the restriction for the parameter estimates for students = faculty = professional staff could not be rejected (p > 10%)).
Figure 1). Since subjects failed to differentiate individual characteristics for ham but did so for beef, it suggests a higher degree of concern about the procedures used to produce and process beef than ham. One could surmise this results from more highly publicized food scares in recent years being related to beef than to pork.

Our results suggest that many consumers would be willing to pay for TTA characteristics in red meat products. Average bids for each individual TTA characteristic as well as the combined characteristics were found to be positive. The potential market segments for TTA red meat products appear to be large suggesting a significant marketing opportunity might be exploited if red meat producers developed TTA products. These results imply that U.S. consumers would be willing to pay for TTA characteristics in red meat products meeting the criterion suggested by Wiemers for considering the implementation of these systems. While field trials are still needed to confirm our results, the results presented here are strong enough to justify continued interest in examining ways to implement TTA red-meat systems in the United States.

Conclusions

The implementation of some sort of TTA system for red meat in the United State seems inevitable as our trading partners and competitors move rapidly to develop such systems. While possible TTA systems in the U.S. are being examined, and in some cases implemented, the USDA and producer groups in the U.S. have sought evidence that TTA systems would produce a net benefit to the industry.

We elicited consumer willingness-to-pay data for TTA characteristics in pork and beef products in a nonhypothetical setting. Our results indicate that U.S. consumers would be willing to pay for TTA characteristics in red meat. Consumers seem to value specific TTA attributes or
combinations of attributes more than just traceability or identity preservation in beef and pork. This implies that system of meat traceability alone may not be valued enough to justify its creation. Systems that provide traceability can, however, provide additional information on TTA characteristic(s) that consumers do value. The characteristic most valued by consumers in our experiments was food safety, and so safety guarantees are likely an important component of any profitable TTA system.

We also find some distinct results for beef and pork. Specifically, consumers seems more willing to pay additional money for knowledge about animal treatment and additional food safety assurances in beef than in pork—this is in addition to what consumers are willing to pay for just meat traceability information. Therefore, markets for specific and distinct TTA guarantees may be worth exploring in beef. Consumers are still willing to pay for TTA characteristics in pork, but we find less evidence for a difference in WTP for food safety and animal treatment guarantees versus traceability than in beef. There is also evidence that a consumer’s demographics are less a determinant of WTP for TTA beef than TTA pork. This has important implications for any marketing strategy for TTA meat products since TTA pork may have to be targeted to more specific consumer demographic groups than TTA beef, which may be a broader potential market.

Our results need to be confirmed by field trials and also do not answer the question of how TTA systems would affect the cost structure for producing and processing red meat. However, our findings offer enough evidence to justify continued examination and determination of the most effective ways for implementing TTA in the U.S. red meat system.
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DeWaal, C. S. Food Safety Director at the Center for Science in the Public Interest. Quote in Food Traceability Report 1(August 2001):12.


Table 1. Regression Results for Ham and Roast Beef Depicting Differences in Bids Different Panels and Sandwich Types.\textsuperscript{a}

<table>
<thead>
<tr>
<th>Item/Independent Variable</th>
<th>Ham</th>
<th>Beef</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations</td>
<td>212</td>
<td>220</td>
</tr>
<tr>
<td>Adjusted R\textsuperscript{2}</td>
<td>0.4603</td>
<td>0.2392</td>
</tr>
<tr>
<td>Intercept</td>
<td>0.943</td>
<td>-0.017</td>
</tr>
<tr>
<td></td>
<td>(0.140)**</td>
<td>(0.097)</td>
</tr>
<tr>
<td><strong>Demographic Type:</strong>\textsuperscript{b}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students</td>
<td>-1.084</td>
<td>0.296</td>
</tr>
<tr>
<td></td>
<td>(0.154)**</td>
<td>(0.105)**</td>
</tr>
<tr>
<td>Faculty</td>
<td>-1.074</td>
<td>0.230</td>
</tr>
<tr>
<td></td>
<td>(0.148)**</td>
<td>(0.103)*</td>
</tr>
<tr>
<td>Professional Staff</td>
<td>0.485</td>
<td>0.345</td>
</tr>
<tr>
<td></td>
<td>(0.150)**</td>
<td>(0.103)**</td>
</tr>
<tr>
<td><strong>Meat Characteristic(s):</strong>\textsuperscript{c}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sandwich 1 (animal treatment)</td>
<td>0.038</td>
<td>0.265</td>
</tr>
<tr>
<td></td>
<td>((0.152)</td>
<td>(0.104)*</td>
</tr>
<tr>
<td>Sandwich 2 (food safety)</td>
<td>0.127</td>
<td>0.375</td>
</tr>
<tr>
<td></td>
<td>(0.152)</td>
<td>(0.104)**</td>
</tr>
<tr>
<td>Sandwich 4 (combined characteristics)</td>
<td>0.676</td>
<td>0.802</td>
</tr>
<tr>
<td></td>
<td>(0.152)**</td>
<td>(0.104)**</td>
</tr>
</tbody>
</table>

\textsuperscript{a}Standard errors are in parentheses.
\textsuperscript{b}Base is professional staff.
\textsuperscript{c}Base is Sandwich 3 (traceability).
*Significantly different than zero at the 5% level.
**Significantly different than zero at the 1% level.