Valuing Safer Food: Lessons from a Decade in the Lab

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Society’s demand for safer food has tracked its ever-increasing ability to detect and identify foodborne illness. Well-publicized outbreaks of *Salmonella* and *E. Coli 0157* have made people more aware that foodborne disease makes a lot of us sick every year—an estimated 76 million illnesses in the United States, with over 300,000 hospitalizations and 5000 deaths, imposing tens of billions in annual costs (Meade et al.; Crutchfield et al.). People now demand more investment, both private and public, in processes and technologies that can produce inexpensive food with fewer foodborne risks. But these same people often react negatively to technological solutions that would satisfy their demand—growth hormones and food irradiation can trigger uncomfortable futuristic images in the mind’s eye. Disentangling the desire for safer food from worries over new food technologies is a challenge for demand revelation methods.

This paper reflects on how we used laboratory auctions to address this challenge, and the lessons we learned by observing bidding behavior for safer food over the last decade. As a compliment to traditional tools like econometrics, hedonics and contingent valuation, laboratory auctions have developed into a useful method to elicit consumer values for real decisions in a controlled environment. Laboratory experiments use auctions to sell real goods for real money within a stylized setting. The method therefore entails real payments and binding budget constraints. Using demand-revealing auctions such as the second-price, sealed-bid auction mechanism, people participate in a repeated market that allows for learning as they realize the actual monetary consequences of their bidding. People learn that sincere bidding of their true preferences is the best strategy. Evidence suggests that individual choices over food safety in the laboratory can track their decisions in retail markets.

More importantly, experimental designs can isolate and control the market setting to address specific questions. But the contextual design of laboratory auctions matters. First
among these is having subjects make actual decisions—exchanges of money for real goods. Unlike hypothetical surveys, real exchanges of money and goods induce sincere behavior and punish irrational behavior. The well-known bias often found in responses to hypothetical questions can be reduced or calibrated once people respond to real incentives. Lab research has also found seemingly trivial aspects of the laboratory protocol to be important. Paying participants of an experimental auction prior to the auction rather than afterwards reinforces the monetary incentive. Further, reminding the participants that bidding zero is acceptable mitigates any assumption that positive bidding is expected. Auction multiple goods at once also can be done, but designing demand-revealing auctions becomes more complicated.

Repeated trials in laboratory auctions can prove to be important. The repetition allows bidders to learn from market discipline, and therefore adjust their behavior to better match their real values and preferences. The repetition provides the researcher with valuable options for specific questions. The impact of information, for instance, can be estimated by observing behavior before and after the release of information. Similarly, the impact of marketing and taste can be estimated with repeated auctions. Posting the winning bid after each auction, for example, can change subsequent bidding behavior. Evidence suggests that posted prices influence bidders who are inexperienced or unfamiliar with the good in question. Posted prices in repeated auctions can eliminate the often-observed divergence between willingness to pay and willingness to accept in the case of market goods with close substitutes.

We have gained insight into how and why experimental design matters for valuation. Now consider some lessons we learned about the value of reduced risk from food borne pathogens, growth hormones, and irradiation.
Food Borne Pathogens

Naïve consumers underestimate the objective risk of food-borne pathogens but experience and information are influential in risk assessment. Evidence from laboratory auctions consistently suggests that people initially underestimate the risk of illness from food-borne pathogens (Hayes et al.). In these auctions, people indicated their willingness to pay to reduce the individual and combined risks of five different food-borne pathogens—Campylobacter, Salmonella, Staphylococcus aureus, Trichinella spiralis, and Clostridium perfringens. The underestimation of risk arises in experimental auctions that elicit both the option price and compensation measures of value for reduced risk from the food-borne pathogens. This design, as will the others discussed herein, used a second-price auction to reveal preferences for risk reduction sincerely.

Results generally indicate that people will pay significantly more for safer food after gaining auction experience and receiving the objective risk information on four of the five pathogens. Figure 1 shows the average pre- and post-information bid by pathogen. People initially underestimated the risk associated with these pathogens, but adjusted upward their estimate after experience and objective information. Research suggests that marginal willingness to pay decreases as risk increases—indicating that people place more weight on their prior beliefs than the objective information. While this general result appears to contradict the common finding that people overestimate the risks of low probability events, the observation may be consistent with the broader interpretation that people underestimate extremely low levels of risk and overestimate less extreme low risks.

Consumers seem to possess general preferences and values for food safety—rather than pathogen-specific. The risks from foodborne pathogens are relatively low compared to driving a
car or other everyday activities. It is not completely surprising that the lab suggests people do not significantly differentiate pathogens when valuing food safety. If people differentiate between specific pathogens, the values elicited for the combined risk should significantly differ from the values elicited for the individual pathogens. Results however suggest otherwise. Combined and pathogen-specific values were similar whether the person was acting on subjective or objective risks (see Figure 1). The general values arising from the laboratory auctions indicate that the average person was willing to pay approximately $0.70 per meal for safer food. If one could transfer these values to the U.S. population, the value of food safety could be at least three times the largest previously available estimates.

People are willing to pay a price premium to help them learn their preferences for safer food. The open question is whether the unique lab environment inflated the values for food safety. The $0.70 food safety premium exceeded some experts’ expectations of what people would pay in retail markets. One explanation might be the novelty of the experimental experience. Lab auctions are usually a one-time experience, and the concern is that people might experiment with their bids, bidding high because the costs of doing so are low. Theory suggests an alternative explanation for the high price premia—the novelty of the good. Many bidders have never experienced the goods up for auction, e.g., irradiated meat. In this case, theory says that a bid will reflect two elements of value—the consumption value of the good and the information value of learning how the good fits into his or her preference set. Preference learning would exist if people bid large amounts for a good because they wanted to learn about an unfamiliar good they had not previously consumed, because it was unique, or because it was unavailable in local stores. We tested these competing explanations by auctioning off three goods that vary in familiarity—candy bars, mangos, and irradiated pork, in four consecutive
experimental auctions over two-weeks. Their results suggest that preference learning seems to explain the high price premia. No statistical change in bids was measured for candy bars and mangos, whereas the price premia for irradiated pork dropped by 50% over the four sessions. These findings suggest people benefit from learning how an unfamiliar good fits into their preference ordering.

**Growth Hormones**

*Hormones appear to be acceptable with most people willing to purchase the treated food at a discount or regular price.* Information increases the acceptability but a few consumers exhibit a strong and persistent aversion to treated food. Laboratory auctions suggest that genetically engineered, or hormone treated, food products are acceptable to the majority of consumers. Using a split-valuation experimental auction, we elicited the willingness to pay to consume (or avoid consuming) leaner pork due to genetically engineered growth enhancers (Buhr et al.). The split-valuation auction separates the value of positive and negative attributes—the pros being leaner meat and the cons being hormone treatment. While results show the average consumer will pay to avoid hormone treatments, he is also willing to pay a greater amount for the improved quality of the meat due to genetically engineering. Findings imply the typical consumer has a positive net value for hormone treated pork.

Related studies confirm these initial findings. We used laboratory auctions to examine consumer preferences for somatotropin growth enhancer, either pst pork or bst milk, in Iowa, Arkansas, Massachusetts, and California (Fox et al.). The results for the pork valuation auctions suggest that the average person has a significant preference for the leaner pork yielded from the pst hormone treatment (see Figure 2). We find similar results when eliciting consumer preferences for milk produced by cows treated with somatotropin. More than 60 percent of
subjects indicated they would be willing to buy hormone produced milk at little or no discount (see Figure 3). Two additional results emerge. First, preferences for hormone treated products increased significantly as people become more informed about the treatment process. Second, a minority of people exhibited a strong and persistent aversion to genetically engineered pork.

**Irradiation**

*Irradiation appears to be acceptable with most people willing to pay a premium for irradiated food. Laboratory auctions indicate that consumers are not averse to using irradiation as a risk reduction technology.* We used laboratory auctions to elicit consumer willingness to pay for safer chicken breasts without disclosing the risk reduction technology. The result was compared to equivalent auctions in which the technology was disclosed to be irradiation with standard USDA information. Consumer willingness to pay was statistically equal in each case – approximately $0.80 per chicken breast. We also find that nearly 80 percent of the laboratory consumers preferred the irradiated chicken to the nonirradiated chicken if it was available for the same price (Shogren et al.). Thirty percent of the consumers were willing to pay a 10 percent premium for the irradiated chicken while 20 percent were willing to pay a 20 percent premium (see Figure 4). Results therefore strongly suggest that irradiation is an acceptable risk reduction technology to informed consumers and estimates of willingness to pay for irradiation more than covers the cost of commercial scale implementation.

*Negative reports concerning irradiation had a larger impact on consumer preference and values than positive reports—even when the negative reports were unscientific.* Evidence from the lab indicates that information significantly impacts consumer attitudes towards irradiation. We asked people to characterize their attitude to food irradiation as neutral, negative, or positive before and after reading information provided by the USDA. While the naïve respondents had a
distribution of attitudes of 15 percent negative, 63 percent neutral, and 22 percent positive, informed respondents had a distribution of 7 percent negative, 26 percent neutral, and 67 percent positive. We find that the influence extends to consumer willingness to pay (Fox et al.). Laboratory auctions examined how consumer willingness to pay for safer pork sandwiches was affected by alternative descriptions of food irradiation. Results follow intuition with favorable description of irradiation increasing willingness to pay and unfavorable descriptions decreasing willingness to pay. But when presented with both a favorable and unfavorable description, willingness to pay decreased—indicating that the negative portrayal dominated the positive (see Figure 5). This relative impact of the unfavorable description was evident even when the negative representation was a non-scientific account written by a consumer advocacy group. Such a result illustrates the incentive of partisan groups to promote unscientific claims for advancing an agenda that yields possible loss in general welfare.

**Concluding remarks**

Sometimes the most useful approach is also the most obvious one. We were interested in how consumers would react to food safety and new food technologies, so we set up experiments in which they indicated their preferences with real money and consumed the actual food products. One of the alternatives we considered was to use econometric techniques to tease out preferences from aggregate data collected for some other purpose. We decided that this method did not provide results we considered robust for our purpose. A second alternative was to conduct actual test marketing of the food in a retail store. Apart from the obvious cost of this exercise we were also concerned we would lose control of the scientific setting. For example, it is difficult to collect information on consumers within a store without influencing their behavior, nor could we control the availability and prices of close substitutes. A third alternative was to
survey consumers in person by mail or by phone. The absence of any reality check in these surveys, however, caused some participants to respond in unrealistic and biased manner.

After ten years of work on lab design, these experimental procedures have passed at least one critical test. We learned things about consumer behavior that would have been impossible to discover from any of the alternative procedures we might have used. One example stands out—when faced with both positive and negative information about new food technologies consumers react as if they had received only negative information.

We also learned that there are limitations to what can be achieved with experiments. We had hoped to collect refined information about the value of reductions in individual pathogens but we discovered that we could detect only general preferences about food safety. We discovered that subtle changes in the experimental procedure such as whether we paid the participants ahead of time, asked for willingness to pay or willingness to accept, or posted other bids could significantly impact the results. Finally, we discovered that bids for new foods or food processes can be unrealistically high when participants viewed them as a novelty. Over time as designs are refined, improved reality-based consumer experiments will continue to become an increasingly important method for applied economists.
For More Information


Figure 1. Average Bid to Exchange a Risky Sandwich for Riskless Sandwich

- Campylobacter
- Salmonella
- Staphylococcus aureus
- Trichinella spiralis
- Clostridium perfringens
- All pathogens

$Pre-Information bids$
$Post-Information bids$
Figure 2. Average Bid to Exchange Non-pst pork for pst pork

<table>
<thead>
<tr>
<th>State</th>
<th>Pre-Information Bids</th>
<th>Post-Information Bids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iowa</td>
<td>$0.4</td>
<td>$0.5</td>
</tr>
<tr>
<td>Arkansas</td>
<td>$0.6</td>
<td>$1.0</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>$0.7</td>
<td>$0.9</td>
</tr>
<tr>
<td>California</td>
<td>$0.5</td>
<td>$0.6</td>
</tr>
</tbody>
</table>
Figure 3. Average Bid to Exchange bst-Milk for non-bst Milk

$\begin{array}{c}
\text{Iowa} \\
\text{Arkansas} \\
\text{Massachusetts} \\
\text{California-urban} \\
\text{California-rural}
\end{array}$

$\begin{array}{c}
\text{Pre-Information bids} \\
\text{Post-Information bids}
\end{array}$
Figure 4. "Yes" to Stated Price for Irradiated Chicken (Percent)
Figure 5. Average Bid to exchange Meat for Irradiated Meat before and after Information

![Bar graph showing average bids for exchanging meat for irradiated meat with and without information.](image)