March 2016 APEC RR16-03

How Safety Recalls Affect Consumer Preferences for Eggs: An Experimental Analysis

Tongzhe Li
John C. Bernard
Zachary A. Johnston
Kent D. Messer
University of Delaware

Harry M. Kaiser
Cornell University

APPLIED ECONOMICS & STATISTICS

APEC Research Reports

Department of Applied Economics and Statistics • College of Agriculture and Natural Resources • University of Delaware

ABSTRACT

How Safety Recalls Affect Consumer Preferences for Eggs: An Experimental Analysis

Keywords: Consumer preferences; Laboratory experiments; Revealed preference; Food recall; Shell eggs

This study analyzes a unique data set to estimate how consumers respond to food-safety recalls. In August 2010, more than half a billion eggs were recalled because of a Salmonella outbreak. We conducted experimental auctions shortly before and after the recall outside the affected area. Our results suggest that the recall had a heterogeneous effect on consumers' willingness to pay for both conventional and organic eggs rather than causing a unidirectional shift, and in general, the recall did not lead to a statistically significant change in consumer preferences for shell eggs. This seemingly counter-intuitive finding coincides with prior empirical evidence regarding how safety recalls affect consumer behavior. In addition, we examined if providing additional positive information on the recall can mitigate the negative media information. Results show that it has a marginally significant positive effect on consumer willingness to pay for conventional eggs.

Suggested Citation for APEC Research Reports

Li, T., J.C. Bernard, Z.A. Johnston, K.D. Messer, and H.M. Kaiser. 2016. "How Safety Recalls Affect Consumer Preferences for Eggs: An Experimental Analysis." Applied Economics & Statistics Research Report, University of Delaware, RR16-03.

How Safety Recalls Affect Consumer Preferences for Eggs:

An Experimental Analysis

Tongzhe Li, John C. Bernard, Zachary A. Johnston, Kent D. Messer

University of Delaware

Harry M. Kaiser

Cornell University

This study analyzes a unique data set to estimate how consumers respond to food-safety recalls. In August 2010, more than half a billion eggs were recalled because of a *Salmonella* outbreak. We conducted experimental auctions shortly before and after the recall outside the affected area. Our results suggest that the recall had a heterogeneous effect on consumers' willingness to pay for both conventional and organic eggs rather than causing a unidirectional shift, and in general, the recall did not lead to a statistically significant change in consumer preferences for shell eggs. This seemingly counter-intuitive finding coincides with prior empirical evidence regarding how safety recalls affect consumer behavior. In addition, we examined if providing additional positive information on the recall can mitigate the negative media information. Results show that it has a marginally significant positive effect on consumer willingness to pay for conventional eggs.

JEL Classifications: D12; M31; Q13

Keywords: Consumer preferences; Laboratory experiments; Revealed preference; Food recall; Shell eggs

1. Introduction

Each year, approximately 48 million Americans contract a foodborne illness, resulting in 128,000 related hospitalizations and 3,000 deaths (Centers for Disease Control and Prevention, 2016). Consequently, the need for a better understanding of consumers' reactions to food scares has been recognized by the federal government, the food industry, and scientific and research communities (Böckera and Hanf, 2000; Lloyd et al., 2001, 2006; Hallman et al., 2009). A recall is an important response used to control outbreaks of foodborne illnesses, but it also has the potential to inflict serious damage on an industry.

A useful measure of consumers' responses to a food recall is its effect on their willingness to pay (WTP) for the product (Roberts, 2007). Ultimately, understanding those effects can improve the effectiveness of future food recalls in terms of preserving both consumers' welfare and the economic well-being of the food industry. Economists commonly use experiments to elicit WTP, but experiments that test the impacts of a food recall usually rely on a laboratory setting and hypothetical food-safety risks (Kaiser et al., 1992; Maruyama and Kikuchi, 2004) since institutional review boards (IRBs) are reluctant to approve projects that expose participants to significant health risks. Thus, the treatment used to test the impact of a food recall is purely hypothetical or provides information about a 'potential' risk unless the experiment can somehow include an actual recall. The study presented here benefits from an experiment on food preferences

that was conducted shortly before one of the largest egg recalls in U.S. history and that allowed us to design a follow-up experiment to examine the effects of an actual recall.

On August 13, 2010, Wright County Egg Farms of Iowa initiated a voluntary recall of shell eggs and followed shortly thereafter with an expansion of the recall on August 18, 2010. Two days later, the recall was once again expanded to include Hillandale Farms of Iowa. In total, more than 550 million eggs distributed throughout the United States (see figure 1) were identified as presenting a potential risk of *Salmonella* contamination. Naturally, the recall received extensive attention by local and national media outlets. We take advantage of this naturally occurring food-safety event, which provides a unique opportunity to examine consumer behavior in the midst of a situation in which the long-term health consequences of the recall were uncertain during the time of the experiment sessions.

Just prior to the recall, we had conducted an experiment involving adult participants in the mid-Atlantic region of the United States, which was not heavily affected by the subsequent recall, to investigate consumers' WTP for conventional and organic food products, several of which were shell egg varieties. After the recall was announced, we contacted the participants from that study about their willingness to participate in a follow-up study. Of the original 117 participants, 74 (63.24%) took part

in the follow-up study, which was conducted during the first two weeks of September 2010.[1]

Both the initial and the follow-up study used a Vickrey fourth-price auction to analyze the influence of the recall on consumer WTP for shell eggs. The post-recall study included two periods. In the first period, all participants answered questions about their demographic characteristics, food consumer habitats, and attitudes about food before bidding on several food products. In the second period, the participants were split into two groups. The first group was given "negative" information obtained from a media source consisting of then-current information about the recall. The second group was given a more "balanced" set of information as it contained both the negative information and additional positive information about the recall that could potentially mitigate decreases in WTP caused by their receiving the negative information. To gauge the participants' knowledge of the recall, questions about it were asked before the experimental information treatments. To determine if consumer WTP for eggs in the face of a recall differed by the eggs' attributes, participants bid on conventional and organic eggs.

Based on our experimental design, the study addresses several research questions. First, were consumers who resided outside the primary area affected by the recall

[1] The original recruitment of the participants made no mention of possible experiment sessions as they were planned only after the Salmonella outbreak occurred.

influenced by it? If so, to what extent? Second, did participants react heterogeneously to the recall, and what factors contributed to any such difference? Third, did participants react in opposit Finally, did the mitigating positive information about the recall result in a greater WTP compared to providing negative media information only?

2. Literature Review

Food scares have received much attention and generated numerous empirical studies of market-level data to determine the impacts of food recalls on demand and to assess existing and develop new food-safety policies (e.g., Maynard and Wang, 2011; Richards and Nganje, 2014). In addition, despite the constraint of having to use hypothetical treatments, economics experiments have been widely adopted to study consumer valuations regarding food safety (Dillaway et al., 2011).

There have been several significant outbreaks of foodborne illness in the United States in recent years. In 2006 when an outbreak of *Escherichia coli* was linked to spinach, the U.S. Food and Drug Administration (FDA) issued a warning to advise consumers not to consume bagged spinach. Arnade et al. (2009) constructed a retail demand model that measured the impact of the announcement on sales of fresh spinach over 68 weeks following the advisory. They concluded that overall retail expenditures for bagged spinach declined 20% while retail expenditures for all leafy greens fell by only 1%. Thomsen et al. (2006) found a similar result after studying a series of brand-specific recalls of frankfurters and luncheon meats due to an outbreak of *Listeria*

monocytogenes. As expected, sales of the impacted brand declined roughly 22% while other brands experienced no significant decline in sales. These studies provide evidence that recalls influence consumers' behavior so that they stop consuming potentially contaminated foods, but do not become unduly fearful of similar products that are not recalled.

Several studies found that food recalls had only a small impact on consumption and that consumer awareness can fade quickly. Dahlgran and Fairchild (2002), for example, found that a decline in consumption in response to a 1982 recall of chicken was small economically and that the adverse effects of the publicity dissipated quickly. In an investigation of consumers' responses to information regarding the safety of consuming meat, Piggot and Marsh (2004) showed that, while there have been large changes in demand in response to prominent food-contamination events, the average change in demand in response to food-safety concerns was small.

Many studies have used experimental economics to elicit WTP for food-safety attributes. In one of the earliest studies, Hayes et al. (1995) used an experimental auction and found that consumers would pay a premium for a reduction in risk associated with a food product. In a series of experimental auctions, Dickinson and Bailey (2002) found that U.S. consumers were willing to pay a premium for meat traceability, and Hobbs et al. (2005) observed a similar response in a study of Canadian consumers.

Studies show that consumer valuations of food safety depend heavily on effective communication (Grobe et al., 1999; Hastings et al., 2004; Huffman et al., 2004). Fox et al. (1994) for example, found that consumers who were ignorant of bovine somatotropin prior to participating in an experiment exhibited an immediate negative response to milk from cows treated with it. Once those participants in this study, were presented with a more complete and scientifically balanced product description, their negative bias was mitigated. Fox et al. (2002) later examined how various descriptions of food irradiation influenced consumers' preferences for irradiated pork in experimental auctions. As expected, they found that negative information deflated WTP while positive information inflated WTP. Interestingly, when participants received the balanced treatment that provided contradictory positive and negative information, the impact of the negative information outweighed that of the positive information and WTP values declined. Liaukonyte, Streletskaya, and Kaiser (2015) also found that negative information greatly outweighs positive information in impacting consumer WTP in the short run. However, in the long-run, most of the negative impacts on WTP wore out. Verbeke and Ward (2001) concluded that fresh meat advertising had only a minor impact compared with negative press. Later on, Messer et al. (2011) explored the issue of whether positive generic advertising regarding a food commodity could mitigate the potential impact of a negative media message regarding the safety of a food product in terms of bovine spongiform encephalopathy. They also found that the effect of positive

generic advertising, though not dominant, did mitigate the impact of the negative media information.

Our study represents an important opportunity because it captures data on an immediate, direct consumer response to an actual outbreak of a foodborne illness and large-scale recall. Using experimental economics, we analyze the impact of a food recall on consumers' WTP for the affected product and identify the factors that were most critical in shaping the consumers' reactions.

3. Experimental Design

This study uses data from experimental sessions conducted shortly before and after the recall of shell eggs in August 2010. The first sessions were conducted in July 2010 for a project that examined consumer WTP for local and organic food products. Participants were drawn from the mid-Atlantic region of the United States. In the study, participants bid on several varieties of conventional and organic shell eggs. Following announcement of the recall, the 117 participants in that study were contacted via e-mail regarding their interest in participating in what was referred to as a follow-up study. The 74 participants in the second sessions, conducted in September 2010, represented 63.8% of the original participants. None of the participants in either study were identified; their responses in the two experiments were matched using their answers to the demographic questions.

To avoid influencing the responses, the second set of experimental sessions, which were conducted after the recall, were presented solely as follow-up studies. After signing in and filling out consent forms, participants were seated at computers equipped with privacy shields. The experiment lasted about 45 minutes, and participants earned approximately $45 in cash or a combination of cash and food products of equal value. This relatively large payment was used to avoid potential initial-endowment effects since the initial endowment far exceeded both the maximum allowed bid and the market prices of the products offered in the experiment (Loureiro et al., 2003).

In both studies, a Vickrey fourth-price auction was used to collect the WTP data. This auction is a variant of the second-price auction proposed in Vickrey (1961) in which the three highest bidders win the auction and pay the fourth-highest price for the product. The initial and follow-up experiments began with questionnaires in which participants described their shopping habits and demographic characteristics. Next, they received written and verbal instructions regarding the food auction that emphasized that bidding their highest WTP was the best strategy. To further ensure that the participants understood the bidding process, we conducted practice rounds, which are commonly used in experimental auctions, and then displayed some of the results from the practice auction to illustrate explicitly how bidding true valuations was each participant's optimal strategy.

In an evaluation of experimental auction procedures, Lusk et al. (2004) noted a disadvantage of multiple-good valuations: subsequent valuations may be affected by a reduction in demand, also known as wealth effects, caused by the bidder's purchases in prior rounds. The authors noted that this potential problem can be accounted for using a randomly selected binding round, which prompts the participants to submit an optimal bid in each round. We used an approach followed in many experimental auctions (e.g., Hayes et al., 1995; Bernard et al., 2006 and Kanter et al., 2009; Liaukonyte, Streletskaya, and Kaiser, 2015) in which participants were notified that only one product from one of the rounds of bidding would be binding and that the product would be randomly selected. The purchased product and binding round were revealed to participants at the end of the experiment.

In the follow-up study after the egg recall, participants entered a WTP bid in each round for one dozen grade-A large shell eggs of various types, including conventional and organic. They were provided with printed information that defined the attributes of the egg products and additional information was provided by the experiment administrator regarding organic and conventional food attributes.[2]

After completing the first round, participants answered questions regarding their attitudes about food safety, including questions designed to determine how much they

[2] Chicken and strawberry products were also included in the bidding since participants had bid on them in the first study. It is reasonable to question if egg recalls can affect consumer preferences for chickens. Our experiments do not find supporting evidence.

knew about the August egg recall, and then answered additional questions regarding their food purchasing habits. In order to test if mitigating information has an effect on consumer behavior, prior to the final round, each participant was randomly presented with one of the two information treatments—negative information about the recall only or negative and positive information about it.

The negative information primarily consisted of details about the recall: the scope, the reason for it, and information about FDA inspections of the producers involved. The information is as follows:

Treatment 1 (Negative Information)

- On August 19 the FDA issued an URGENT Nationwide Egg Recall
- 550 million conventional eggs recalled from two large Iowa producers
    - Eggs distributed to much of USA
    - Largest ever egg recall
- *Salmonella* Enteritidis
    - Around 1,500 confirmed illnesses
    - No known deaths
    - Largest recorded outbreak
- The FDA is uncertain if all eggs have been accounted for
- Inspection reports released by the FDA noted numerous violations including rodents, rodent holes, live and dead flies, 8-foot high manure pile, and uncaged (escaped) hens tracking manure from pits into caged house area
- On site egg graders from the USDA did not notice problems

The positive information, which was designed to mitigate impacts of the negative information, stated, among other things, that the recall was voluntary. The more balanced information is as follows:

Treatment 2 (Balanced) Negative Information + Mitigating Information)

Negative

- On August 19 the FDA issued an URGENT Nationwide Egg Recall
- 550 million conventional eggs recalled from two large Iowa producers
    - Eggs distributed to much of USA
    - Largest ever egg recall
- *Salmonella* Enteritidis
    - Around 1,500 confirmed illnesses
    - No known deaths
    - Largest recorded outbreak
- The FDA is uncertain if all eggs have been accounted for
- Inspection reports released by the FDA noted numerous violations including rodents, rodent holes, live and dead flies, 8-foot high manure pile, and uncaged (escaped) hens tracking manure from pits into caged house area

Positive

- The egg recall is voluntary
- Recall represents less than 1% of all eggs
- Scientists estimate that on average only about 1 in 20,000 eggs might contain Salmonella
    - An average consumer would get a contaminated egg once every 84 years
- New FDA Egg Safety Rules started after the recall began will greatly reduce the risk of a similar salmonella outbreak in the future
- Eggs safe to eat if refrigerated, handled and cooked properly

Following the information treatment, the participants completed the final round of bidding, once again bidding on the same food products as in previous rounds.

3.2 Data

Table 1 summarizes the demographic characteristics of the respondents for the overall sample of 74 participants who participated in both experimental sessions. The average age was approximately 37 years, and 35% of the respondents had at least one child younger than 18 living with them. The participants were diverse in terms of ethnic affiliations—73% White (non-Hispanic), 9.5% African-American, 2.7% Hispanic, 1.4%

Native American, 6.8% Asian, and 6.8% other ethnic groups—and 62.2% were female. The respondents' education level was higher than the national average; 24.3% had a graduate degree, 39.2% had a bachelors' degree, 23% had some college education, and 10.9% had a high school diploma only. In terms of annual income, 24.3% respondents earned $24,999 or less, 12.2% respondents earned $25,000 to $34,999, 16.2% earned $35,000 to $49,999, 20.3% earned $50,000 to $74,999, 14.9% earned $75,000 to $99,999, and 12.2% earned $100,000 or more. In sum, our sampled population was representative of the U.S. population, but was slightly upscale compared to the general population in the mid-Atlantic region in which the experiments were conducted.

Table 2 summarizes the participants' responses to the survey questions regarding their purchasing habits and demographic characteristics. Seventy percent of the respondents were the primary shoppers in their households, and 6.7% were vegetarians. Health issues that affected their diets were reported by 14.9%. Most participants (89.2%) report being aware of the 2010 egg recall.

Table 3 summarizes consumer reaction to the recall. As expected, most of the individuals looked into more information (64%), checked eggs at home (62%), and/or told their friends and family (52%). On the other hand, less participants stopped eating (29%), buying (29%) or ordering (27%) eggs. In addition, only 17% of the participants three out all eggs. Table 4 represents the participant reported importance of elements from information treatments on their WTP. On a scale from 1 (not at all important) to 7

(extremely important), the importance of each element lies between 4 and 6. From the media information, participants believe that unsanitary conditions on egg farms are most important to their WTP, followed by failure of the USDA to notice egg safety issues. From the balanced information, unsanitary conditions on farms are also the most important, followed by the knowledge that eggs are safe if cooked correctly. Consumers also think it is important to know that less than 1% eggs were affected.

Factor analysis is utilized to aid in the identification of other potential influences on bidding behavior such as risk perception. Intuitively when examining the impact of a food recall on consumers' WTP for the affected food product, each consumer's inherent risk perceptions and tolerances will influence their bidding behavior. In an attempt to identify and measure each consumer's risk perception, an exploratory factor analysis was conducted. As shown in table 5, based on the factor loadings and selection of scale (Hair et al., 1998), RecallRiskF was identified as capturing a latent sense of risk associated with food recalls and InstitutionRiskF as describing a latent negative attitude towards the safety of the food industry. These two variables are then included in the econometric model described in the next section.

4. Analysis and Results

4.1 Model

We use a random effect Tobit model to estimate whether the egg recall shifted WTP. Selection of a two-limit random effect Tobit model is based on the format of the

experiments. In the auctions, participants' bids are confined to a range of \$0 to \$10. Therefore, we assume that a latent variable, *bid**, exists that represents each participant's true WTP for the eggs offered in the auction round. The latent variables are related to the observed bid_{ij} by

$$bid_{ij} = \begin{cases} 0 & \text{if } bid^*_{ij} \leq 0 \\ bid^*_{ij} = \mathbf{X}'_{ij}\boldsymbol{\beta} + \mathrm{u}_{ij} + \varepsilon_{ij} & \text{if } 0 < bid^*_{ij} < 10 \\ 10 & \text{if } bid^*_{ij} \geq 10, \end{cases} \quad (1)$$

where $\mathbf{X}_{\mathrm{it}}$ represents relevant independent variables, which include the demographic and recall-attitude variables; a dummy variable for observations after the recall, and a variable for the egg attributes. $\boldsymbol{\beta}$ is a vector of coefficients. u_{ij} is the between-entity error and ε_{ij} is the within-entity error.

We test three hypotheses: (a) WTP for shell eggs before and after the 2010 egg recall is identical. (b) WTP changes after the recall and the change is the same for all individuals. (c) WTP changes after the recall and the change is the same for both negative-only and balanced mitigating information. d) WTP changes are identical for conventional and organic eggs.

4.2 Results

Table 6.1 reports the results for participants' WTP for conventional and organic eggs after the recall, and Table 6.2 reports the results for the information treatments. A corresponding graphic demonstration is shown in figure 3.

The results for WTP are particularly interesting. Although a large number of participants were less willing to pay for shell eggs following the recall, a nearly equal number were more willing. After the information treatments, a roughly equal number of individuals were more and less willing to pay for eggs. However, in auctions for organic eggs in which the negative media information was provided, 38% increased their WTP and 25% reduced their WTP. The average difference in WTP under the negative information treatment appears to be larger for those whose WTP increased ($\left|\overline{Increased\ Bids} - \overline{Decreased\ Bids}\right| > 0$). The reverse is true for participants who received the balanced mitigating information treatment ($\left|\overline{Increased\ Bids} - \overline{Decreased\ Bids}\right| < 0$), particularly for organic eggs.

Figure 2 shows the results of the questions that identified participants' knowledge of the egg recall. The vast majority of participants (89.2%; 66 of 74), indicated that they were aware of the August 2010 recall of shell eggs. While participants could have falsely answered these questions to avoid appearing ill-informed, nearly 65% (48) answered correctly that *Salmonella* was the pathogen associated with the recall.

If the recall caused consumers to become concerned about the general safety of eggs, we would expect that all WTP bids collected after the recall would be less than the ones collected before the recall. The results of the random effect Tobit model, however, do not support this hypothesis.

Table 7 shows that the 2010 recall did not have a statistically significant impact on participants' WTP for either conventional or organic eggs. Nor did the negative and mitigating information treatments on conventional eggs, perhaps because most of the participants were already aware of the recall. However, after the participants were given the negative information, WTP for organic eggs increased marginally - $0.27 at a 10% significance level. Since the recall was only on conventional eggs, this result coincides with intuition. Consumer WTP for organic eggs was not sensitive to demographic variables other than for male and those who went to college, who bid more on average. For conventional eggs, women also bid less on average, while wealthier bid more.

Table 8 summarizes the results on the factors that contribute to the WTP difference before and after the 2010 recall. Age has a positive effect on the difference for organic eggs, so do variables that measure how much participants value food safety and have negative attitude towards the food industry. The findings are different for conventional eggs. Participants who went to college, those who have children in their households, and who had foodborne illness before are more sensitive to the recall and reported larger decrease in their WTP after the recall. Individuals who have negative attitude towards the food industry also have a larger decrease.

To examine the effect of the mitigating information on consumers' WTP for eggs, we use a two-limited Tobit model. The results in Table 9 show that the change in WTP is about the same after negative-only and mitigating information. Balanced information

had a marginally positive effect on WTP only for conventional eggs ($0.47 at a 10% level). However, we observe an interesting heterogeneity among different groups of participants. White, older and college educated consumers and those who have children on their households were more willing to pay for eggs after receiving the negative information about the recall. As expected, consumers who had foodborne illness before were more sensitive to the recall and to potential risks.

5. Conclusions

Due to increasing concern among U.S. consumers over food-safety issues and the perception that the number of food recalls is increasing (Hallman et al., 2009), a better understanding of how consumers react to a recall is an important goal for both the food industry and the federal government. This study investigates the impact of an actual food recall on consumers' WTP for the product associated with the recall.

We examine the effect of one of the largest egg recalls in U.S. history in August 2010 caused by an outbreak of *Salmonella* on consumers' WTP for conventional and organic eggs. In the study, we use data from an experimental auction designed to elicit consumers' food preferences that was conducted shortly *before* the recall in a follow-up experimental auction to examine the effects shortly *after* an actual recall event. The vast majority were aware of the participants in the follow-up experiment were aware of the recall and the majority could identify its source, an outbreak of *Salmonella*.

We use a random effect two-limit Tobit model to examine changes in consumers' WTP the effect of provision of a balanced (negative and positive) information treatment relative to a negative-only information treatment on WTP. Our results suggest that the shift in consumers' WTP was not unidirectional; instead, the recall rotated consumers' WTP, and in aggregate, the recall did not lead to a statistically significant change in consumer preferences for organic or conventional shell eggs. Surprisingly, there was little difference in the number of participants who reported relatively high and relatively low WTP both before and after the recall. This seemingly counter-intuitive finding coincides with some empirical evidence regarding how safety recalls affect consumer behavior (e.g., Arnade et al., 2009). In addition, it calls attention to a potential Hawthorne effect in which individuals may modify their behavior in response to their awareness of being observed (Adair, 1984). This effect can skew the results of experimental studies of consumer responses to food risks, which typically have found that food-risk information had a significant negative effect on participants' WTP (Kalaitzandonakes et al., 2004; Lusk et al., 2005; McCluskey et al., 2005).

This study also analyzes factors that contribute to consumer heterogeneity in terms of WTP for a recalled food. For consumers who had health issues related to food, the recall had a negative effect on WTP. Interestingly, we find no significant effect for most of the demographic variables, and provision of balanced information results in marginally significant higher WTP only for conventional eggs.

References

Adair, J.G. 1984. "The Hawthorne Effect: A Reconsideration of the Methodological Artifact." *Journal of applied psychology* 69(2): 334–345.

Arnade, C., Calvin, L., and Kuchler, F. 2009. "Consumer Response to a Food Safety Shock: The 2006 Food-Borne Illness Outbreak Of E. Coli O157: H7 Linked To Spinach." *Applied Economic Perspectives and Policy,* 31(4): 734–750.

Bernard, J.C., Zhang, C., and Gifford, K. 2006. "An Experimental Investigation of Consumer Willingness to Pay for Non-GM Foods When an Organic Option Is Present*." Agricultural and Resource Economics Review,* 35(2): 374–385.

Böcker, A., and Hanf, C.H. 2000. "Confidence Lost and—Partially—Regained: Consumer Response to Food Scares." *Journal of Economic Behavior & Organization*, *43*(4): 471–485.

Centers for Disease Control and Prevention. 2016. "*Estimates of Foodborne Illness in the United States."* http://www.cdc.gov/foodborneburden/index.html (January 4, 2016).

Dahlgran, R.A., and Fairchild, D.G. 2002. "The Demand Impacts of Chicken Contamination Publicity—A Case Study." *Agribusiness* 18: 459–474.

Dickinson, D.L., and Bailey, D.V. 2002. "Meat Traceability: Are U.S. Consumers Willing to Pay for It?" *Journal of Agricultural and Resource Economic*s 27(2): 348–364.

Dillaway, R., Messer, K. D., Bernard, J. C., and Kaiser, H. M. 2011. "Do Consumer Responses to Media Food Safety Information Last?" *Applied Economic Perspectives and Policy*, *33*(3): 363–383.

Fox, J.A., Hayes, D.J., Kliebenstein, J.B., and Shogren, J.F. 1994. "Consumer Acceptability of Milk from Cows Treated with Bovine Somatotropin." *Journal of Dairy Science*, *77*(3): 703–707.

Fox, J.A., Hayes, D.J., and Shogren, J.F. 2002. "Consumer Preferences for Food Irradiation: How Favorable and Unfavorable Descriptions Affect Preferences for Irradiated Pork in Experimental Auctions." *The Journal of Risk and Uncertainty,* 24(1): 75–95.

Grobe, D., Douthitt, R., and Zepeda, L. 1999. "A Model of Consumers' Risk Perceptions toward Recombinant Bovine Growth Hormone (rbGH): The Impact of Risk Characteristics." *Risk Analysis*, *19*(4): 661–673.

Hair, J.H., R.E. Anderson, R.L. Tatham and W.C. Black. 1998. "Multivariate Data Analysis. "New Jersey: Prentice-Hall Inc.

Hallman, W.K., Cuite, C.L., and Hooker, N.H. 2009. "Consumer Responses to Food Recalls: 2008 National Survey Report." Food Policy Institute. RR-0109-018. Rutgers: The State University of New Jersey.

Hastings, G., Stead, M., and Webb, J. 2004. "Fear Appeals in Social Marketing: Strategic and Ethical Reasons for Concern." *Psychology & Marketing*, *21*(11): 961–986.

Hayes, D.J., Shogren, J.F., Shin, S.Y., and Kliebenstein, J.B. 1995. "Valuing Food Safety in Experimental Auction Markets." *American Journal of Agricultural Economics,* 77(1): 40–53.

Hobbs, J.E., Bailey, D.V., Dickinson, D.L., and Haghiri, M. 2005. "Traceability in the Canadian Red Meat Sector: Do Consumers Care?" *Canadian Journal of Agricultural Economics,* 53(1): 47–65.

Huffman, W.E., Rousu, M., Shogren, J.F., and Tegene, A. 2004. "Who Do Consumers Trust for Information: The Case of Genetically Modified Foods." *American Journal of Agricultural Economics*, *86*(5): 1222–1229.

Kalaitzandonakes, N., Marks, L.A., and Vickner, S.S. 2004. "Media Coverage of Biotech Foods and Influence on Consumer Choice." *American Journal of Agricultural Economics*, *86*(5): 1238–1246.

Kanter, C., Messer, K.D., and Kaiser, H.M. 2009. "Does Production Labeling Stigmatize Conventional Milk?" *American Journal of Agricultural Economics,* 91(4): 1097–1109.

Kaiser, H.M., Scherer, C.W., and Barbano, D.M. 1992. "Consumer Perceptions and Attitudes towards Bovine Somatotropin." *Northeastern Journal of Agricultural and Resource Economics*, *21*(1): 10–20.

Liaukonyte, J., Streletskaya, N., and Kaiser, H.M.. "The Long Term Impact of Positive and Negative Information on Food Demand." *Canadian Journal of Agricultural Economics*, 63(2015): 539–562.

Lloyd, T.A., McCorriston, S., Morgan, C.W., and Rayner, A.J. 2001. "The Impact of Food Scares on Price Adjustment in the UK Beef Market." *Agricultural Economics*, *25*(2-3), 347–357.

Lloyd, T.A., McCorriston, S., Morgan, C.W., and Rayner, A.J. 2006. "Food Scares, Market Power and Price Transmission: the UK BSE Crisis." *European Review of Agricultural Economics*, *33*(2): 119–147.

Loureiro, M.L., Umberger, W.J., and Hine, S. 2003. "Testing the Initial Endowment Effect in Experimental Auctions." *Applied Economics Letters,* 10(5): 271–275.

Lusk, J.L., Feldkamp, T., and Schroeder, T.C. 2004. "Experimental Auction Procedure: Impact on Valuation of Quality Differentiated Goods." *American Journal of Agricultural Economics,* 86(2): 389–405.

Lusk, J. L., Jamal, M., Kurlander, L., Roucan, M., and Taulman, L. 2005. "A Meta-Analysis of Genetically Modified Food Valuation Studies." *Journal of Agricultural and Resource Economics*, 28–44.

Maruyama, A., and Kikuchi, M. 2004. "Risk-Learning Process in Forming Willingness-to-Pay for Egg Safety." *Agribusiness,* 20: 167–180.

Maynard, L., and Wang, X. 2011. "Context-Dependent BSE Impacts on Canadian Fresh Beef Purchases." *Journal of Food and Agribusiness Marketing* 23: 32–55.

McCluskey, J.J., Grimsrud, K.M., Ouchi, H., and Wahl, T.I. 2005. "Bovine Spongiform Encephalopathy in Japan: Consumers' Food Safety Perceptions and Willingness to Pay for Tested Beef." *The Australian Journal of Agricultural and Resource Economics,* 49: 197–209.

Messer, K.D., Kaiser, H.M., Payne, C., and Wansink, B. 2011. "Can Generic Advertising Alleviate Consumer Concerns over Food Scares?" *Applied Economics,* 43(12): 1535–1549.

Piggot, N.E., and Marsh, T.L. 2004. "Does Food Safety Information Impact U.S. Meat Demand?" *American Journal of Agricultural Economics,* 86(1): 154–174.

Richards, T.J., and Nganje, W. 2014. "Welfare Effects of Food Safety Recalls." *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie,* 62(1): 107–124.

Roberts, T. 2007. "WTP Estimates of the Societal Costs of U.S. Food-Borne Illness." *American Journal of Agricultural Economics,* 89(5): 1183–1188.

Thomsen, M.R., Shiptsova, R., and Hamm, S.J. 2006. "Sales Responses to Recalls for Listeria monocytogenes: Evidence from Branded Ready-to-Eat Meats." *Review of Agricultural Economics,* 28(4): 482–493.

Verbeke, W., and Ward, R.W. 2001. "A Fresh Meat Almost Ideal Demand System Incorporating Negative TV Press and Advertising Impact." *Agricultural Economics*, *25*(2-3): 359–374.

Vickrey, W. 1961. "Counterspeculation, Auctions, and Competitive Sealed Tenders." *Journal of Finance,* 16(1): 8–37.

Table 1. Summary statistics for demographic variables

Number of respondents	74
Average age	37
Variables	**Percentage of respondents**
Female	62.16%
Children under 18 present in household	35.14%
Income	
Less than $10,000	8.11%
$10,000 – $14,999	8.11%
$15,000 – $24,999	8.11%
$25,000 – $34,999	12.16%
$35,000 – $49,999	16.22%
$50,000 – $74,999	20.27%
$75,000 – $99,999	14.86%
$100,000 – $149,999	5.41%
$150,000 – $199,999	4.05%
$200,000 or more	2.70%
Education	
Less than High School	2.70%
High School	10.81%
Some College	22.97%
College	39.19%
Post Graduate	24.32%
Racial/Ethnical Identification	
White	72.97%
Black (African American)	9.46%
Hispanic (Latino)	2.70%
Native American	1.35%
Asian	6.76%
Other	6.76%

Table 2. Response summary to selected questions

Number of respondents	74
Variables	**Percentage of respondents**
Primary Shopper	
Yes	70.27%
No	29.73%
Vegetarian	
Yes	6.76%
No	93.24%
Aware of the Recall	
Yes	89.20%
No	10.80%
Health Issues that affect diet	
Yes	14.86%
No	85.14%

Table 3. Reaction to Recall Summary

When you first heard about the egg recall did you…	Yes	No
Stop Eating Eggs	19 (29%)	47 (71%)
Tell Friends and Family	34 (52%)	32 (48%)
Look for More Info	42 (64%)	24 (36%)
Throw Out all Eggs	11 (17%)	55 (83%)
Stop Buying Eggs	19 (29%)	47 (29%)
Check Eggs at Home	41 (62%)	25 (38%)
Stop Ordering Egg Dishes	18 (27%)	48 (73%)

Table 4. Importance of elements from information treatments on participants' WTP

Element	Information Treatment	
	Media	Balanced
Number of Eggs Recalled	4.8889	4.7368
Lack of Known Deaths	4.5000	4.6579
Unsanitary Conditions on Egg farms	5.3611[1]	5.4474[1]
Number of Confirmed Illnesses	4.6389	4.6316
Nationwide Scope of Recall	5.0000	4.8947
Failure of USDA to notice issues	5.1667[2]	5.1053[3]
Recall is voluntary		4.5789
Average Odds of Contaminated Eggs		5.0000
Eggs are Safe if Cooked		5.3684[2]
Less than 1% eggs affected		5.1053[3]
New FDA Rules		4.8158

All means are based of a scale of 1 (Not at all important) to 7 (Extremely Important)

Table 5. Factor Analysis Results Summary

Variable	Question Contents	Factor Loading	Score Coefficient
Factor 1 - Risk Associated with Food Recall (RecallRiskF)			
E2WorryChick	Very worried about the food safety of chicken	0.854	0.197
E2WorryEggs	Very worried about the food safety of eggs	0.829	0.128
E2NoBuyEggs	Not buying any eggs	0.821	0.166
E2AvoidEggs	Trying to avoid eating eggs	0.791	0.185
E2AvoidChick	Trying to avoid eating chicken	0.751	0.125
E2NoBuyChick	Not buying any chicken	0.734	0.177
E2NoEggDish	Not ordering egg dishes in restaurants	0.678	0.065
E2DontTry	I don't try foods again for a long time after a recall	0.577	0.065
E2SlowBuy	Other Consumers will be slow to buy eggs again	0.565	0.071
E2IndustryRegs	The food industry needs more safety regulations	0.496	0.064
Factor 2 - Distrust of Food Industry (InstitutionRiskF)			
nFDASafe	The FDA does a great job keeping the food supply safe	0.832	0.233
nUSDASafe	The USDA does a great job keeping the food supply safe	0.831	0.235
E2IndustryCares	The egg industry cares about consumers	-0.817	-0.246
nFarmersSafe	Farmers do a great job keeping the food supply safe	0.663	0.126
E2CompaniesSafe	Food companies don't care enough about food safety	0.584	0.114
nUSfoodSafe	The US food supply is the safest in the world	0.580	0.070
nTreatWell	Egg Producers treat chickens well	0.569	0.085
nStoresSafe	Stores do a great job removing recalled foods	0.535	0.077

*Questions drawn consumer evaluation of food safety issues where agreement with statement was rated from 1 to 7 (1-Strongly Disagree 7-Strongly Agree)

Table 6.1. Bid Difference After–Before Recall

	Bid Change	Obs	Mean
Conventional	Decreased	34	–0.597
	Increased	30	0.665
	No Change	10	0
Organic	Decreased	38	–1.178
	Increased	27	1.014
	No Change	9	0

Table 6.2. Bid Change Behavior After–Before Information Treatments

	Treatment 1			**Treatment 2**		
Bid Rd.3 – Rd.2	(Media Info)			(Mitigating Info)		
	Bid Change	Obs	Mean	Bid Change	Obs	Mean
Conventional	Decreased	8	–0.694	Decreased	11	–0.775
	Increased	8	0.994	Increased	11	0.548
	No Change	20	0.000	No Change	16	0.000
Organic	Decreased	9	–0.528	Decreased	13	–1.702
	Increased	14	0.821	Increased	15	0.533
	No Change	13	0.000	No Change	10	0.000

*A negative mean value represents a decrease in WTP from one round to the next

Table 7. Random Effect Tobit Regression Results for Conventional and Organic Eggs

Variables	Coefficient Estimates	
	Conventional	Organic
After No Info	-0.005	-0.052
	(0.080)	(0.113)
After Media Info	0.068	0.270*
	(0.107)	(0.153)
After Industry Info	-0.009	-0.212
	(0.105)	(0.149)
Male	0.331*	0.576**
	(0.174)	(0.257)
Children	0.010	0.095
	(0.196)	(0.279)
Age	0.009	0.015
	(0.007)	(0.011)
Income	0.003*	0.002
	(0.002)	(0.002)
College	0.121	0.571*
	(0.219)	(0.319)
Conventional Eggs Opinion	0.140**	0.155
	(0.068)	(0.097)
OrganicSafer	–	0.181*
		(0.100)
Had Foodborne Illness	-0.442***	0.371
	(0.172)	(0.245)
Constant	1.096	0.417
	(0.769)	(1.197)

Note: *10% significance level, **5% significance level, ***1% significance level.

Table 8. Tobit Regression Results on WTP Difference After-Before Recall

Variables	Coefficients Estimates	
	Conventional Eggs	Organic Eggs
Age	–	0.03**
		(0.01)
College	-0.60***	–
	(0.13)	
Children	-0.29*	–
	(0.14)	
Food Safer	–	0.25**
		(0.11)
Had Foodborne Ilness	-0.32***	–
	(0.11)	
ConEggOpinion	-0.85**	–
	(0.05)	
InstitutionRiskF	-0.15**	0.27*
	(0.06)	(0.14)

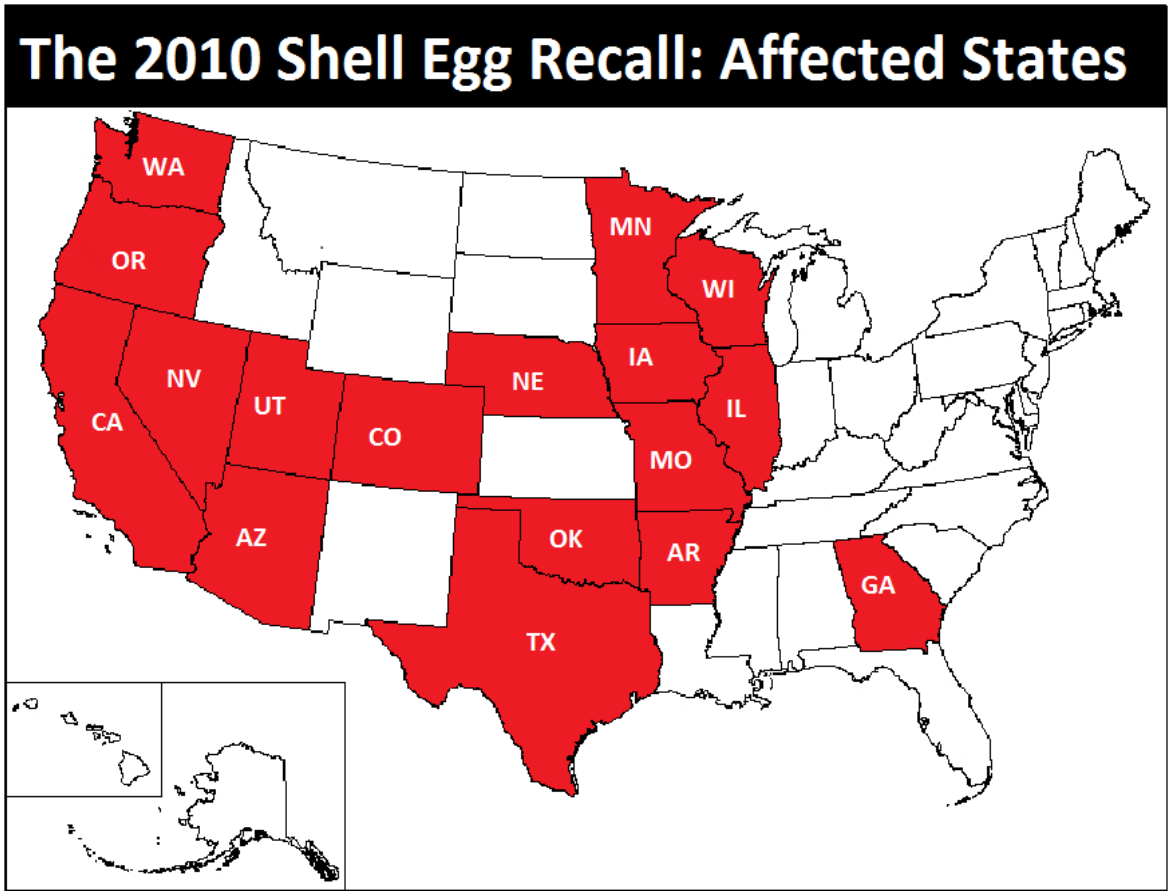
Note: *10% significance level, **5% significance level, ***1% significance level. Only variables that are significant at the 10% level are reported.

Table 9. Tobit Regression Results on WTP Difference After-Before Information

Variables	Coefficients Estimates	
	Conventional Eggs	Organic Eggs
Balanced Info	0.47*	–
	(0.25)	
Age	0.12*	–
	(0.01)	
White	0.28*	–
	(0.16)	
College	0.44**	–
	(0.18)	
Children	0.44***	–
	(0.16)	
Worry Safe	–	-0.44**
		(0.20)
RecallRiskF	–	0.42*
		(0.23)
InstitutionRiskF	-0.15**	-0.31*
	(0.07)	(0.16)
Had Foodborne Ilness	-0.28*	–
	(0.14)	
ConEggOpinion	0.19***	–
	(0.06)	
Balanced_worry safe	0.05***	–
	(0.01)	

Note: *10% significance level, **5% significance level, ***1% significance level. Only variables that are significant at the 10% level are reported.

Figure 1. Map of States Affected by the 2010 Shell Egg Recall



Source:
http://www.standeyo.com/NEWS/10_Food_Water/101109.salmonella.eggs.html
(Retrieved February 2016)

Figure 2. August 2010 Egg Recall Quiz Results

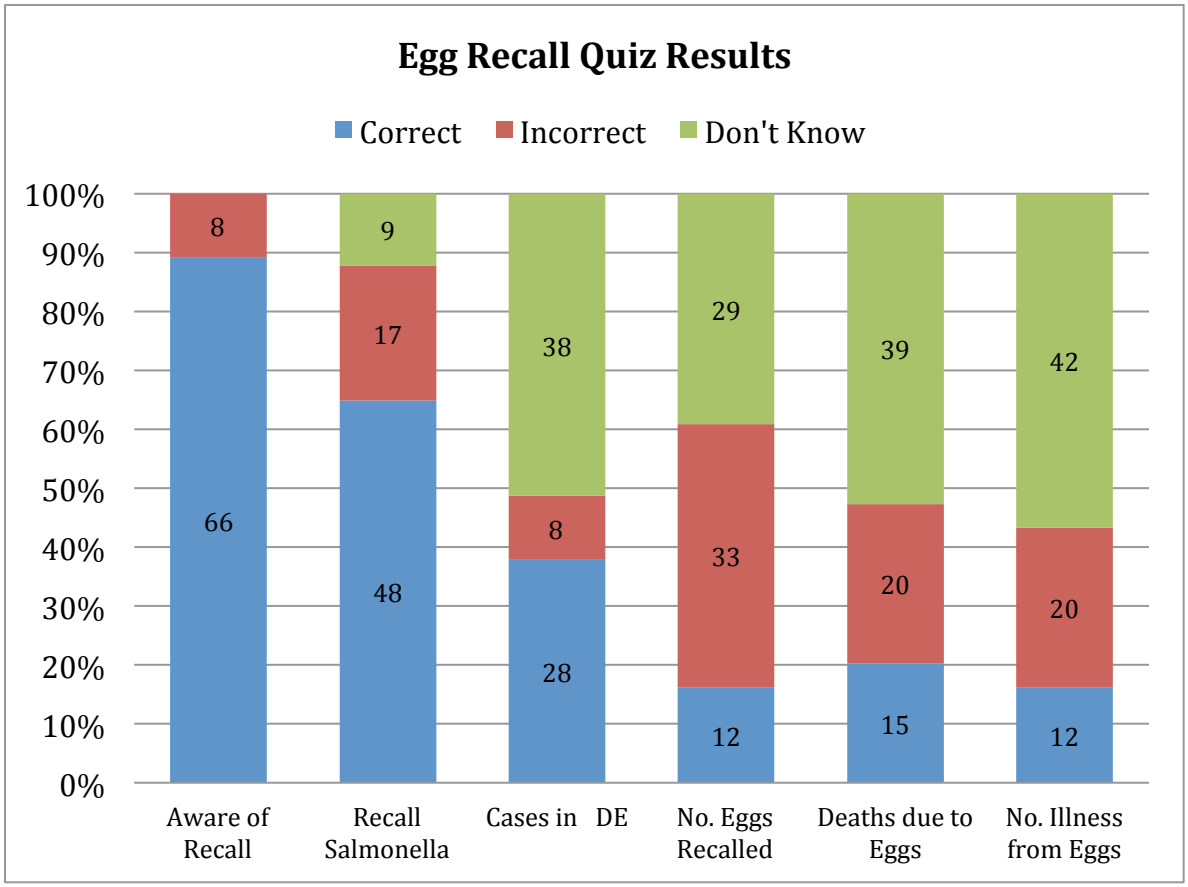
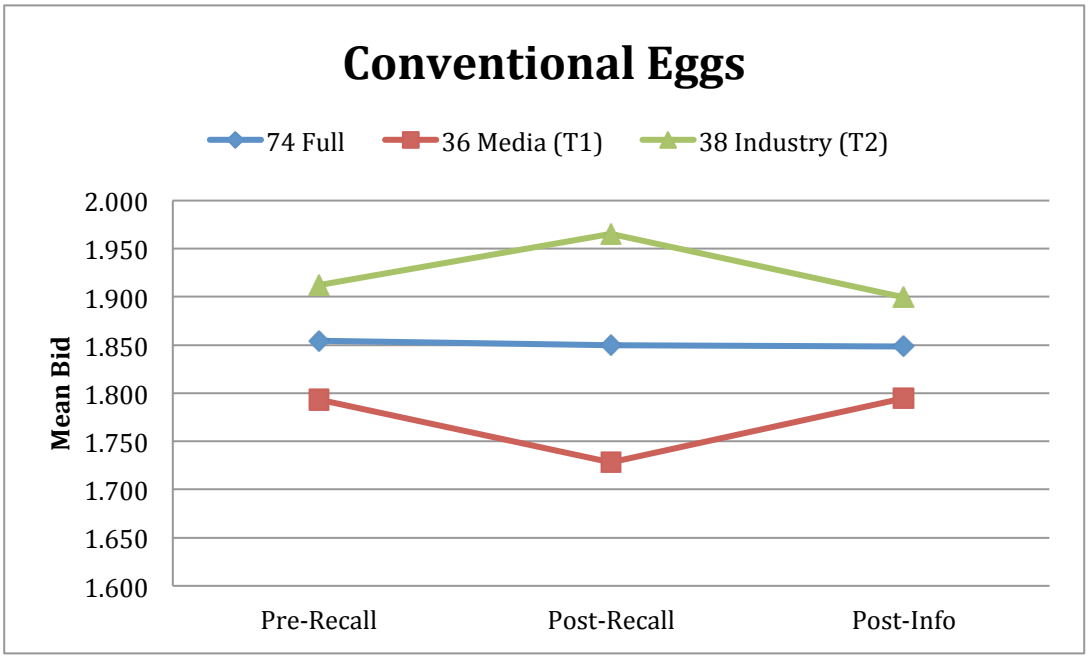
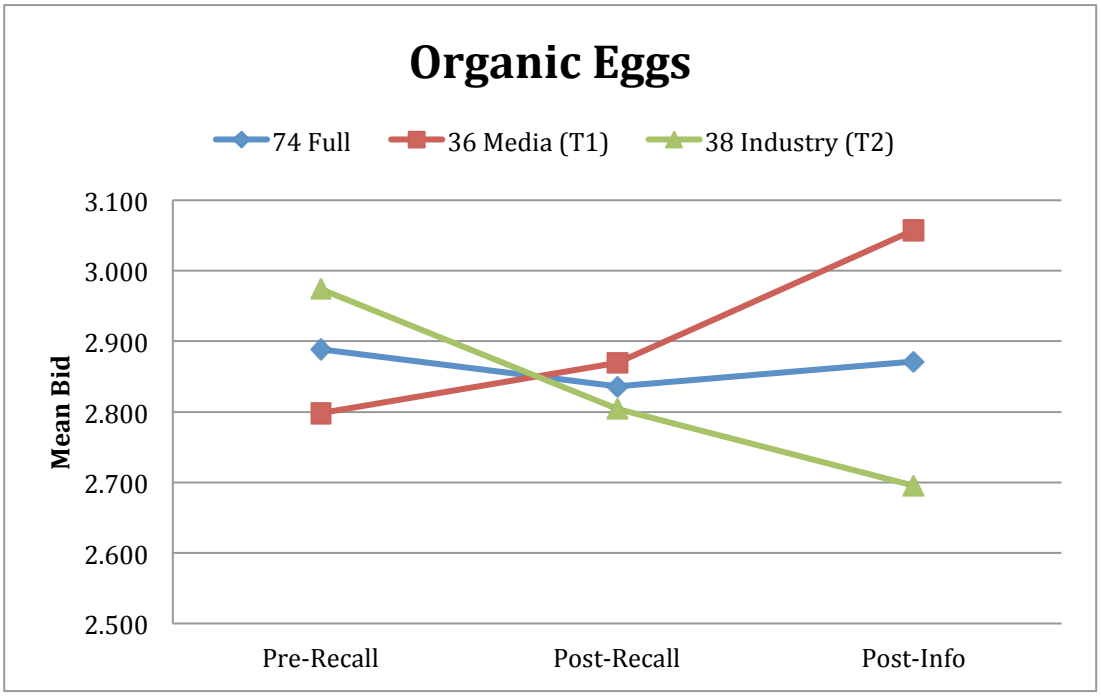


Figure 3. Bid Change Summary





The Department of Applied Economics and Statistics
College of Agriculture and Natural Resources
University of Delaware

The Department of Applied Economics and Statistics carries on an extensive and coordinated program of teaching, organized research, and public service in a wide variety of the following professional subject matter areas:

Subject Matter Areas

- Agricultural Policy
- Environmental and Resource Economics
- Food and Agribusiness Management and Marketing
- International Agricultural Trade
- Natural Resource Management
- Price and Demand Analysis
- Rural and Community Development
- Statistical Analysis and Research Methods

The department's research in these areas is part of the organized research program of the Delaware Agricultural Experiment Station, College of Agriculture and Natural Resources. Much of the research is in cooperation with industry partners, the USDA, and other State and Federal agencies. The combination of teaching, research, and service provides an efficient, effective, and productive use of resources invested in higher education and service to the public. Emphasis in research is on solving practical problems important to various segments of the economy.

The mission and goals of our department are to provide quality education to undergraduate and graduate students, foster free exchange of ideas, and engage in scholarly and outreach activities that generate new knowledge capital that could help inform policy and business decisions in the public and private sectors of the society. APEC has a strong record and tradition of productive programs and personnel who are engaged in innovative teaching, cutting-edge social science research, and public service in a wide variety of professional areas. The areas of expertise include: agricultural policy; environmental and resource economics; food and agribusiness marketing and management; international agricultural trade; natural resource management; operations research and decision analysis; rural and community development; and statistical analysis and research methods.

APEC Research Reports are published by the Department of Applied Economics and Statistics, College of Agriculture and Natural Resources of the University of Delaware.