Do rBST-Free and Organic Milk Stigmatize Conventionally Produced Milk?

Christopher Kanter, Kent D. Messer, and Harry M. Kaiser

Christopher Kanter is a graduate student in the Department of Applied Economics and Management at Cornell University. Kent D. Messer is an assistant professor in the Department of Food and Resource Economics at the University of Delaware. Harry M. Kaiser is a professor in the Department of Applied Economics and Management at Cornell University.

Selected Paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Orlando, FL, July 27-29, 2008.

Introduction

Ideally, the labeling of products based on the production methods used should improve consumers' welfare by offering more choices, while at the same time allowing producers to differentiate their products and potentially secure additional profits from consumers who are willing to pay (WTP) more for a commodity produced with "preferable" methods. However, producers often express concerns that labeling which promotes the benefits of one technique also casts the conventional commodity in a negative light. For example, milk producers are troubled with regards to labeling some milk free of recombinant bovine somatotropin (rBST), which is a synthetically produced version of the naturally occurring hormone bovine somatotropin (bST). Farmers use rBST to boost the milk yields of their dairy cows. Dairy organizations are worried that by labeling some milk "hormone free", consumers will stigmatize conventionally produced milk (also referred to in this article as "conventional milk") and therefore avoid purchasing the product.[1] In fact, as of January 1, 2008, the State of Pennsylvania no longer permits milk labels to include phrases such as "hormone free" or "contains no artificial hormones", and the State of Ohio is considering similar regulations (Martin 2007).

In ex ante studies of the impact of rBST on consumers' milk purchasing behavior, it was found that numerous factors would likely reduce the demand for milk produced by cows treated with rBST (Kaiser, Scherer, and Barbano 1992). These factors include the amount of information about rBST the consumers possessed, the quantity of milk they consumed, and how much they were concerned with milk prices. This study confirms that, despite assurances from the Food and Drug Administration with respect to the safety of rBST for human consumption, consumers are not convinced that the use of rBST in the general fluid milk supply is in their best interests.

The question of the desirability of rBST for consumers has become even more relevant as large fluid milk processors and retailers, including Wal-Mart, Kroger, and Dean Foods, have begun requiring suppliers to cease the usage of rBST on their dairy herds. Whether this decision was made with the interests of consumers in mind, or for some other reason, remains unclear. What is clear, however, is consumers are moving away from purchasing conventionally produced milk and towards alternative products that are viewed as safer and more attractive, mainly organic milk and rBST-free milk.

A shift in consumers' preferences away from conventional milk, which may or may not contain rBST, towards rBST-Free alternatives is likely to have a significant impact on fluid milk producers. Estimates of rBST adoption rates in the United States vary significantly – studies have found rates anywhere from 15% in Wisconsin herds to as high as 44% in New York and Texas herds (Barham, Foltz, Moon, and Jackson-Smith 2002). According to Monsanto, the largest producer of rBST, 17% of dairy farmers nationwide used rBST to some degree on their herds, and these herds accounted for 33% of the total dairy cows in the U.S. If fluid milk retailers and processors continue to push farmers to stop the use of rBST on their herds, there will likely be significant costs to the farmers as they transition back to dairy production techniques that do not utilize rBST (Forbes 2008).

In this research, we address the question of whether the move away from conventional milk (and towards milks labeled as free of milk hormones) by fluid retailers is being driven by consumers' bias against rBST or for some other reason. We consider the potential bias of consumers towards conventional milk in the context of psychological stigma, a phenomenon in which certain objects become viewed in a negative manner, even when no actual problems or health risks have been identified. The question is addressed in an experimental economics

setting by eliciting WTP measures for milk produced via different production methods and of varying fat contents from adult subjects. By eliciting WTP values in an experimental setting, we are able to observe directly the behaviors of experiment subjects, rather than using survey techniques to pose subjects hypothetical questions. Through altering the order in which participants bid for the different types of milk, we find that consumers are indeed willing to pay a premium for rBST-Free milk despite a lack of scientific evidence regarding harmful effects of rBST on human health. Given the premium consumers are willing to pay for milk produced without rBST, it is likely that the move towards rBST-Free milk by fluid retailers is indeed being driven by consumer preferences.

Literature Review

Early research involving rBST was mainly concerned with how quickly dairy farmers would adopt the new technology and exactly how much milk production would increase as a result of the drug's availability. Fallert et al. (1987) found that early adopters of rBST would likely see reduced unit costs and increased output, but that since rBST was a relatively easy technology to implement, gains for the early adopters would be short-lived. The long run implications would depend on how the U.S. Dairy Price Support Program would change to take into account the higher production per cow resulting from rBST usage. McGuckin and Ghosh (1989) likewise found that the U.S. government was unprepared to absorb the increased Commodity Credit Corporation purchases of milk that would result from rBST adoption, and that the technology either needed to be restricted or the support price for milk needed to be reduced. Tauer and Kaiser (1991) alternately proposed that when the rate of adoption for rBST is modeled endogenously (as a function of rBST profitability and learning) and voluntary supply controls were implemented, the decrease in milk prices resulting from rBST usage were not as severe as previous studies predicted when adoption rates were exogenously modeled. The consensus from the early production-side research generally agreed that introducing rBST to supplement milk production would tend to increase overall milk production and decrease prices to some degree.

While the supply-side effects of the introduction of rBST into dairy herds were well documented, the effects of increased milk production, as well as the effects of introducing an unfamiliar biotechnology into a familiar good, were less well known. A limited number of studies were made to gauge how consumers would react to the presence of rBST in their milk. In a survey of consumers in New York and Virginia, it was found that one-third and one-fifth of consumers, respectively, were concerned about the safety of rBST in their milk, and only 30% and 35%, respectively, believed that milk supplemented with rBST was safe to drink (McGuirk and Kaiser 1991). Additionally, 85% of the respondents in both states believed that milk containing rBST should be labeled as such, the implication being they were not fully convinced of the safety of rBST and would like the option of avoiding milk containing the hormone if they so chose.

In another study of consumer opinions regarding rBST, it was found that, even taking into account reduced prices from rBST-induced milk production expansion, there would likely be a decrease in milk consumption after the introduction of rBST (Kaiser, Scherer, and Barbano 1992). After adjusting for increased consumption due to lower prices, milk consumption was still projected to decrease by 1.6%. A key finding of this study, however, was that many consumers did not possess enough information about rBST to make judgments regarding its safety, and that a "proactive educational strategy should be pursued by the dairy industry to deliver explanations and facts about these technologies to consumers."

Consumers' reluctance to embrace rBST as a beneficial technology, as well as the presence of conflicting information regarding the safety of rBST in milk, bears many similarities to consumers' reactions to the availability of genetically modified organisms (GMOs) and other biotechnology in food items. There is a sizable segment of the population who believe that the reduction in prices brought about by GMOs and biotechnology in agriculture are not worth the risks to human health and the environment, even if these risks can be demonstrated to be insignificant. In one study of consumers' WTP for GMO food items, it was found that 35% of consumers were not willing to pay anything for food items containing any level of GMOs (Noussair, Robin, and Ruffieux 2004). The other 65% of consumers in the study were willing to buy GMO food items at a reduced price, leading the authors to conclude that a segmented market, with items being clearly labeled as either containing or not containing GMOs, would lead to the most efficient outcomes for consumers, despite the additional costs for producers to separate their products between those with and without GMOs. A separate study of the effects of labeling GMO products in Europe as compared to the United States came to a similar conclusion – in Europe, where GMO and non-GMO products have been labeled as such for years, the segmentation of the two product categories has been welfare enhancing for consumers; meanwhile in the United States, where labeling of GMO products is not required, the introduction of GMO labeling would likely be welfare enhancing with a small reduction in segregation costs (Lusk et al 2005).

This type of market segmentation is analogous to the current situation with regards to rBST in milk. Many consumers are unwilling to purchase milk containing rBST at any price, while some are willing to purchase milk containing rBST at a discount compared to rBST-Free and organic milk. A recent ruling by the Pennsylvania Agriculture Department prohibiting milk producers from advertising their milk as rBST-Free highlights this tendency to discount the value and safety of milk produced with rBST. According to Dennis Wolff, Pennsylvania's Secretary of Agriculture, the ruling was made as a result of complaints that the hormone free label implies to consumers that there is a "nonsafe dimension" to conventional milk that would lead consumers to conclude that there is "'good' milk and 'bad' milk" (Martin 2007; USA Today 2007). Consumers continue to insist that they would like the option to avoid rBST in their milk, while the government maintains that conventional milk produced and milk produced without rBST are essentially the same.

It seems that consumers share many of their biases for GMO foods with rBST; the question of why this bias is present remains unclear. There is a plethora of information available regarding the safety of rBST, and much of it conflicts. In a study of decision making with divergent risk information, it was found that decision makers will put more weight on high-risk information than on low-risk information (Viscusi 1997). Another study by Fox, Hayes, and Shogren (2002) on consumers' reactions to food irradiation came to a similar conclusion – consumers' WTP for irradiated pork decreased more after exposure to negative information than it increased from exposure to positive information regarding the pork. Additionally, it seems that consumers are not adept at assessing food risks; in an experimental study of consumers' WTP for increased food safety, it was found that participants were likely to rely more on personal experience than scientific information when determining their values for avoiding illness (Hayes et al. 1995). This could very well be occurring in the case of rBST. With the ease of acquiring information from the internet, it can be difficult for potential milk consumers to separate reliable information about rBST and human health risks from less reliable sources, especially since Canada, Japan, and a number of countries in Europe currently ban the use rBST entirely. In a

situation such as this, with conflicting risk information, consumers may be putting more weight on the high-risk information (or existing personal beliefs) than on the more reliable low-risk information and adjust their purchasing behavior accordingly.

A topic related to the emphasis on high-risk information is the concept of stigma. Stigma, originally a psychological term, can be thought of as "a negative feature that typically pervades and dominates an otherwise acceptable entity (Rozin 2004)." Objects that are associated with a stigma normally share several characteristics. Stigma is passed on via direct contact with a contaminated object in a phenomenon known as contagion (Rozin, Millman, and Nemeroff 1986). Another key element of stigma, at least in Western societies, is that people tend to describe their feelings of revulsion for a stigmatized object in terms of how it impacts their health (as opposed to an object possessing some innate evil characteristic). In other words, people "medicalize" the negative feelings they experience for a contaminated object (Rozin 2004).

There are other key aspects to stigma. However, with regards to the possible stigmatization by rBST, the properties of contagion and medicalization of risk are especially salient. Milk is considered a healthy, desirable food to consume until the milk undergoes contact with rBST via contagion, despite the lack of substantial chemical change in the milk. People who see the addition of rBST to milk as a negative action tend to cite possible negative health consequences to humans and cows as justification for their views. Both of these properties play into the possible role of production labeling in stigmatizing conventionally produced milk. By distinguishing between conventionally produced and rBST-Free milk through the use of labeling, milk retailers can potentially tap into consumers' fears regarding the safety of conventionally produced milk in order to charge higher prices for rBST-Free milk.

Conventionally produced milk shares several of the characteristics of goods that are considered to be stigmatized. In this article, we will expand upon these qualitative properties of rBST stigmatization and show experimentally that consumers' psychological bias against conventional milk also has economic implications. In the next sections, we describe the design and results of our experiment and show that consumers' negative feelings towards rBST reduce their WTP for milk produced by cows treated with hormones.

Experimental Design

In order to determine whether the presence of rBST stigmatizes milk to consumers, a three-part experiment was designed (Table 1). Part A consisted of rounds designed to familiarize participants with the Becker-DeGroot-Marschak (BDM) (1964) bidding mechanism, where induced "cash values" were used. Advantages of the BDM mechanism for private goods include its incentive compatibility and demand revealing properties, making it ideal for this experiment (Irwin et al. 1998)**.** Part B also used the BDM mechanism and had subjects submit bids to purchase a pencil. Finally, Part C used the BDM mechanism to elicit WTP values for milk produced using three different production techniques (conventional milk, rBST-Free milk, and organic milk) and three fat types (0% skim, 1% lowfat, and 3.25% whole). Each experiment session lasted approximately one hour, and the average earnings were $15.

For each part of the experiment, participants received written instructions (Reviewer Appendix) with an oral explanation and were provided a chance to ask questions. Subjects were seated randomly at computers that were equipped with privacy shields, and no communication was permitted between subjects. Experiment data was collected using Excel spreadsheets programmed in Visual Basic and all information provided was kept confidential. At the

completion of the experiment, participants were asked to fill out a questionnaire regarding their milk purchasing behavior and knowledge, their attitudes towards risk, and general demographic information.

Part A consisted of 5 rounds. At the start of each round, *t,* participants were provided with a $5 initial balance, Y_t, and were presented with a "cash value", V_t, of $1, $2.50, or $4 (Table 1). Participants were then asked to record the highest amount that they would be willing to pay to receive that cash value – we refer to this amount as their "bid", B_{it}. Once all participants recorded their bids, a price, C_t, was drawn from a random numbers table containing values of $0 to $4.99 and announced to all the subjects.

As described by Irwin et al. (1998), utility maximizing subjects in this mechanism submit a bid, given initial income, Y^0, that maximizes:

$$(1)\ EU = \int_0^B p(C)U(Y^0 + E + V - C)dR + \int_B^E p(C)U(Y^0 + E)dR\,.$$

Examination of the left side of equation (1) shows that it is not in the best interests of a participant to bid below her WTP. In the event that the randomly drawn price falls between her actual WTP and stated WTP, the participant loses the opportunity to earn a larger profit. The logic behind not overstating WTP is shown in right side of equation (1). Participants would not want to submit a bid higher than their actual WTP – if a participant bids higher than their actual WTP, and the randomly selected price is between her actual WTP and stated WTP, the participant could potentially end up paying more than their value for an object. The derivative of equation (1) with respect to B leads to:

$$(2)\ \frac{dEU}{dB} = p(B)[U(Y^0 + E + V - B) - U(Y^0 + E)] = 0$$

Since the probability of the bid being equal to the price ($p(B) > 0$), a participant who is maximizing their utility will submit bids equal to value ($B=V$), demonstrating the incentive compatibility of the mechanism.

Each round produced two possible outcomes for the participants, depending upon their bids and the random price. If the participant's bid was greater than or equal to the random price ($B_{it} \geq P_t$), the participant purchased the cash value at the randomly selected price yielding a payoff of $Y_t + \pi_t - P_t$. However, if the participant's bid was less than the price ($B_{it} < P_t$), then the participant just retained the initial balance, Y_t.

The primary objective to Part A was to give subjects an opportunity to learn how the BDM mechanism operated. To this end, the procedures followed those of Noussair, Robin, and Ruffieux (2004) as participants were informed that their best strategy for each round was to place a bid equal to the cash value ($B_t = \pi_t$), as bidding an amount equal to the cash value results in the participants receiving the highest possible payoff for each round, regardless of the price. To reinforce this message, at the conclusion of each round of Part A, participants were given the chance to view all of the bids from each subject in the round, as well as the random price and the payoff outcomes. These bids were displayed on a screen at the front of the laboratory listed in order from the lowest bid to the highest bid without identifying which participants had submitted which bids. The subjects could thus see how closely their own strategy for bidding matched the optimal strategy that would yield the highest possible earnings.

Part B of the experiment served as a transition from Part A to Part C. In part A, participants are asked to bid on an exogenously selected cash value which, for some participants, can be a difficult concept to understand. Part B provides a bridge between Part A and Part C, so that participants can accustom themselves to implementing the BDM mechanism with a real-

world object for which each person has a unique, endogenously-selected value. In Part B, participants were asked to bid on a Ticonderoga-brand pencil (Table 1). Part B consisted of a single round of bidding, participants were given an initial balance of $0.50, and they were asked to bid between $0 and $0.50 for a pencil. Once all bids were submitted, a price between $0 and $0.49 was determined using a new random numbers table. As in Part A, if the bid was equal to or greater than the price, the participant received the pencil, but had the price subtracted from their initial balance. If the bid was lower than the price, the participant did not receive a pencil, but instead retained the entire initial balance of $0.50. At the end of the round, pencils were handed out to participants where appropriate.

For Part C, participants were given an initial balance of $5 and asked to submit a bid[2], ranging from $0 to $5, for nine different food items that would be presented sequentially. Participants were told that after submitting bids for each of the nine food items, they would learn which item and corresponding bids would be used to determine the final payout. This selection was done randomly, and thus, subjects were advised to submit bids for each food item as if it would be the one used to determine cash earnings.

The nine choices of Part C were presented in three flights based on production type – conventional, rBST-Free, and organic milk (Table 1). For each flight of milk, participants were given a three-column taste-testing template (Figure 1), along with three five-ounce tasting cups filled with 0% skim milk, 1% lowfat milk, and 3.25% whole milk. Participants were asked to taste each milk type and afterwards to answer two questions regarding the quality and freshness of each sample.[3]

To mimic the information provided in a grocery store setting, subjects were given handouts containing nutritional and production information for each flight of milk. Importantly, the nutrition information differed only on fat type and not on the production technique (Figure 2). The information handout for rBST-Free milk included a statement that the milk "does not contain artificial growth hormones" and the organic milk include a statement that the milk was "produced without the use of antibiotics, synthetic growth hormones, or pesticides". The wording for both statements came directly from the labels on the cartons of the original milk. The information sheet for conventional milk did not make any claims regarding the production process.[4] To avoid and packaging or branding effect, all nine milks were served in a clear pitcher, and subjects did not see the brand of milks used in the experiment.

Once all nine bids were placed and the milk type was selected, a price was drawn randomly, and the quarts of milk were distributed where appropriate.

Results

The experimental results show support for a stigma effect on conventional milk. However, when looking at average WTP for milk of a given fat type, this stigma effect is difficult to detect. For example, participant's average willingness-to-pay for skim milk produced conventionally, produced without rBST, and produced using organic production practices are $1.06, $1.08, and $1.35 respectively (Table 2). Contrary to our expectations, participants were actually willing-to-pay a similar value for conventional milk and rBST-Free milk. However, the stigma effect becomes apparent when we separate WTP by the order in which the milks were presented during Part C of the experiment. As seen in table 3, when conventional milk was the first milk tasted and considered for purchase by participants, the mean WTP offer was $1.28. Recall that subjects were not aware of what the other products were going to be, therefore, this measurement of WTP with the first flight of milks is relatively free of direct comparisons to other milk products.

However, when conventional milk was presented last (the third of three flights), the subjects were aware of the complete set of products, had the chance to taste all of them, and, much like in a modern grocery store, were presented with a wide variety of milk choices, average WTP values fall to $0.61. On the other hand, the trend is very different for rBST-free, where the values generally increased. For example, when rBST-Free milk was presented first, the mean WTP was $1.05; when the same milk was the presented last, the mean WTP increased to $1.15.

The results also show some interesting behavior with regards to WTP bids of zero. A WTP bid of zero indicates that a participant would not be willing to buy a given quart of milk at any price. This type of shunning of products is a common behavioral response to stigmatized objects, although a zero bid is not necessarily indicative of the presence of stigma in all cases. Our results indicate that a similar number of participants were willing to pay some amount for conventional and rBST-Free milk. For example, with regards to conventional milk presented last, 51% of participants were willing-to-pay some positive amount, while 55% of participants were willing to pay some positive amount for rBST-Free milk. Organic milk, however, shows a much lower number of zero bids – 86% of participants were willing to pay some non-zero amount for a quart of organic milk. These results suggest that participants view conventional and rBST-Free milks as comparable goods, with organic milk considered superior to both. The number of non-zero bids may also lend credence to the stigma effect shown by the difference of the mean WTP when milk is presented first as compared to last. For example, organic milk shows both consistently high WTP values and low numbers of non-zero bids (Figure 5), while milk produced with (without) rBST show mean WTP values that decrease (increase) substantially when the milk is presented last instead of first (Table 3), and at the same time exhibiting somewhat similar, lower (as compared to organic milk) numbers of non-zero bids (Figures 3 and 4).

To obtain our WTP values, participants were asked to place bids between $0.00 and $5.00. Hence, we utilize a two-limit tobit model to explain our data. Participants gave WTP values for nine quarts of milk; the regression is run as a single equation, with WTP as the dependent variable and with dummy variables to indicate the fat content of the milk, as well as the method used to produce the milk. Dummy variables were also used to indicate whether a participant was the primary shopper in the household, to indicate whether the participant was aware of the availability of rBST-Free and organic milks prior to the experiment, and to indicate gender. Additional variables included the values for participant's answers to the questions asked during the taste tests, how thirsty they were before tasting the milk samples, the frequency with which participants purchase milk produced with and without rBST and organic milk, a variable for risk preference, the number of children under ten in the participant's household, highest level of education obtained, income, and a BDM mechanism variable indicating the participant's deviation from the induced value in our final practice round during Part A.

Most importantly for our analysis, a dummy variable was included to indicate the order in which milks produced using the different production techniques was presented. Conventional milk is labeled as *C*, rBST-Free milk is labeled as *R*, and organic milk is labeled as *O*. The order of presentation is indicated by the order of the letters coded. For example, conventional milk presented before rBST-Free milk is coded as *CR*, organic milk presented before conventional milk is coded as *OC*, and so on. For a given experiment session, if conventional milk was presented before rBST-Free milk, then the value of *CR* for all the bids during that session would be coded as one, and conversely, the values for *RC* (rBST-Free milk presented before

conventional milk) would be coded as a zero. Using this naming convention, we end up with six dummy variables to indicate the order in which milks were presented.

The full model is broken down into six equations in order to isolate potential stigma effects on the WTP for milk.[5] The breakdown of the equations is as follows: since each participant gave WTP values for three milk products with varying fat levels produced using three different methods, each of the six equations utilizes the bids for only a single production technique as the dependent variable. This results in two nearly identical equations for each production method, with the only differences being the treatment order dummy variable and the taste test data used. For example, there are two equations for participants' WTP for milk produced with rBST. They are

$$(3)\quad WTP_C = \alpha + \beta_1 * TASTE\_R + \beta_2 * TASTE\_C + Full\ Model + \beta_3 * RC + \varepsilon$$

and

$$(4)\quad WTP_C = \alpha + \beta_1 * TASTE\_O + \beta_2 * TASTE\_C + Full\ Model + \beta_3 * OC + \varepsilon,$$

where *TASTE_C*, *TASTE_O*, and *TASTE_R* represent the taste testing data for milk produced with rBST, without rBST, and organic milk, respectively, and *RC* and *OC* represent the order variables – *RC* indicating milk produced without rBST presented before milk produced with rBST, and *OC* indicating organic milk presented before milk produced with rBST. Taste test data for milk produced using the production technique that is not being considered in the treatment order variable is omitted in each equation.

By setting up our equations in this manner, we are able to isolate the effects of varying the order of tasting and bidding in the different treatments on the participants' WTP values. If participants are willing-to-pay a significantly lower amount for conventional milk after they had tasted and considered purchasing rBST-Free milk *and* they did not lower their WTP for rBST-Free milk when it was presented after conventional milk, then we have strong evidence that rBST-Free milk stigmatizes conventional milk.

WTP for Conventional Milk:

Equations (3) and (4) were the regressions run on WTP for conventional milk (Table 3). In equation (3), the marginal effect coefficient for the order dummy variable *RC* is negative[6] (-0.427) and significant ($t = -2.30$, $p = 0.021$) at the 5% level. The negative value for the coefficient indicates that participants are willing-to-pay $0.427 per quart less for conventional milk after tasting and being exposed to information regarding rBST-Free milk (i.e. rBST-Free milk "Does not contain any artificial growth hormones"). These results suggest that experiment participants view conventional milk more negatively after tasting and considering rBST-Free milk. In addition, the differences in taste test scores between the two milks are not statistically significant (in fact, conventional milk scored slightly higher overall). The very act of tasting and making a purchase decision on conventional milk after becoming aware of rBST-Free milk lowers participants' WTP for milk produced with rBST, and supports the idea that conventional milk is a stigmatized good.

The presence of a negative and significant value for the coefficient on *RC* is not sufficient to infer a stigma effect on conventional milk. We must also observe a lack of significance on the other order variables; otherwise, the only conclusion we may reach is the order of taste testing affects participants' WTP for milk. In equation (4), we find that the coefficient on the order variable *OC* is positive (0.053) and not statistically significant ($t = 0.25$, $p = 0.802$). Therefore, we find no evidence that the order in which participants are presented conventional milk and organic milk affect their WTP for conventional milk.

Several other variables besides the order dummy variables bear mentioning. In equation (3), the coefficient for the dummy variable for 1% lowfat milk (*FAT1*) is positive (0.124) and significant (t = 2.09, $p = 0.036$) at the 5% level. In other words, subjects are willing to pay \$0.124 more for 1% milk relative to our baseline, skim milk. In equation (4), the coefficient for the same variable was also positive (0.108) and significant at the 10% level (t = 1.82, $p = 0.069$). These results are not surprising, as 1% lowfat milk is the most popular fat content of milk commonly available for purchase; it appears that some consumers would be willing-to-pay more for lowfat milk than for skim milk. The variable indicating whether the participant is their household's primary shopper (*PRIMSHOP*) has a positive coefficient and is significant at the 5% level for both equations (3) and (4), suggesting that the household member who normally does the shopping is typically willing-to-pay more for conventional milk than those who do not. The coefficient on the variable for risk preference[7] (*RISKP*) is positive in both equations (3) and (4), and is significant at the 5% and 10% level in equations (3) and (4) respectively (Eq. (3) t = 2.02, $p = 0.043$; Eq. (4) t = 1.88, $p = 0.060$). In fact, the coefficient for *RISKP* is positive and significant in all six equations; judging by these results, one can conclude that participants who are concerned about the risk factors in the questionnaire are willing to pay more for milk in general, regardless of the production method. The coefficient on the dummy variable indicating the participant was aware of the availability of organic milk previous to entering the experiment (*ORGAV*) is negative and significant at the 1% level in both equations – people who know of the existence of organic milk have lower WTP values for rBST-Free milk produced than participants who are not aware. Additionally, the variable for the answer to the taste test question for conventional whole milk (*TASTE_CWHOLE*) has a positive coefficient in equation (3) (0.119) and is statistically significant at the 1% level (t = 2.57, $p = 0.010$).

In equation (4), the coefficients on the variables for the answers to the taste test questions for organic lowfat milk (*TASTE_OLOW*) and organic whole milk (*TASTE_OWHOLE*) are negative and positive, respectively – both are significant at the 5% level (*TASTE_OLOW*: t = -2.28, p = 0.022; *TASTE_OWHOLE*: t= 2.02, $p = 0.044$). These results indicate that, for equation (3), participants are willing-to-pay more for conventional milk in general if they enjoy conventional whole milk. For equation (4), participants are willing-to-pay less for conventional milk the more favorably they view the taste of organic lowfat milk. Alternatively, they are willing to pay more for conventional milk the more favorable their opinion of organic whole milk. Variables for income, gender, number of children under ten years old, and level of thirst before the experiment are not statistically significant.

WTP for rBST-Free Milk:

The regressions on WTP for rBST-Free milk are very similar to Equations (3) and (4) and the results are shown in table 5.

(5) $WTP_R = \alpha + \beta_1 * TASTE\_C + \beta_2 * TASTE\_R + Full\ Model + \beta_3 * CR + \varepsilon$

and

(6) $WTP_R = \alpha + \beta_1 * TASTE\_O + \beta_2 * TASTE\_R + Full\ Model + \beta_3 * OR + \varepsilon.$

In equation (5), the coefficient on the order dummy variable *CR* is positive (0.358) and statistically significant (t = 1.99, $p = 0.046$) at the 5% level. This coefficient can be interpreted in a similar manner to the coefficient on the order dummy *RC* in equation (3). If participants express a lower WTP for conventional milk after tasting and considering purchasing rBST-Free milk, as discussed earlier, it stands to reason that participants would also be willing to pay more

for rBST-Free milk after tasting and considering purchasing conventional milk. Thus, the stigma effect is consistent regardless of the order.

In equation (6), the coefficient on the dummy variable OR is negative (-0.254) and is not statistically significant (t = -1.33, $p = 0.183$). As in the previous section, the order in which organic milk is presented relative to the milk produced using different techniques does not affect participants' WTP values for those milks. Therefore, the stigma effect on conventional milk appears to be coming from the direct comparison to rBST-Free milk, which appears to be viewed as a more direct substitute, and not due to comparisons to organic milk.

We find similar results with respect to the coefficients on the other variables from equations (3) and (4). Coefficients for *PRIMSHOP* are once again positive and statistically significant, while coefficients for *ORGAV* are negative and significant. Unlike equations (3) and (4), however, the dummy variable for 1% lowfat milk (*FAT1*) is no longer significant; participants are willing-to-pay no more for 1% lowfat rBST-Free milk than they are for the other fat contents. In addition, the coefficient on the taste test variable for the rBST-Free skim milk (*TASTE_RSKIM*) in both equations (5) and (6) are positive and statistically significant, implying participants with a favorable opinion of rBST-Free skim milk were WTP a larger value for rBST-Free milk. The coefficient in equation (6) on the taste test variables for organic lowfat milk (*TASTE_OLOW*) and organic whole milk (*TASTE_OWHOLE*) were negative and positive, respectively, and both coefficients were statistically significant at the 10% level. Participants with a favorable opinion of organic lowfat milk are willing-to-pay less for rBST-Free milk, in general, while those with a favorable opinion of organic whole milk were willing-to-pay more for rBST-Free milk.

<u>*WTP for Organic Milk:*</u>

The regressions on WTP for milk produced without rBST are similar to those presented previously, and the results are shown in table 5.

(7) $WTP_O = \alpha + \beta_1 * TASTE\_C + \beta_2 * TASTE\_O + Full\ Model + \beta_3 * CO + \varepsilon$

and

(8) $WTP_O = \alpha + \beta_1 * TASTE\_R + \beta_2 * TASTE\_O + Full\ Model + \beta_3 * RO + \varepsilon.$

In equation (7), the coefficient on the order dummy variable *CO* is negative (-0.323) and not statistically significant (t = -1.44, $p = 0.149$). In equation (8), the coefficient on the order variable *RO* is positive (0.215) and is not statistically significant (t = 0.92, $p = 0.359$). The lack of significance on either order variable reinforces our results from the other WTP regressions; just as the order in which milks were sampled relative to organic milk did not impact the WTP values for milk produced with and without rBST, the order of taste testing similarly did not affect participant's WTP for organic milk. The consistency of these results is further evidence for the presence of a stigma effect on milk produced using rBST.

In terms of the coefficients on the non-order variables, we find results similar to those from equations (3) through (6). The variable *PRIMSHOP* is again positive and significant in both equation (7) and equation (8), while *ORGAV* is negative and statistically significant. The coefficients on the taste test variables for organic skim milk (*TASTE_OSKIM*) and organic whole milk (*TASTE_OWHOLE*) are positive and significant (the coefficient for *TASTE_OSKIM* in equation (5) is significant at the 10% level, $p = 0.061$) in both equations (5) and (6), implying that participants who view organic skim milk and whole milk favorably are willing-to-pay more for organic milk in general. One notable difference in the WTP regressions for organic milk is the significance of the dummy variables for whole milk (*FAT3*). The negative value and

statistical significance ($t = -2.67$, $p = 0.008$ in both equations (7) and (8)) of the variable suggests that participants are willing-to-pay less for whole organic milk than for other fat contents. A possible explanation for this phenomenon could be the perception many consumers have of organic milk as a health food – those who purchase organic milk may be more likely to seek out skim and lowfat milk as opposed to whole milk due to their lower fat contents, and therefore be less inclined to pay a high amount for whole milk.

Conclusion

The economic implications of the stigmatization of goods have not been thoroughly examined. Producers of conventional items have frequently been concerned about the negative consequences that may result from the introduction of new similar products with labels touting better production methods, such as bird-friendly coffee, free-range chicken, sustainably-harvested wood, eco-friendly bananas, and a variety of products marketed under the label of fair-trade. In the dairy industry, the use of recombinant bovine somatotropin (rBST), a synthetic version of a naturally occurring hormone, on milk-producing cows is an example of how stigma effects can have economic repercussions to the conventional product. While the vast majority of studies have found that conventional milk is no more risky to consume for human health than rBST-free milk, the results of this research show that consumers have very different willing-to-pay for the two products when the two products are presented in varying orders. These results confirm the patterns observed in the marketplace, where firms can charge a price premium for rBST-Free milk and large retailers, such as Wal-Mart, have begun requiring that their suppliers not use rBST.

References

Barham, Bradford, J.D. Foltz, S. Moon, and D. Jackson-Smith. 2004. "A Comparative Analysis of Recombinant Bovine Somatotropin across Major U.S. Dairy Regions." *Review of Agricultural Economics* 26(1):32-44.

Becker, Gordon M., M.H. DeGroot, and J Marschak. 1964. "Measuring Utility by a Single-Response Sequential Method." *Behavior Science* 9(3):226-232.

Fallert, R., T. McGuckin, C. Betts, and G. Bruner. 1987. *bST and the Dairy Industry: A National, Regional, and Farm Level Analysis*. Washington, D.C.: U.S. Department of Agriculture, ERS, October.

Forbes, Beth. 2008. "Loss of Milk Production Booster Could Cost Dairy Farmers, Consumers." Purdue News Service, Purdue University, 31 January. Available at http://news.uns.purdue.edu/x/2008a/080131SchutzMilk.html.

Fox, John A.; D.J. Hayes, and J.F. Shogren. 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.

Hayes, Dermot J.; J.F. Shogren, S.Y. Shin, and J.B. Kliebenstein. 1995. "Valuing Food Safety in Experimental Auction Markets." *American Journal of Agricultural Economics* 77:40-53.

Irwin, Julie R., G.H. McClelland, M. McKee, W.D Schulze, and N.E. Norden. 1998. "Payoff Dominance vs. Cognitive Transparency in Decision Making." *Economic Inquiry* 36(2):272-285.

Kaiser, Harry M., C.W. Scherer, and D.M. Barbano. 1992. "Consumer Perceptions and Attitudes toward Bovine Somatotropin." *Northeastern Journal of Agricultural and Resource Economics* 21(2):10-20.

Lusk, Jayson, W.B. Traill, L.O. House, C. Valli, S.R. Jaeger, M. Moore and B. Morrow. 2005. "Consumer Welfare Effects of Introducing and Labeling Genetically Modified Food." *Economic Letters* 88(September):382-388.

McGuckin, J.T. and S. Ghosh. 1989. "Biotechnology, Anticipated Productivity Increases, and U.S. Dairy Policy." *North Central Journal of Agricultural Economics* 11:277-288.

McGuirk, Anya M. and H.M. Kaiser. 1991. "bST an Milk: Benefit or Bane?" *Choices,* First Quarter, pp. 20-26.

Martin, A. 2007. "Consumers Won't Know What They're Missing" *New York Times,* November 11. Available at http://www.nytimes.com/2007/11/11/business/11feed.html

Noussair, Charles; S. Robin, and B. Ruffieux. 2004. "Do Consumers Really Refuse to Buy Genetically Modified Food?" *The Economic Journal* 114(1):102-120.

"Pa. Bars Hormone-Free Milk Labels." 2007. Associated Press. *U.S.A. Today.* 13 November. Available at http://www.usatoday.com/news/nation/2007-11-13-milk-labels_N.htm

Rozin, P. 2004. "Technological Stigma: Some Perspectives from the Study of Contagion," In J. Flynn, P. Slovic and H. Kunreuther, eds. *Risk, Media, and Stigma: Understanding Public Challenges to Modern Science and Technology*. Sterling, VA: Earthscan Publication Ltd, pp. 31-40.

Rozin, P., L. Millman, and C. Nemeroff. 1986. "Operation of the Laws of Sympathetic

Magic in Disgust and Other Domains." *Journal of Personality and Social Psychology* 50:703-712.

Tauer, L. and H.M. Kaiser. 1991. "Optimal Dairy Policy with Bovine Somatotropin." *Review of Agricultural Economics* 13:1-17.

Viscusi, W. Kip. 1997. "Alarmist Decisions with Divergent Risk Information." *The Economic Journal* 107(11):1657-1670.

Table 1. Experiment Design

Part	Item for Sale	Initial Balance	Range of Costs	Bids per Round	Cash Payoff Rounds	Exchange Rate
A	**Cash Values**: *$1, $2.50, $4*	$5.00	$0.00-$4.99	1	5	2:1
B	**Pencil**	$0.50	$0.00-$0.49	1	1	1:1
C	**Quart of Milk** Fat Types: *0%, 1%, 3.25%* Production Type: *Conventional, rBST-Free, Organic*	$5.00	$0.00-$4.99	9	1	1:1

Table 2. Mean WTP and Tasting Values for Milk, by Fat Type and Production Method.

WTP	0%	1%	3.25%	Overall
Conventional	$1.03	$1.11	$1.04	$1.06
rBST-Free	$1.06	$1.14	$1.02	$1.08
Organic	$1.40	$1.43	$1.23	$1.35
Tasting Score				
Conventional	4.87	5.76	5.60	5.41
rBST-Free	4.87	5.56	5.45	5.30
Organic	6.18	6.75	6.26	6.40

Table 3. Mean WTP for Milk, by Fat Type, Production Method, and Order of Tasting

	Conventional		rBST-Free		Organic	
	Tasted First	**Tasted Third**	**Tasted First**	**Tasted Third**	**Tasted First**	**Tasted Third**
0% Skim	$1.23	$0.55	$1.03	$1.14	$1.53	$1.32
1% Lowfat	$1.37	$0.64	$1.16	$1.22	$1.39	$1.41
3.25% Whole	$1.24	$0.63	$0.96	$1.09	$1.19	$1.34
Sample Size	61	29	43	59	44	60
All Fat Types	$1.28	$0.61	$1.05	$1.15	$1.37	$1.36
Sample Size	183	87	129	177	132	180

Table 4. Mean Tasting Values by Fat Type, Production Method, and Order of Tasting

	Conventional		rBST-Free		Organic	
	Tasted First	**Tasted Third**	**Tasted First**	**Tasted Third**	**Tasted First**	**Tasted Third**
0% Skim	5.47	4.43	6	4.19	6.45	6.25
1% Lowfat	6.22	5.07	6.67	5.22	6.57	6.93
3.25% Whole	6.07	5.43	6.26	5.16	5.62	6.45
Sample Size	61	29	43	59	44	60
All Fat Types	5.92	4.98	6.31	4.86	6.21	6.54
Sample Size	183	87	129	177	132	180

Table 5. Two-Limit Tobit Marginal Effect Coefficients

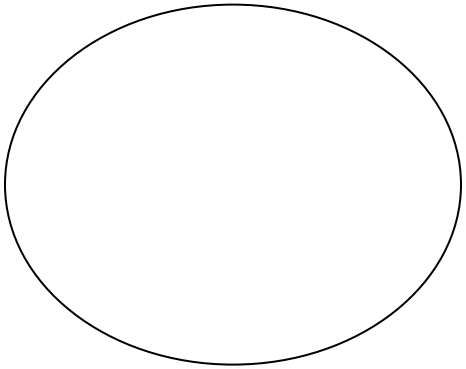
	Dependent Variable					
	Conventional		rBST-Free		Organic	
Variable Eq. #:	1	2	3	4	5	6
TASTE_RSKIM	0.036	NA	0.141***	0.107**	NA	0.065
	(0.049)		(0.047)	(0.048)		(0.055)
TASTE_RLOW	-0.019	NA	-0.062	-0.017	NA	0.008
	(0.061)		(0.056)	(0.053)		(0.070)
TASTE_RWHOLE	-0.016	NA	0.101**	0.048	NA	-0.061
	(0.046)		(0.046)	(0.049)		(0.057)
TASTE_OSKIM	NA	0.066	NA	0.011	0.094*	0.117**
		(0.045)		(0.041)	(0.051)	(0.049)
TASTE_OLOW	NA	-0.115**	NA	-0.105**	-0.065	-0.040
		(0.050)		(0.050)	(0.059)	(0.059)
TASTE_OWHOLE	NA	0.101**	NA	0.133***	0.157***	0.179***
		(0.050)		(0.045)	(0.056)	(0.054)
TASTE_CSKIM	0.056	0.051	-0.015	NA	0.033	NA
	(0.051)	(0.048)	(0.050)		(0.057)	
TASTE_CLOW	-0.013	0.032	-0.001	NA	0.045	NA
	(0.057)	(0.054)	(0.051)		(0.066)	
TASTE_CWHOLE	0.119***	0.047	0.040	NA	-0.013	NA
	(0.046)	(0.050)	(0.040)		(0.057)	
FAT1	0.124**	0.108*	0.101*	0.104*	0.034	0.035
	(0.060)	(0.060)	(0.062)	(0.063)	(0.071)	(0.072)
FAT3	0.025	0.011	-0.049	-0.051	-0.190***	-0.189***
	(0.059)	(0.059)	(0.061)	(0.062)	(0.071)	(0.071)
THIRSTY	-0.019	-0.017	-0.012	0.004	0.057	0.052
	(0.039)	(0.041)	(0.037)	(0.038)	(0.046)	(0.044)
FREQCON	0.106	0.131*	0.107	0.130*	0.061	0.009
	(0.073)	(0.080)	(0.081)	(0.070)	(0.093)	(0.084)
FREQRBST	-0.153	-0.083	-0.088	-0.107	-0.005	-0.132
	(0.139)	(0.140)	(0.106)	(0.126)	(0.139)	(0.139)
FREQORG	0.065	0.051	0.097	0.095	0.063	-0.051
	(0.105)	(0.099)	(0.092)	(0.095)	(0.110)	(0.109)

Table 5. Continued

PRIMSHOP	0.508**	0.620***	0.497**	0.681***	0.952***	0.945***
	(0.228)	(0.215)	(0.218)	(0.213)	(0.235)	(0.249)
RBSTAV	0.152	0.116	0.281	0.185	0.240	0.332
	(0.205)	(0.211)	(0.205)	(0.208)	(0.237)	(0.230)
ORGAV	-1.103***	-1.049**	-0.976***	-0.947**	-1.60***	-1.448***
	(0.400)	(0.443)	(0.400)	(0.435)	(0.395)	(0.464)
RISKP	0.072**	0.070*	0.112***	0.108***	0.149***	0.143***
	(0.036)	(0.038)	(0.037)	(0.037)	(0.045)	(0.043)
MALE	0.032	0.113	0.259	0.107	0.391	0.249
	(0.206)	(0.242)	(0.228)	(0.225)	(0.243)	(0.258)
CHU10	-0.082	-0.041	-0.139	-0.170	-0.130	-0.126
	(0.139)	(0.129)	(0.131)	(0.132)	(0.143)	(0.145)
HIGHED	-0.096*	-0.122**	-0.092	-0.077	-0.102*	-0.095
	(0.058)	(0.055)	(0.057)	(0.055)	(0.062)	(0.065)
INCOME	-4.77e-7	-5.75e-7	1.35e-6	9.28e-7	3.93e-7	2.18e-6
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
BDM	0.149	0.006	0.015	-0.146	-0.215	-0.144
	(0.242)	(0.211)	(0.227)	(0.233)	(0.361)	(0.266)
	RC	*OC*	*CR*	*OR*	*CO*	*RO*
ORDER	-0.427**	0.053	0.358**	-0.254	-0.323	0.215
VARIABLE:	(0.182)	(0.211)	(0.174)	(0.190)	(0.225)	(0.233)
Log Likelihood	-456.801	-461.878	-477.654	-474.783	-507.239	-505.118
Wald χ^2	78.37	81.75	80.82	90.88	119.68	99.25
# of Uncensored	249	250	257	257	274	274
# of Left-censored	132	134	129	129	107	104
# of Right-censored	24	24	19	19	27	27

Notes: Standard errors in parentheses.
Significance is indicated by * for 10% significance level; ** for 5% significance level; and *** for 1% significance level or less.

Figure 1. Taste Testing Template



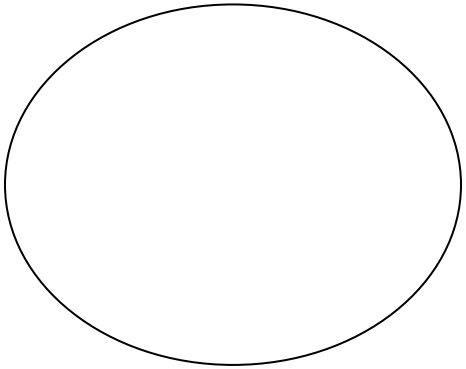
0%MILK (Skim)

1) Please rate how closely this product matches your expectation of fresh, high quality milk (1 = Worse than Expected; 5 = Meets Expectations; 10 = Better than Expected).

Worse than Expected **Better than Expected**
1 2 3 4 5 6 7 8 9 10

2) Please rate how much you like this product (from 1-10, with 10 being most favorable).

Least Favorable **Most Favorable**
1 2 3 4 5 6 7 8 9 10



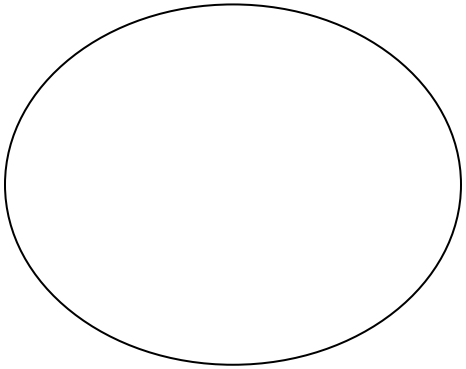
1%MILK (Lowfat)

1) Please rate how closely this product matches your expectation of fresh, high quality milk (1 = Worse than Expected; 5 = Meets Expectations; 10 = Better than Expected).

Worse than Expected **Better than Expected**
1 2 3 4 5 6 7 8 9 10

2) Please rate how much you like this product (from 1-10, with 10 being most favorable).

Least Favorable **Most Favorable**
1 2 3 4 5 6 7 8 9 10



3.25%MILK (Whole)

1) Please rate how closely this product matches your expectation of fresh, high quality milk (1 = Worse than Expected; 5 = Meets Expectations; 10 = Better than Expected).

Worse than Expected **Better than Expected**
1 2 3 4 5 6 7 8 9 10

2) Please rate how much you like this product (from 1-10, with 10 being most favorable).

Least Favorable **Most Favorable**
1 2 3 4 5 6 7 8 9 10

Figure 2. Nutritional Information Sheet

Nutrition Information: 0% Fat (Skim)

Serving Size:	1 cup (240 mL)	
Calories:	90	
Calories from Fat:	0	
*% Daily Value**		
Total Fat:	0g	0%
Saturated Fat:	0g	0%
Trans Fat:	0-5mg	
Cholesterol:	0-5mg	0-1%
Sodium:	125mg	5%
Carbohydrate:	11-13g	4%
Dietary Fiber:	0g	0%
Sugar:	11-12g	
Protein:	8g	16%
Vitamin A:		10%
Calcium:		30%
Vitamin D:		25%
Vitamin C:		4%
Iron:		0%

**% Daily Values are based on a 2000 calorie diet*

Ingredients: Fat Free Milk, Vitamin A Palmitate, Vitamin D3 added.

Nutrition Information: 1% Fat (Lowfat)

Serving Size:	1 cup (240 mL)	
Calories:	100-110	
Calories from Fat:	20	
*% Daily Value**		
Total Fat:	2-2.5g	3-4%
Saturated Fat:	1-1.5g	5-8%
Trans Fat:	0g	
Cholesterol:	10mg	3%
Sodium:	125mg	5%
Carbohydrate:	11-13g	4%
Dietary Fiber:	0g	0%
Sugar:	11-12g	
Protein:	8g	16%
Vitamin A:		10%
Calcium:		30%
Vitamin D:		25%
Vitamin C:		4%
Iron:		0%

**% Daily Values are based on a 2000 calorie diet*

Ingredients: 1% Lowfat Milk, Vitamin A Palmitate, Vitamin D3 added.

Nutrition Information: 3.25% Fat (Whole)

Serving Size:	1 cup (240 mL)	
Calories:	150	
Calories from Fat:	70	
*% Daily Value**		
Total Fat:	8g	12%
Saturated Fat:	5g	25%
Trans Fat:	0g	
Cholesterol:	30-35mg	10-11%
Sodium:	125mg	5%
Carbohydrate:	11-12g	4%
Dietary Fiber:	0g	0%
Sugar:	11g	
Protein:	8g	16%
Vitamin A:		4-6%
Calcium:		30%
Vitamin D:		25%
Vitamin C:		4%
Iron:		0%

**% Daily Values are based on a 2000 calorie diet*

Ingredients: Milk, Vitamin D3 added.

Figure 3. Percentage of Subjects WTP for Conventionally Produced Milk at a Particular Price

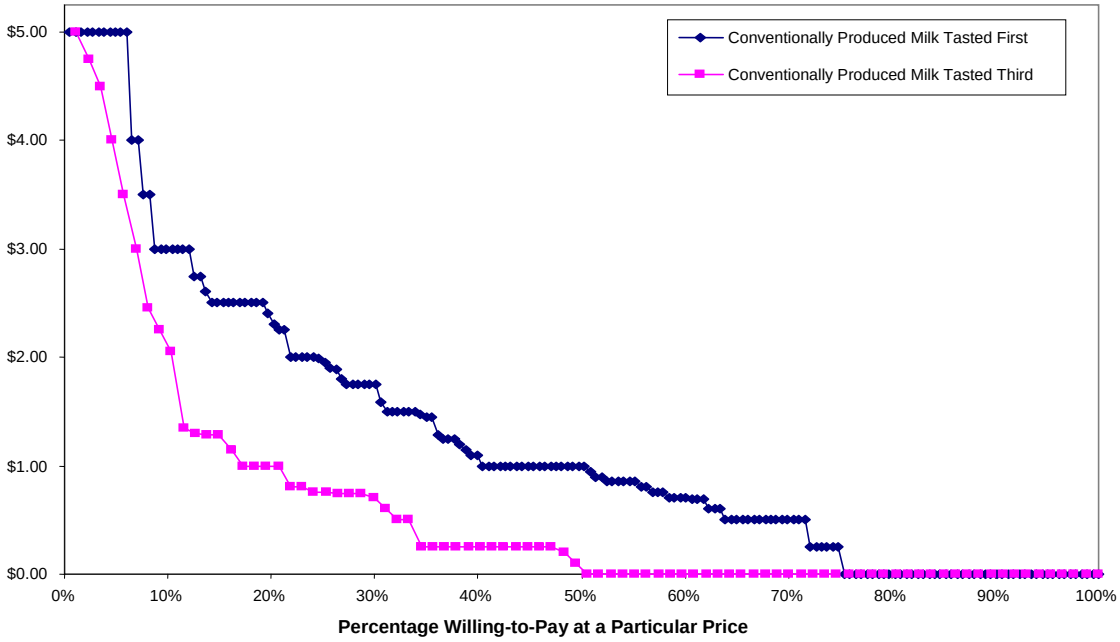


Figure 4. Percentage of Subjects WTP for rBST-Free Milk at a Particular Price

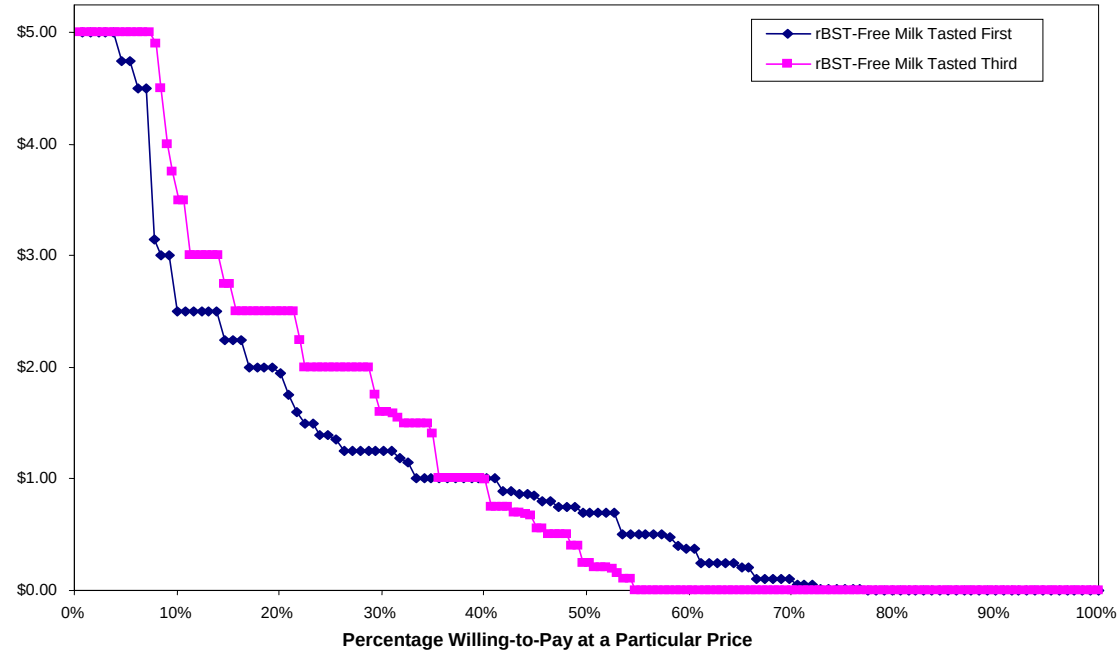
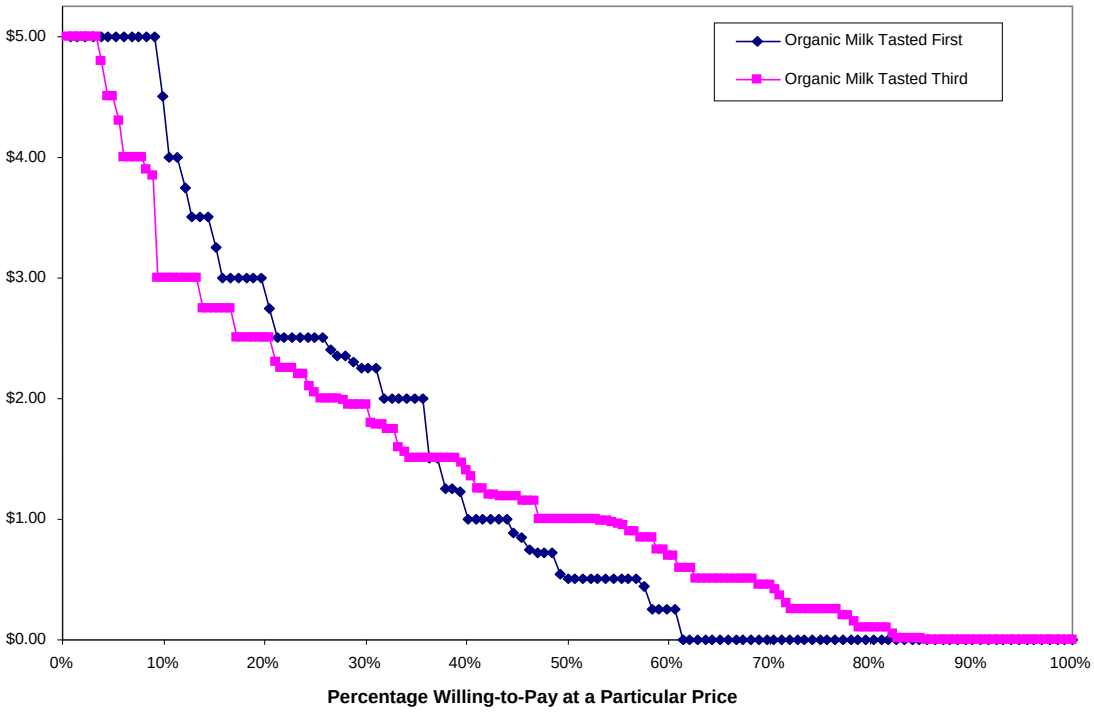


Figure 5. Percentage of Subjects WTP for Organic Milk at a Particular Price



[1] In this article, *conventional* refers to the majority of milk sold in the marketplace, which is unlabeled and may or may not have been produced with rBST.
[2] All bids in Part C were made for one-quart cartons of milk.
[3] See Figure 1 in the Appendix for taste testing questions.
[4] To avoid potential problems with brand effects, subjects never saw the original containers for the milk. All milk was poured from clear plastic pitchers.
[5] There are actually twelve equations. However, six of the equations are identical to the six we chose to analyze, with the signs reversed. Our results hold for the six omitted equations as well.
[6] Marginal effect coefficients deflate the tobit coefficients so that we may directly examine the marginal effect of increasing a given dependent variable one unit. We cannot make this comparison with the normal tobit coefficients.
[7] The value for the risk preference variable is the mean of the answers to four questions regarding the participant's attitudes towards the riskiness of pesticides, antibiotics, artificial hormones, and herbicides/fungicides – a higher number indicates a higher level of concern for a given risk factor.