Does Production Labeling Stigmatize Conventional Milk?

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

Production labeling is a common approach for differentiating otherwise similar products in the marketplace. While these labels may convey positive messages to consumers about the new product, they may simultaneously stigmatize the conventionally produced product by highlighting perceived problems. The net economic result for producers can be negative since consumers may decrease their willingness to pay for the conventional product that dominates the market, while the new product has a relatively small market share. This experimental research identifies this stigma effect in the case of milk, where the introduction of rBST-free and organic milk reduces consumers' willingness to purchase conventional milk.

Key words: conventional milk, experimental economics, organic milk, production labeling, rBST-free milk, stigma effect.

Ideally, labeling a product based on its production method should improve consumers' welfare by offering more choice while at the same time allowing producers to differentiate their products and potentially secure additional profits from consumers who are willing to pay more for a commodity produced with "preferable" methods. However, labeling to promote the benefits of one technique may also cast the conventional commodity in a negative light. An example of this is the labeling of some milk products as free of recombinant bovine somatotropin (rBST), which is a synthetically produced version of the naturally occurring hormone bovine somatotropin (bST). Dairy farmers use rBST to boost the milk yields of their dairy cows. Some dairy industry officials believe that labeling various milk products as "hormone free" or "rBST-free" stigmatizes conventionally produced milk, resulting in a reduction in consumption of conventional milk and perhaps even of fluid milk in general.[1] In fact, several states have considered or are considering bans on milk labels that include phrases such as "hormone free" or "contains no artificial hormones" because of the potential stigma effect (Martin 2007).

In *ex ante* studies of the impact of rBST on consumers' milk purchasing behavior, several factors were found to reduce the demand for milk produced by cows treated with rBST, including the amount of information about rBST that consumers possessed, the quantity of milk they consumed, and how much they were concerned with the level of milk prices (Kaiser, Scherer, and Barbano 1992). Likewise, our study confirms that, despite assurances from the Food and Drug Administration regarding the safety of rBST for human consumption, many 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, Dean Foods, and Starbucks, have begun requiring that their milk suppliers cease using 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

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[1] In this article, *conventional* milk refers to the majority of milk sold in the marketplace, which is unlabeled and may or may not have been produced with rBST. All *organic* milk and *rBST-free* milk comes from farmers who pledge not to administer rBST to their cows.

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clear, however, is that consumers are moving away from purchasing conventionally produced milk and toward 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, toward 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—from 15% in Wisconsin herds to as high as 44% in New York and Texas herds (Barham et al. 2004). According to Monsanto, the largest producer of rBST, 17% of dairy farmers nationwide in 2006 used rBST to some degree on their herds, which accounted for 33% of the total number of dairy cows in the United States. If fluid milk retailers and processors continue to push farmers to stop using 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 it (Forbes 2008).

In this research, the potential bias of consumers against conventional milk is examined in the context of stigma, a psychological phenomenon in which an object becomes viewed in a negative manner even when no actual problem or health risk has been identified. The question is addressed using experimental economics and eliciting adult subjects' willingness to pay (WTP) for fluid milk produced via different methods and with various fat contents. Through altering the order in which participants bid for different types of milk, we find that consumers are willing to pay a premium for organic and/or rBST-free milk despite a lack of scientific evidence regarding harmful effects of conventional milk on human health, and hence it is likely that the trend toward rBST-free milk products is being driven by consumer preferences.

Literature Review

Early research involving rBST was mainly concerned with how milk production would increase due to rBST adoption and the resulting implications for dairy policy (see, for example, Fallert et al. 1987, McGuckin and Ghosh 1989, and Tauer and Kaiser 1991). While the supply-side effects of the introduction of rBST into dairy herds have been studied extensively, the demand effects of introducing an unfamiliar biotechnology into a familiar good are less well understood. A limited number of studies were done to gauge how consumers would react to the presence of rBST in their milk. In a survey of consumers in New York and Virginia, 33% and 20% of consumers were concerned about the safety of rBST in milk and only 30% and 35% 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 that they were not fully convinced of the safety of rBST and would like the option of avoiding milk containing it. Another study of consumer opinions regarding rBST found that, even taking into account reduced prices from rBST-induced milk production expansion, there would likely be a 1.6% decrease in milk consumption after the introduction of rBST (Kaiser, Scherer, and Barbano 1992). Outside the United States, a number of countries, including Canada, Japan, and several countries in Europe, currently ban the use of rBST.

The introduction of organic milk is the closest parallel to that of rBST-free milk. While there has been much economic research on organic milk, little has been done on its potential stigma effect on conventional milk. However, there has been some research regarding premiums that consumers are willing to pay for organic milk. Using scanner data and a hedonic econometric model, Bernard and Mathios (2005) found that consumers were willing to pay premiums for both organic ($0.73 per gallon) and rBST-free ($0.26 per gallon) milk. The higher price premium for organic milk implies that consumers are willing to pay more for the additional attributes corresponding to organic production. Bernard and Bernard (2009) used experimental price auctions to decompose consumers' WTP for various attributes of organic milk, with an emphasis on the rBST-free and no-antibiotic characteristics. They found that consumers place a significant value on both of these attributes of organic milk. Dhar and Foltz (2005) used supermarket scanner data and a quadratic, almost ideal demand system model to examine the value consumers place on having organic and rBST-free milk in the marketplace in addition to conventional milk. The authors found substantial benefits to consumers ($2.53 billion) in terms of "competitive" and "variety" effects of having these two products in the market. Based on the previous research, therefore, it appears that consumers (1) prefer having a market that offers the choice of conventional,

organic, and rBST-free milk, and (2) are willing to pay significant premiums for organic milk and somewhat smaller premiums for rBST-free milk compared with conventional milk.

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 use of genetically modified organisms (GMOs) and other biotechnologies in food production (e.g., Noussair, Robin, and Ruffieux 2004; Lusk, Feldkamp, and Schroder 2004). One question is why the bias against rBST persists. There is a plethora of information available regarding the safety of rBST and much of it is conflicting. A topic related to the possible negative impact of introducing new production labels to the marketplace is the concept of stigma. Stigma can be thought of as "a negative feature that typically pervades and dominates an otherwise acceptable entity" (Rozin 2004). 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. The effects of stigma have been observed in a variety of economic situations, such as a large decrease in the value of homes near some toxic waste sites where the actual health risk posed by the sites in many cases has been relatively small and, therefore, objective risk alone cannot explain the consumer response (Messer et al. 2006; Dale et al. 1999; Adams and Cantor 2001; Guntermann 1995). Other examples of stigmatized products include cyanide in Tylenol bottles, exploding gas tanks that plagued the Ford Pinto, Firestone tire failures on the Ford Explorer, and mad cow disease with beef.

Regarding the possible stigmatization of conventional milk by organic and rBST-free milk, 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 cows producing milk as a negative action tend to cite possible negative health consequences to humans and cows as justification for their views. Both properties—contagion and medicalization—play into the potential for production labeling to stigmatize 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.

Experimental Design

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) bidding mechanism, which uses induced "cash values" (Becker, DeGroot, and Marschak 1964). Advantages of the BDM mechanism for private goods include its incentive compatibility in an expected utility framework and its demand-revealing properties, making it ideal for this experiment.[2] Part B asked subjects to submit bids using the BDM mechanism to purchase a pencil. Finally, Part C elicited WTP values with the BDM mechanism for milk labeled with three production techniques (conventional, rBST-free, and organic) and three fat contents (0% skim, 1% low fat, and 3.25% whole). Experiment subjects were recruited via e-mail announcements to graduate student and staff e-mail list servers, as well as through *Pawprint Flash*, an online publication containing articles, information, and announcements for Cornell University employees. Fifteen experiment sessions were conducted with each lasting approximately one hour. Participants earned an average of $15.

For each part of the experiment, participants received both written and oral instructions 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 were collected using Excel spreadsheets programmed in Visual Basic for Applications, and all information provided was kept confidential. At

[2] As pointed out by Karni and Safra (1987) and Horowitz (2006), the BDM mechanism in a private good context where the price is unknown may not be incentive-compatible in cases outside of the expected utility model. Their argument is also true for the alternative WTP elicitation mechanisms commonly used in experimental settings, such as the Vickrey auction and n^{th}-price auctions. This research is based on the assumption of expected utility and the numerous experimental studies that have demonstrated the demand-revealing characteristics of the BDM mechanism in induced-value settings (i.e., Irwin et al. 1998).

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

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

Part A consisted of five rounds (table 1). 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. Participants were then asked to record the greatest amount that they would be willing to pay to receive that cash value—we refer to this amount as the "bid," B_{it}. Once all participants recorded their bids, a price, P_t, was drawn from a random-number table containing values from $0 to $4.99 and announced to all subjects. Each round produced one of the two possible outcomes for a participant, which depended on the participant's bids and the random price. If the participant's bid was greater than or equal to the random price ($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 retained only the initial balance, Y_t.

The primary objective of Part A was to give subjects an opportunity to learn how the BDM mechanism operates. To this end, the procedures followed those of Noussair, Robin, and Ruffieux (2004) and Messer et al. (in press); participants were informed that the best strategy for each round was to place a bid equal to the cash value ($B_t = \pi_t$) since that would result in the participants receiving the greatest possible payoff for each round regardless of the price. To reinforce this message, at the conclusion of each round of Part A, participants viewed all of the bids from lowest to highest on a screen along with the random price and payoff outcomes. The subjects could thus see how closely their bidding strategies matched the optimal strategy for the greatest possible earnings.

Part B of the experiment served as a transition from Part A to Part C. In Part A, participants were asked to bid on an exogenously selected cash value. Part B provided participants with the opportunity to submit a bid using the same mechanism for an object for which each person had an endogenously selected value. In the single round in Part B (table 1), participants bid on a Ticonderoga-brand pencil and were given an initial balance of $0.50. Subjects could bid between $0 and $0.50 for a pencil. Once all of the bids had been submitted, a price between $0 and $0.49 was determined using a new random-number table. As in Part A, if the bid was equal to or greater than the price, the subject received the pencil and its price was subtracted from her initial balance. If the bid was lower than the price, the participant did not receive the pencil but retained the entire initial balance of $0.50. At the end of the round, pencils were handed out to participants who had submitted bids equal to or higher than the drawn price.

For Part C, participants were given an initial balance of $5 and asked to submit bids ranging from $0 to $5 for nine different products that would be presented sequentially.[3] Participants

[3] Unlike other experiments on food preferences, this design did not endow participants with a base product (such as conventional milk) and then assess their WTP for upgrading to another product such as rBST-free milk. The endow-and-upgrade design was made popular by Shogren et al. (1994) and has been shown to affect WTP in some experimental settings (Corrigan and Rousu 2006; Lusk, Feldkamp, and Schroeder 2004). However, in their review of endowment biases in BDM auctions, Lusk, Feldkamp, and Schroeder (2004) pointed out that providing an endowment does not significantly affect bids in the BDM mechanism (p. 404). In the experimental design in this research, "upgrade" options were not defined, especially the differences in fat type for which a consumer makes a trade-off between preferences for taste and fat intake, so only positive WTP for the products was elicited.

were told that, after submitting bids for each of the nine products, they would learn which product and corresponding bids would be used to determine the final payout. This selection would be done randomly so subjects were advised to submit bids for each product as if it would be the one used to determine cash earnings. This type of experiment is commonly referred to as a within-subject design because the same subject is asked multiple questions. An advantage of within-subject designs is that they allow for direct comparisons of how a person views different types of products and information while also naturally controlling for a variety of individual-specific observable and unobservable elements.

The nine choices of milk in Part C were presented in three flights based on label type: conventional, rBST-free, and organic (table 1). For each flight of milk, participants were given a three-column taste-testing template along with three five-ounce tasting cups, each filled with the same type of milk but varying by fat content—0% skim, 1% low fat, and 3.25% whole. Participants were asked to taste each cup of milk and afterward to answer two questions regarding the quality and freshness of each sample (Kanter, Messer, and Kaiser 2009). The questions asked, on a scale of one to ten, how closely the taste of the milk matched the subjects' expectations of fresh, high-quality milk and how well they liked the milk sample overall. The taste-testing questions were based on two hedonic milk studies in which experiment participants were asked to rate their level of "like" for milk, as well as rating the intensity of various milk characteristics (Chapman and Boor 2001; Chapman, Lawless, and Boor 2001). After answering the tasting questions, participants submitted bids representing the highest amount that they would pay for a quart carton of each sample of milk.

This research focused particularly on comparing how participants' WTP for milk changed when the flights of milk were presented in different orders. In the real marketplace, the introduction of rBST-free milk expanded a typical milk consumer's set of choices from eight milk varieties (conventional or organic milk and 0%, 1%, 2%, or 3.25% fat) to twelve. Our experiment design focused on recreating, as much as possible, the set of products a milk consumer would consider in making a purchase decision—in this case, nine milk varieties (milk labeled as conventional, rBST-free, or organic and 0%, 1%, and 3.25% fat)—and then asked the subjects to bid on milk produced using a given method in isolation, without considering their WTP for milk produced using the other two methods. While the ideal experimental design would be a perfect replication of the real-world milk purchase decision (Louviere 2006), this experimental design offers several advantages. First, the experiment is aided by the familiarity of the purchase decision since the adult participants in this study had made milk purchases repeatedly over many years and were accustomed to considering the purchase of milk at different prices (such as price differences commonly observed for different container sizes or whether the milk is purchased at a grocery store, shoppers' club, or convenience store) and with different characteristics (such as organic/conventional production or flavored milk).

Furthermore, to answer the questions posed in this study, use of the BDM mechanism is superior to a dichotomous yes/no choice on a posted price (the setting most commonly found in marketplaces) because the BDM mechanism yields specific point estimates for consumers' WTP for different types of milk, something that would be very costly to do with dichotomous choice because the posted prices would have to be varied over a large range of possibilities, requiring a much larger sample size. Finally, the bids, questionnaire data, and data regarding the order in which the different types of milk were presented can be combined to analyze how the introduction of rBST-free milk into the market affected consumers' WTP for conventional milk.

To mimic the information provided in a grocery store setting, subjects were given handouts containing nutrition and production information for each flight of milk (Kanter, Messer, and Kaiser 2009). Importantly, the nutrition information differed only by fat type and not by production technique. The handout for rBST-free milk included a statement that the milk "does not contain artificial growth hormones" and the handout for organic milk included 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 milks. The information sheet for conventional milk did not make any claims regarding the production process. In the oral protocols, participants were informed that conventional milk was the type of milk most commonly available in grocery and convenience stores.

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

	0% Milk		1% Milk		3.25% Milk		Overall	
	WTP	Difference from Conventional	*WTP*	Difference from Conventional	*WTP*	Difference from Conventional	*WTP*	Difference from Conventional
Conventional	$1.03	—	$1.11	—	$1.04	—	$1.06	—
rBST-Free	$1.06	+$0.03	$1.14	+$0.03	$1.02	−$0.02	$1.08	+$0.02
Organic	$1.40	+$0.37	$1.43	+$0.32	$1.23	+$0.19	$1.35	+$0.29
	Tasting Score	Difference from Conventional	Tasting Score	Difference from Conventional	Tasting Score	Difference from Conventional	Tasting Score	Difference from Conventional
Conventional	4.87	—	5.76	—	5.60	—	5.41	—
rBST-Free	4.87	0.00	5.56	−0.20	5.45	−$0.15	5.30	−0.11
Organic	6.18	+1.31	6.75	+0.99	6.26	+$0.66	6.40	+0.99

To avoid any packaging or branding effect, all nine milks were served in clear pitchers and subjects did not see the brands of milk used in the experiment. Subjects were told that they could take any milk they purchased with them immediately after the experiment, have it placed on ice and wrapped within two plastic bags for free, or have it delivered for free to their offices at the end of the day. Once all nine bids had been placed and the milk type selected, a random price was drawn and the quarts of milk were distributed to those who submitted bids greater than or equal to the drawn price.

Results

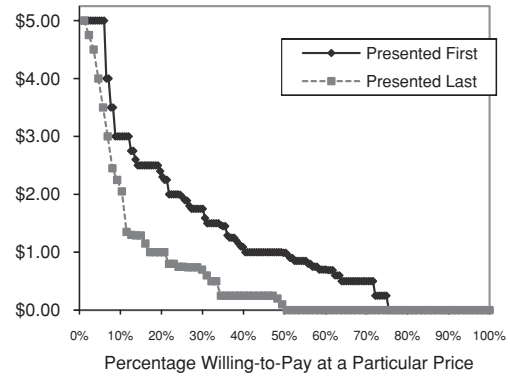
The experimental results from 148 adult subjects support the existence of a stigma effect from both organic and rBST-free milk on conventional milk. However, when looking at average WTP for milk of a given fat type, the stigma effect—especially the one from the introduction of milk labeled rBST-free—is initially difficult to detect. For example, as seen in table 2, participants' average WTP was $1.03 for skim milk produced conventionally, $1.06 for skim milk produced without rBST, and $1.40 for skim milk produced using organic practices; the average tasting scores for these skim milks were 4.87, 4.87, and 6.18, respectively. The stigma effect becomes apparent when the average WTP values are separated by the order in which the milks were presented. The impact of the order of presentation is shown in figure 1. Most notable is the decrease in overall WTP for conventional milk from when it was presented first to when it was presented last (figure 1a). When conventional milk was the first product presented, the average WTP offer was $1.28 (table 3).[4] 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 grocery store, were presented with a wide variety of milk choices. In this case, average WTP values for conventional milk fell to $0.61 (a decline of 52.3%). On the other hand, the trend for rBST-free milk is different as the values generally increased (figure 1b). When rBST-free milk was presented first, the mean WTP was $1.05; when the same milk was presented last, the mean WTP increased by 9.5% to $1.15. Organic milk saw essentially no change in WTP due to order, as mean WTP was $1.37 when presented first and $1.36 when presented last.

While some of the decline in WTP for conventional milk may have been anticipated since the average tasting value for conventional milk dropped 15.9% from 5.92 when presented first to 4.98 when presented last (table 3), the decrease in perceived taste does not explain all of the decline. For example, rBST-free milk saw an even more dramatic decrease in its tasting value due to order—from 6.31 when presented first to 4.86 when presented last (a decline of 23.0%)—even though the WTP *increased* by 9.5%.[5]

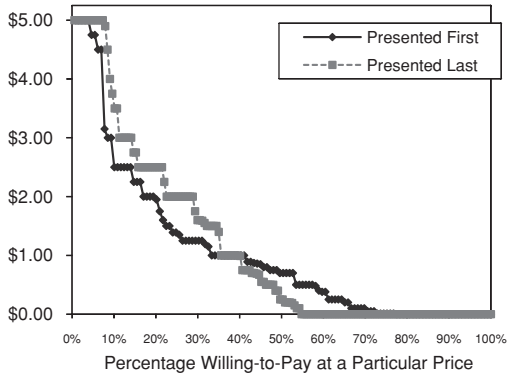
[4] Participants initially did not know what the nine products would be so the measurement of WTP from the first flight of milks should be free of direct comparisons to other milk products.

[5] Not all of the tasting values declined with the introduction of additional milk products. For instance, the average taste values for organic milk *increased* from 6.21 when presented first to 6.54 when presented last.

a) Conventional Milk



b) rBST-Free Milk



c) Organic Milk

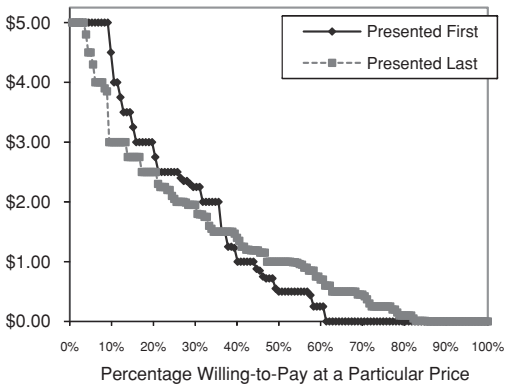


Figure 1. Percentage of subjects willing to pay at a particular price by order presented

A stigma effect is also potentially present when we pool together the subjects' WTP for milk produced using all three techniques, effectively considering a single demand curve for conventionally produced, rBST-free, and organic milk. The mean WTP for all three milk types when conventional milk was presented first was \$1.22; the mean WTP when conventional milk was presented third was \$0.90 (the difference in mean WTP is statistically significant at the 1% level ($p = 0.0014$)). This suggests that the introduction of milk labeled as being rBST-free or organic could have a much greater influence than simply reducing WTP for conventional milk—the availability of rBST-free and organic milk could reduce the demand for all types of milk.

While the descriptive statistics and figures previously discussed are suggestive of a stigma effect, to evaluate formally whether this phenomenon is a result of the order, a detailed analysis of subjects' WTP is necessary. Since participants in the experiments were asked to submit bids for multiple milks with varying fat types and these bids were constrained to between \$0.00 and \$5.00, we utilized a two-limit random-effect Tobit model. To evaluate whether there is a stigma effect from milk labeled as rBST-free and organic on conventional milk, the differences in WTP for milks with the same fat content were evaluated in three different models.[6]

The models included dummy variables to indicate the fat content of the milk (*FAT1* – 1% low-fat milk; *FAT3* – 3.25% whole milk), whether the participant was the primary shopper in the household (*PRIME_SHOP*), whether the participant was aware of the availability of rBST-free (*RBST_AVAIL*) and organic milk (*ORG_AVAIL*) prior to the experiment, whether the participant was lactose intolerant (*LACT_INT*), and the participant's gender (*MALE*). The participants responded to questions related to the frequency with which they purchased conventional (*FREQ_CONV*), rBST-free (*FREQ_RBST*), and organic milk (*FREQ_ORG*) and how risky they considered milk (*MILK_RISK*).[7] Subjects also reported the number of children under ten in the household (*CHU10*), the highest level of education obtained (*EDUC*), and income (*INCOME*). As a control on the participants' understanding of the BDM mechanism, a variable was included to represent their deviations from the final induced-value round during the first part of the experiment (*BDM*). Since a participant's perceptions of the taste

[6] Censored bids (bids of \$0 or \$5) that did not differ between the milks with different labels were excluded from the analysis, since—given the censored nature of the data—the analysis could not determine whether there was truly a zero difference between the subjects' WTP (or willingness to accept (WTA) in the case of censored bids of \$0) for the milks or whether the change in real WTP/WTA occurred outside the range of observation.

[7] The value for the risk-preference variable is the mean of the answers to four questions regarding the participants' 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.

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

(a) Average WTP for Milk

	Tasted First				
	WTP Conventional[a]	WTP rBST-Free[b]	Difference from Conventional	WTP Organic[c]	Difference from Conventional
0% Skim	$1.23	$1.03	−$*0.20*	$1.53	+$*0.20*
1% Low Fat	$1.37	$1.16	−$*0.21*	$1.39	+$*0.02*
3.25% Whole	$1.52	$1.24	−$*0.28*	$1.19	−$*0.05*
All Fat Types	**$1.28**	**$1.05**	**−$*0.23***	**$1.37**	**+$*0.09***

	Tasted Last				
	WTP Conventional[d]	WTP rBST-Free[e]	Difference from Conventional	WTP Organic[f]	Difference from Conventional
0% Skim	$0.55	$1.14	+$*0.59*	$1.32	+$*0.77*
1% Low Fat	$0.64	$1.22	+$*0.58*	$1.41	+$*0.77*
3.25% Whole	$0.63	$1.09	+$*0.46*	$1.34	+$*0.71*
All Fat Types	**$0.61**	**$1.15**	**+$*0.54***	**$1.36**	**+$*0.75***

(b) Average Tasting Values for Milk

	Tasted First				
	Conventional[a]	rBST-Free[b]	Difference from Conventional	Organic[c]	Difference from Conventional
0% Skim	5.47	6.00	*+0.53*	6.45	*+0.98*
1% Low Fat	6.22	6.67	*+0.45*	6.57	*+0.35*
3.25% Whole	6.07	6.26	*+0.19*	5.62	*−0.45*
All Fat Types	**5.92**	**6.31**	***+0.39***	**6.21**	***+0.29***

	Tasted Last				
	Conventional[d]	rBST-Free[e]	Difference from Conventional	Organic[f]	Difference from Conventional
0% Skim	4.43	4.19	*−0.24*	6.25	*+1.82*
1% Low Fat	5.07	5.22	*+0.15*	6.93	*+1.86*
3.25% Whole	5.43	5.16	*−0.27*	6.45	*+1.02*
All Fat Types	**4.98**	**4.86**	***−0.10***	**6.54**	***+1.56***

[a] Sample size = 61.
[b] Sample size = 43.
[c] Sample size = 44.
[d] Sample size = 29.
[e] Sample size = 59.
[f] Sample size = 60.

of a milk could have been influenced by the order of presentation of the milks, a two-stage model was used that included estimated values for the differences in taste values (*TASTE_RC*, *TASTE_OC*, and *TASTE_OR*) as instrumental variables to avoid simultaneous-equation bias.[8]

[8] The explanatory variables in the analysis of the difference in taste variables were the same as those used in the general model except that the exact order of the presentation of the milk was also included. The complete model results are available upon request from the authors.

The average values for some of these variables offer insight into the demographic breakdown of the participants. For example, 83% identified themselves as the primary shopper for the household, and household milk consumption averaged almost 1.5 gallons per week of mainly conventional milk. Awareness of organic-labeled milk in the marketplace was much greater (92%) than was awareness of milk labeled as rBST-free (just 54%). The average participant attended some college without earning a degree and had an annual household

income of slightly more than $57,000; 27% of households had children under the age of ten living at home.

Most importantly for our analysis, a dummy variable was included to indicate the order in which the flights of milk were presented. Conventional milk was labeled as *C*, rBST-free milk as *R*, and organic milk as *O*. Thus, the order of presentation was indicated by the order of the letter code. For example, if rBST-free milk was presented before conventional milk, the dummy variable for the session was *RC*. Likewise, if organic milk was presented before conventional milk, that session was coded as *OC*. By setting up the models in this manner, we were able to isolate the effect of varying the order of presentation with the order variables—*RC*, *OC*, and *OR*—representing the size of the stigma effect and the coefficients on the other variables representing the price premium that participants with that particular attribute would pay for the alternative milk, *ceteris paribus*.

Using these models, we were able to test three different hypotheses regarding how participants' WTP for milk changes as the order in which they taste flights of milk is altered. The null hypothesis in each of the cases asserts that difference in WTP for the milk does not change as the order the flights are tasted changes, while the alternative hypothesis asserts that WTP for milk varies as the order changes.

Difference in WTP for rBST-free and Conventional Milk

As seen in column (1) of table 4, the difference in WTP when rBST-free milk is presented before conventional milk (model 1) shows that the marginal effect coefficient[9] for the order dummy variable *RC* (0.351) is statistically significant ($t = 2.35$, $p = 0.019$). Thus, we can reject the hypothesis that order does not affect WTP for rBST-free and conventional milk. The coefficient for *RC* indicates that participants are willing to pay $0.35 per quart less for conventional milk after tasting and being exposed to label information regarding rBST-free milk (i.e., rBST-free milk "does not contain any artificial growth hormones").

Several other variables besides the order dummy variable bear mentioning. The instrumental variable representing the difference in taste perception between rBST-free and conventional milk (*TASTE_RC*) is statistically significant, indicating the intuitive behavioral response that participants who thought that rBST-free milk of a given fat type tasted better than the conventional version of the same fat type were willing to pay more for it. Additionally, the more frequently a participant consumes either conventional or rBST-free milk (*FREQ_CONV* and *FREQ_RBST*), the larger the difference in WTP between rBST-free and conventional milk as both coefficients are positive and significant at the 0.05 level or better. Also, the coefficient on the variables related to whether the participant is the primary shopper (*PRIME_SHOP*) is large, a $1.11 difference for a quart of milk, and statistically significant at the 0.01 level. This suggests that the household member who normally does the shopping is typically willing to pay more of a premium for rBST-free milk than those who do not. Importantly, these results imply that the stigma effect is not a phenomenon of naive and infrequent consumers but is something exhibited by experienced consumers of milk.

Participants who expressed concern about the riskiness of milk (*MILK_RISK*) were willing to pay a higher premium for rBST-free milk, as were those who had more education (*EDUC*) and those who bid higher than the induced value in the last practice round of the BDM mechanism.

Difference in WTP for Organic and Conventional Milk

Column (2) in table 4 shows the results of the model that uses the difference in WTP for organic and conventional milk as the dependent variable. This model again shows a stigma effect on WTP for conventional milk when it is presented after organic milk. In this case, the coefficient for the variable *OR* is even larger (0.482) and statistically significant at the 0.01 level ($p = 0.003$). Thus, we can also reject the hypothesis that order does not affect WTP for organic and conventional milk. Subjects are willing to pay $0.48 per quart less for conventional milk after tasting and being exposed to label information regarding organic milk (i.e., organic milk "produced without the use of antibiotics, synthetic growth hormones, or pesticides"). The larger stigma effect of organic compared with rBST-free milk on conventional milk is intuitive since organic milk is free of more than rBST, having additional claims of being pesticide and antibiotic free.

[9] 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.

Table 4. Two-Limit, Random-Effect Tobit Model of Differences Between WTP

	(1) rBST-Free—Conv.		(2) Organic—Conv.		(3) Organic—rBST-Free	
Variable	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error
CONSTANT	−4.850**	(1.033)	−2.448*	(1.011)	0.406	(1.339)
RC	0.351*	(0.149)				
OC			0.482**	(0.163)		
OR					0.024	(0.165)
TASTE_RC	0.125**	(0.032)				
TASTE_OC			0.051	(0.062)		
TASTE_OR					0.009	(0.063)
FAT1	0.024	(0.679)	−0.029	(0.084)	−0.042	(0.078)
FAT3	0.019	(0.072)	−0.112	(0.125)	−0.112	(0.096)
FREQ_CONV	0.166*	(0.072)	−0.029	(0.079)	−0.091	(0.069)
FREQ_RBST	0.201*	(0.090)	0.129	(0.103)	0.122	(0.110)
FREQ_ORG	0.146	(0.077)	0.011	(0.074)	−0.076	(0.077)
PRIME_SHOP	1.019***	(0.296)	0.507	(0.305)	0.277	(0.300)
RBST_AVAIL	0.256	(0.153)	0.218	(0.191)	0.087	(0.171)
ORG_AVAIL	−0.334	(0.238)	−0.430	(0.247)	−0.497	(0.283)
MILK_RISK	0.078**	(0.027)	0.096**	(0.030)	0.079**	(0.031)
MALE	0.393*	(0.172)	0.200	(0.183)	0.133	(0.187)
CHU10	−0.063	(0.106)	−0.068	(0.108)	−0.098	(0.111)
EDUC	0.083*	(0.040)	0.058	(0.055)	−0.023	(0.045)
INCOME	3.01×10^{-6}	(1.92×10^{-6})	6.40×10^{-7}	(1.97×10^{-6})	3.04×10^{-8}	(2.43×10^{-6})
BDM	0.394*	(0.161)	0.321	(0.178)	0.157	(0.177)
LACT_INT	0.256	(0.199)	0.111	(0.223)	−0.212	(0.201)
Log Likelihood	−271.3		−317.0		−322.8	
Wald χ^2	65.74		68.90		25.01	
Prob > chi^2	0.000		0.000		0.095	
No. of uncensored	282		294		294	
No. of Left-censored	0		0		0	
No. of Right-censored	1		3		2	

Note: Significance is indicated by single asterisk (*) for the 5% level and double asterisks (**) for 1% level or less.

Additionally, the variable measuring the participants' perceptions of the risks involved with consuming milk (*MILK_RISK)* was highly significant ($p = 0.001$) and had a positive coefficient (0.096). At the same time, several factors that are significant in the regression of WTP for rBST-free and conventional milk are not significant in this model. This could in part be driven by the higher level of preexisting information participants possessed regarding organic milk compared to rBST-free (92% were aware of organic milk while 54% were aware of rBST-free milk). Subjects who are willing to pay a high premium for organic milk likely are consumers who are already aware of its availability and reputation as a "safe" alternative to conventional milk. Hence, perception of the risks involved with consuming milk is a key factor in determining the price premium for organic milk.

Difference in WTP for Organic and rBST-free Milk

Column (3) in table 4 shows the results of the model for the difference in WTP for organic and rBST-free milk, with no significant difference in WTP based on the order of presentation (*OR*). Thus, we fail to reject the hypothesis that order does not affect WTP for organic and rBST-free milk. It is important to note that rejection of the null hypothesis does not indicate that participants were willing to pay the same amount for organic and rBST-free milk, only that the difference in WTP was not caused by the order of presentation.

The only variable that is statistically significant at the 0.05 level is the perception of milk risk (*MILK_RISK)*, which had a positive coefficient (0.079). This indicates that participants view organic milk as a safer product than milk that is only rBST-free, likely due to the labels, which indicate that organic milk is produced without the use of antibiotics and pesticides.

Conclusion

The economic implications of the stigmatization of goods have not been thoroughly examined in the literature. 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, 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, with milk-producing cows is an example of how stigma effects can have economic repercussions for the conventional product. The objective of this research was to determine whether the introduction of rBST-free and organic milk has a stigma effect on conventional milk. The question was addressed using experimental economics and by eliciting WTP measures from adult subjects for milk produced via different methods and varying in fat content. The advantage of using an experimental setting is the ability to observe directly the behavior of participants making actual purchase decisions as opposed to using survey techniques to pose hypothetical questions. The stigma effect was measured by altering the order in which participants were introduced to and asked to bid for the different types of milk.

The results of this study of 148 adult subjects indicate a substantial stigma effect from both organic and rBST-free milk on conventional milk. To measure the stigma effect, differences in WTP for milks with the same fat content were evaluated in three different models. Using a two-limit random-effect Tobit model to control for other factors affecting the difference in WTP, we find negative and statistically significant marginal effects for the coefficients on the variable measuring the stigma effect from organic on conventional milk and from rBST-free on conventional milk. Specifically, participants were willing to pay, on average, \$0.35 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"). This represents a 33% reduction in WTP for conventional milk based on the overall average WTP in our study (\$1.06 per quart). There was an even stronger stigma effect from organic milk; participants were willing to pay, on average, \$0.48 per quarter less for conventional milk after tasting and being exposed to information regarding organic milk (i.e., organic milk "produced without the use of antibiotics, synthetic growth hormones, or pesticides"). This represents a 45% reduction in WTP for conventional milk.

These results suggest that participants view conventional milk more negatively after the introduction of rBST-free and organic milk. This finding supports the idea that conventional milk becomes a stigmatized good after rBST-free and organic milk are introduced into the marketplace.

These results also indicate that all milk types (conventional, rBST-free, and organic) are stigmatized by the introduction of rBST-free and organic milk. The mean WTP for all three milk types when conventional milk was presented first was \$1.22; the mean WTP when conventional milk was presented third was \$0.90. This \$0.32 difference (26%) was statistically significant at the 0.014 level. This finding suggests that the introduction of milk labeled as being rBST-free or organic could have a much greater influence than simply reducing WTP for conventional milk. That is, the introduction of rBST-free and organic milk could potentially reduce the demand for all types of milk.

A caveat on these results should be noted. Our findings are based on observations from a laboratory experiment, which is not identical to real marketplace conditions. In particular, the introduction of organic and rBST-free milk products in the real market occurred gradually over a substantially longer time period than was modeled in our experiment. Given the rapid, sequential introduction of all three product types in our experiment, our results likely represent a short-term measurement of the stigma effect. Further research into how long this stigma effect lasts is thus warranted.

The experimental results illustrate that the recent actions by Wal-Mart, Dean Foods, and Starbucks to ban conventional milk and supply only rBST-free (and organic) milk may have significant negative consequences for conventional milk demand. The implication of the stigma effect found here is that the dairy industry will have to confront this issue head-on or risk a possibly major negative impact on milk consumption.

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