Journal of Agricultural and Applied Economics, 37,3(December 2005):647-657

Consumer Willingness to Pay for "Second-Generation" Genetically Engineered Products and the Role of Marketing Information

Matthew C. Rousu, Daniel C. Monchuk, Jason F. Shogren, and Katherine M. Kosa

Environmental and consumer groups have called for mandatory labeling of genetically engineered (GE) food products in the United States, stating that consumers have the "right to know." Herein, we use a nonhypothetical field experiment to examine the willingness to pay for GE-labeled products, using the only second-generation GE product currently on the U.S. market—GE cigarettes. Our results suggest consumers pay less for GE-labeled cigarettes when marketing information is absent. But, when presented with marketing information on the attributes of the cigarette, we find no evidence that consumers pay less for GE-labeled cigarettes.

Key Words: auctions, BDM mechanism, cigarettes, field experiment, genetically engineered foods, second-generation

JEL Classifications: C91, Q18

Genetic engineering remains a controversial issue. Opponents of genetically engineered (GE) food products have successfully publicized potential threats that could result from eating GE foods, such as environmental degradation, consolidated multinational power, human health threats (e.g., more allergic reactions), and uncertain long-term impacts (see, e.g., Friends of the Earth; Greenpeace 2001a,b,c). These concerns have prompted some nations, including those in the European Union, Australia, and Japan, to require firms to label all GE food products. In contrast, the United States does not require explicit labeling of GE products; rather, labeling in the United States is only required if the product has been modified to alter consumer characteristics. Products genetically engineered to alter the consumer characteristics of the products are called second-generation GE products. For these products, only the modified attribute needs to be identified.

Only one such altered second-generation GE product currently exists in the United

Matthew C. Rousu is an assistant professor in the Department of Economics at Susquehanna University, Selinsgrove, PA; Daniel C. Monchuk is an assistant professor in the Department of Economics at the University of Southern Mississippi, Hattiesburg, MS; Jason F. Shogren is the Stroock Distinguished Professor of Natural Resource Conservation and Management in the Department of Economics and Finance at the University of Wyoming, Laramie, WY; and Katherin M. Kosa is a research analyst at RTI International, Research Triangle Park, NC.

The authors thank seminar participants at North Carolina State University, RTI International, the AAEA annual meeting, and two anonymous reviewers for comments that improved the quality of this article. The standard disclaimer applies.

States, Quest™ cigarettes, a product introduced into the U.S. market in early 2003.[1] Genetic engineering is used to reduce the level of nicotine, and three versions of these Quest cigarettes are now on the U.S. market (low nicotine, extra-low nicotine, and nicotine free).[2] Using genetic engineering as a method to reduce the level of nicotine in tobacco should result in a more desirable product—at least from a smoking-enjoyment viewpoint—relative to conventional means to reduce nicotine levels, such as chemicals and bleaching. Under current regulations, the U.S. Food and Drug Administration (FDA) requires the company to label these new cigarettes—but the label needs only to indicate that the products are lower in nicotine. Federal law requires no explanation of the genetic engineering, only that the consumption characteristics of the product have changed.

We used experimental methods to examine adult smokers' willingness to pay for this second-generation GE product under a 2 × 2 informational design: (1) with and without a label indicating the cigarettes are GE and (2) with and without supplementary marketing information related to the consumer qualities of the new cigarettes. We conducted nonhypothetical field auctions at two grocery stores in the Midwest. To our knowledge, this study is the first to use experimental methods to determine consumer willingness to pay for second-generation GE products. This study is also the first to examine the effect of conventional marketing information on the demand for a GE-labeled product.[3]

We test three hypotheses: (1) in the absence of marketing information, bids for GE-labeled cigarettes are identical to bids for non-GE-labeled cigarettes; (2) when consumers are presented with marketing information, bids for GE-labeled cigarettes are identical to bids for non-GE-labeled cigarettes; and (3) bids for GE-labeled cigarettes when marketing information is presented are identical to bids for GE-labeled cigarettes when marketing information is not presented.

Background

Background on GE Labeling

Many countries require manufacturers to label GE products. The countries in the European Union (EU), for instance, require mandatory labeling for all GE products, and the European Parliament recently voted for a 0.9% threshold, meaning that all products containing more than 0.9% GE material must be labeled as genetically engineered. Other countries that require mandatory labeling for GE products include Australia, Japan, and New Zealand, and these countries have threshold levels ranging between 1% and 5% (Shipman; Rousu and Huffman). Several quantitative studies have reviewed preferences for GE and non-GE food products.

In the United States, consumers prefer non-GE foods instead of first-generation GE food products (i.e., food products that are GE for agronomic benefits). Several studies using experimental-auction markets have concluded that, on average, consumers will pay less for GE food products (e.g., see Huffman et al. 2003; Lusk et al. 2001a). While several reasons exist for why one might oppose GE foods (e.g., see Greenpeace), most researchers conclude the main reasons for opposing GE foods are potential risks from genetic engineering (real or imaginary) and that first-generation

[1] Flavor Savor Tomatoes, which were genetically engineered to increase shelf-life, were on the U.S. market in the 1990s but are no longer sold. Another product, Golden Rice, is genetically engineered to increase the amount of vitamin A, but this product is not yet on the market (Lusk).

[2] In the past, most reduced-nicotine cigarettes were bleached to remove nicotine, resulting in a noticeable difference in taste. In contrast, Quest cigarettes taste similar to leading brand-name cigarettes.

[3] Several studies have examined the impact of positive information on the demand for GE-labeled products, most notably Lusk et al. (2004) and Huffman et al. (2003b). These studies examine information that discusses benefits of genetic engineering. Information dealing with genetic engineering is not typically disseminated by firms trying to convince consumers to purchase their products. In this study, the marketing information given to consumers only deals with the benefits of the cigarettes and does not mention genetic engineering.

GE foods seem to have no benefits for consumers. Consumers show a general dislike for GE food products, although they seem more concerned with whether GE content is in fact present in the product than with the actual amount of GE content present (Rousu et al. 2004a). Studies using surveys and focus groups have found the same general result: U.S. consumers say they will pay less for GE food products (see Chern et al.; Teisl et al.). For a quantitative summary of studies that have estimated willingness to pay (WTP) for GE food products, we refer the interested reader to the meta-analysis by Lusk et al. (2005) of GE-food studies.

Background on How Information Affects Consumer Decisions for GE-Labeled Foods

Until recently, the only GE products available on the U.S. market were first-generation GE products. These products are genetically engineered for agronomic purposes and do not have altered physical, consumer end-use characteristics. Consumer acceptance of these products has been slow, as consumers have shown in surveys and in experimental markets to prefer non-GE products (e.g., see Grimsrud et al.; Huffman et al. 2003a). Some observers, however, have hypothesized that consumer demand could increase when the benefits of consuming GE products are more apparent (e.g., see Hoban). Second-generation GE products are genetically engineered to change the product characteristics (e.g., lower nicotine in GE cigarettes, more vitamin A in golden rice); therefore, consumers could see greater benefits from consumption and be less hesitant about consuming GE products.

Several studies have examined how positive information about genetic engineering information affects consumer demand for first-generation GE products. Huffman et al. (2003a) used experimental auctions and found that information from agribusinesses on the benefits of genetic engineering increases consumer demand for GE-labeled potatoes, tortilla chips, and vegetable oil. They also found that information from agribusinesses has value to consumers. Lusk et al. (2004) extended this study to look at several different types of information describing the benefits of GE foods. They found that all types of information increase acceptance (through auction bids) of GE cookies, but that U.S. consumers were more open to genetic engineering than EU consumers and that they were also more open to information on the benefits of GE foods. Results from a survey by Frewer, Scholderer, and Bredahl showed that consumers in European countries appeared to trust information based on their prior beliefs. Further, if a source provided information contrary to their prior attitudes, European consumers did not change their attitudes toward genetic engineering; instead, they put less trust in the source of the information.[4] These studies examine how information that specifically cites the benefits of genetic engineering changes the demand for first-generation GE products. It remains unclear, however, how marketing information would affect preferences toward genetic engineering for second-generation GE products.

Experimental Design

We designed a field experiment employing auctions to examine the effect on consumer demand of labeling second-generation GE products as genetically engineered. There are trade-offs when deciding to conduct a field experiment instead of a laboratory experiment. Field experiments allow the researcher less control over the environment but allow for a more real-world setting (Lusk et al. 2001b). Our experiments were conducted in a grocery store because many smokers purchase their cigarettes at grocery stores. In addition, because participants were already in the store, they had a lower opportunity cost, and we were able to pay a lower participation fee.

People participated in our experiment either one at a time or in small groups of five or less. Because we anticipated that we would

[4] Scholderer and Frewer also examine attitudes toward GE foods using European consumers. They find that all the communications they tested that explained the benefits of GE foods cause consumers to prefer non-GE foods.

usually work with only one person at a time in our intercept sampling procedure, we used the Becker, DeGroot, Marschak (BDM) auction. Although not perfect in practice, in theory, the BDM mechanism is designed so each participant's weakly dominant strategy reveals his or her true willingness to pay for different cigarettes. Other popular-demand-revealing auction mechanisms, such as the second-price auction (Vickrey) and the random *n*th-price auction (Shogren et al. 2001a) need multiple participants, which restricted their use in this intercept sampling. The BDM auction works as follows: (1) each participant places a bid on the cigarettes; (2) we randomly select a market-clearing price from a uniform distribution on the fixed interval of \$0.10–6.00,[5] with clearing prices rounded to the nearest dime; and (3) a participant who bids less than the market-clearing price does not win and will not purchase any product. A participant who bids more than the market-clearing price wins the auction and purchases the cigarettes at the randomly selected market-clearing price.

Consumers bid on multiple packs of cigarettes in these experimental auctions. Following Shogren et al., only one bid was chosen to be binding (valid) to avoid demand curve effects. We set up tables at two local grocery stores in Ames, IA, which has a population of 50,000 and is home to Iowa State University. Then we posted signs inside the grocery store indicating that smokers could earn \$10 for 10–15 minutes of their time on a research project for Iowa State University. For legal and ethical reasons, we limited our sample to adults who were 18 years of age or older. The experiment monitors checked the participant's photo identification when the participant looked younger than 28 years old. We did not have any trouble recruiting participants.

This experiment had a total of four treatments, each differing in the information consumers received and in the presence or absence of a GE label. Some participants bid on cigarettes that had a GE label affixed to its side reading, "This product has been genetically engineered to reduce nicotine." Some consumers were given marketing information on the attributes of the nicotine-free cigarettes before bidding. The four treatments in our 2 × 2 design were (A) no GE label with no marketing information, (B) no GE label with marketing information, (C) GE label with no marketing information, and (D) GE label with marketing information.

The information sheet that participants in two of our treatments received contained two statements regarding the Quest brand of cigarettes. This marketing information synthesized information from the manufacturer's Web site and was in addition to any information the consumers obtained from the box (which just stated the nicotine level of the cigarettes and a diagram on the back of the box that stated "Step to Nicotine Free!") The two statements read as follows: (1) "Quest is a brand of cigarettes with low or no nicotine" and (2) "Although Quest cigarettes have less nicotine, they look, smoke, and burn the same as conventional cigarettes and offer the same smoking enjoyment." We used this information sheet to test whether a short marketing message on the modified characteristics of these cigarettes would affect consumer demand for genetic engineering. Participants were randomly assigned a treatment group based on what time they participated in the experiment. The experiment monitors switched the treatment at the top of every hour.

Steps in the Experiment

In step 1, after prospective participants indicated interest, we asked them to read and sign consent forms, after which we gave them experimental packets (which can be obtained from the authors on request). In step 2, we explained the BDM auction mechanism and answered any questions from participants. In step 3, we conducted a practice round in which we collected separate bids for two candy bars. This practice round demonstrated to participants that it was truly in their best interests to

[5] Following Shogren et al. (2001b), we chose an upper bound to the limit price of \$6.00, which is approximately double the price one might pay at a store. Our lower-bound choice was \$0.10.

bid only their true value for a good in the auction—no more and no less. We also explained that, when participants bid on multiple products, only one product, chosen at random, would be auctioned. This avoids the possibility of participants purchasing multiple products that are similar and avoids any potential substitution effects. When the bidding for the candy bars ended, we determined whether the participant would purchase the randomly selected candy bar and at what price.

Following the practice round, we started step 4, the round of bidding on the cigarettes. First, we had participants indicate the brand of cigarettes they normally smoke (henceforth referred to as their regular brand). Because these cigarettes were not GE, no GE label was present on these packs of cigarettes. A package of each participant's regular brand of cigarettes was immediately purchased, if their specific brand was not already on hand, and displayed with the three packages of Quest cigarettes (low nicotine, extra-low nicotine, and nicotine free) for bidding. We then asked the participants to rank the four packs before them from most to least preferred. Once the consumers ranked the cigarettes, we asked them to place a separate bid for each of the four packs of cigarettes. Before they placed their bids, however, we reiterated that, similar to the candy bar round, only one of the four packs of cigarettes, chosen at random, would be sold in the auction.

In step 5, the pack of cigarettes to be sold was randomly determined, as was the market-clearing price. In step 6, participants completed a short postauction questionnaire and were paid \$10 for their participation. The experiment concluded with those who won the auction purchasing cigarettes at the selected market-clearing price.

Although we followed standard experimental auction valuation procedures (see Fox, Hayes, and Shogren; Shogren et al. 1994), we made four refinements to more closely replicate the consumer's usual purchasing environment. First, participants submitted one bid per product. This limitation on bidding is a departure from the practice of using multiple rounds of bidding. Proponents claim multiple rounds of bidding will help participants determine their values for products over time in a market environment or can help enforce rationality among consumers who might place bids that are not consistent with their preferences (e.g., see Cherry, Crocker, and Shogren; Lusk et al. 2001a). However, using multiple rounds of bidding can cause a posted-price effect (see Corrigan and Rousu 2003a; List and Shogren), which could distort bids. Second, we did not endow participants with a product and then ask them to upgrade to another product (e.g., Hayes et al.). Instead, participants bid on different cigarettes without an endowment (e.g., see Melton et al.; Rousu et al. 2004b). This practice avoids the risk of an in-kind endowment effect distorting the bidding behavior (see Corrigan and Rousu, in press). Third, we randomly assigned treatments to the participants, so the estimation of the treatment effect is the difference in means across treatments (Wooldridge). Fourth, by using adults in a field experiment, we obtained a more heterogeneous group of auction participants than if we had used only college students in a laboratory experiment. Table 1 summarizes the demographic characteristics of the sample.

Results

We examine unconditional summary statistics and conditional results based on regression analysis. First consider the unconditional results. Table 2 shows the mean bids for the various packs of cigarettes. As would be expected, the highest mean bid, \$2.69, is for the participants' regular brands, and this bid is roughly the average price of a pack of name-brand cigarettes in the area. The bid for the regular brand ranged from a low of \$0.50 to a high bid of \$5.00. While these outlying bids seem unusual given the market price, with a mean bid just slightly below the market price, the auction seemed to perform well at revealing consumers' demand. The mean bids for the Quest Low Nicotine, Quest Extra-Low Nicotine, and Quest Nicotine-Free cigarettes were \$1.66, \$1.59, and \$1.45, with a maximum bid of \$6. Quest cigarettes were not sold in this area at the time of the experiments,

Table 1. Characteristics of the Participants across the Treatments

Treatment	Total	Treatment A: GE Label = 0 Info = 0	Treatment B: GE Label = 0 Info = 1	Treatment C: GE Label = 1 Info = 0	Treatment D: GE Label = 1 Info = 1
Number of participants	112	29	30	29	24
Percentage female	0.38	0.31	0.38	0.52	0.33
	(0.49)	(0.47)	(0.49)	(0.51)	(0.48)
Mean age	28.9[a]	34.1	31.9	24.6	25.4[b]
	(12.1)	(12.5)	(13.5)	(9.68)	(10.0)
Attending college now	0.43	0.28	0.38	0.59	0.47
	(0.50)	(0.45)	(0.49)	(0.50)	(0.51)
The household's mean income	25.9	26.5	26.8	26.0	24.5
	(26.5)	(22.5)	(28.7)	(33.3)	(21.9)
Attenpted to quit recently	0.38	0.41	0.46	0.48	0.20
	(0.49)	(0.50)	(0.51)	(0.51)	(0.41)
Smokes light cigarettes	0.51	0.24	0.50	0.62	0.67
	(0.50)	(0.46)	(0.51)	(0.49)	(0.48)
Smokes a brand of Marlboro cigarettes	0.72	0.69	0.88	0.69	0.67
	(0.45)	(0.47)	(0.34)	(0.47)	(0.48)

[a] Two people did not report, so the sample size for this response was 110.
[b] Two people did not report, so the sample size for this response was 28.

thus, the high bids seem consistent with someone who might be trying to learn their preferences by purchasing the cigarettes (e.g., see Shogren et al. 2000). We created a variable "most-preferred Quest cigarettes," because different participants had different preferences for the reduced-nicotine cigarettes (e.g., some preferred nicotine-free cigarettes to low-nicotine cigarettes, whereas others had the opposite preference). This variable allows us to compare the bids for the participants' regular brands to the brand of Quest that was most preferred. The mean bid for the most preferred brand of Quest cigarettes was $1.84, which was considerably less than the bids for the regular brand. Only 5 of the 112 participants bid more for their most preferred brand of Quest cigarettes than they did for their regular brand.

Next, we compare the differences in bids between the GE-labeled and plain-labeled cigarettes. Table 2 shows the summary statistics for bids on the different types of cigarettes auctioned in this experiment along with the number of zero bids for each type of cigarette. Table 3 shows the mean bids for participants segregated by each of the four treatments. The bids for the consumers' regular brands of cigarettes are similar across the four treatments and the differences are not statistically significant. This similarity makes sense, because the regular brands are not genetically engineered and should be unaffected by the presence of GE labels on the Quest cigarettes. This similarity also provides evidence that the cigarette preferences of our sample are fairly uniform across the treatments.

Table 2. Mean Bids for Cigarettes (N = 112)

	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Zero Bids
Name-brand cigarettes	2.69	2.75	0.85	0.50	5.00	0
Quest low nicotine	1.66	1.75	0.77	0	4.00	3
Quest extra-low nicotine	1.59	1.50	0.80	0	4.00	3
Quest nicotine free	1.45	1.50	1.11	0	6.00	12
Most preferred Quest cigarette	1.84	1.85	1.01	0	6.00	3

Table 3. Mean Bids in Each of the Four Treatments

	Treatment A: GE Label = 0 Info = 0 (N = 29)	Treatment B: GE Label = 0 Info = 1 (N = 30)	Treatment C: GE Label = 1 Info = 0 (N = 29)	Treatment D: GE Label = 1 Info = 1 (N = 24)
Regular cigarettes	2.71	2.65	2.57	2.88
	(0.61)	(0.76)	(1.11)	(0.86)
Quest low nicotine	1.83	1.71	1.21[a]	1.94
	(0.80)	(0.67)	(0.84)	(0.52)
Quest extra-low nicotine	1.66	1.63	1.22[a]	1.89
	(0.74)	(0.80)	(0.85)	(0.66)
Quest nicotine free	1.58	1.46	0.99[a]	1.84
	(1.07)	(1.33)	(0.86)	(1.01)
Most preferred Quest cigarette	2.01	1.94	1.32[a]	2.17
	(0.93)	(1.09)	(0.90)	(0.92)

[a] Difference between these bids and corresponding bids in the other treatments are statistically significant at the 1% level (standard deviations in parentheses).

We now examine how the GE labels and marketing information influenced participant bids for Quest cigarettes. Comparing bids for participants that received no marketing information (treatments A and C), we find that the bids for Quest cigarettes when GE labels were present are lower than the bids for Quest cigarettes when GE labels were not present. These differences are statistically significant at the 1% level. Comparing bids for participants that received marketing information (treatments B and D) we find that those who also saw the GE labels bid more for Quest cigarettes than those who were asked to bid on non-GE-labeled cigarettes. We caution against a broad interpretation of this result, however, as the results are marginally statistically significant using a Wilcoxon rank-sum test (p-values for two-sided tests range between .11 to .15 for the three brands of cigarettes) and not statistically significant at any conventional level using a t-test.

We now consider the conditional results based on regression analysis. Following Huffman et al. (2003b), the dependent variable is the difference in bid prices for the regular-brand cigarettes and the most preferred Quest cigarettes for each participant (the derivations we use to arrive at Equation (1) can be obtained by the authors upon request). We derive this price difference by subtracting one inverse-demand equation for a commodity from the other for the two products, yielding the following equation:

$$(1) \qquad P_j^{\text{regular}} - P_j^{\text{Quest}} = \beta_1^* + \beta_2^* X_{j2} + \mu_j^*.$$

The difference in participant j's bid prices for regular and Quest cigarettes, P_j^{regular} and P_j^{Quest}, is explained by an intercept term, β_1^*, a vector of coefficients, β_2^*, that is multiplied by a vector of exogenous characteristics, X_{j2}, and a random error term, μ_j^*. Differencing the data before model estimation allows us to remove any linear time-invariant, individual-specific unobserved effect, and this method leads to unbiased and consistent estimates of information-treatment effects on the demand for GE-labeled cigarettes (Wooldridge).[6]

Using additional data obtained from the participants on the postauction questionnaire, we ran regressions examining what character-

[6] We ran these regressions using OLS. Censored regressions were also run, yielding similar results, which makes sense because no participants bid zero for their regular brand of cigarettes and only 3 of the 112 participants bid zero for all of the Quest cigarettes. Further, we also ran these regressions using an alternative dummy variable scheme for the treatments (which included a dummy variable that equals one for those that bid on GM-labeled cigarettes, a dummy variable that equals one for those that received marketing information, and a dummy variable cross term). The results were similar. All nonpublished results are available from the authors on request.

Table 4. OLS Regression Model

Regressor	(1)	(2)	(3)	(4)	(5)
Intercept	1.37[a]	1.50[a]	1.37[a]	1.35[a]	1.42[a]
	(0.24)	(0.24)	(0.24)	(0.25)	(0.26)
Treatment (A): no GE label and received no information	−0.57[b]	−0.57[b]	−0.68[a]	−0.69[a]	−0.69[a]
	(0.26)	(0.24)	(0.24)	(0.25)	(0.24)
Treatment (B): no GE label and received information	−0.53[b]	−0.60[b]	−0.68[a]	−0.68[a]	−0.68[a]
	(0.24)	(0.24)	(0.24)	(0.24)	(0.24)
Treatment (D): GE label and received information	−0.57[b]	−0.55[b]	−0.58[b]	−0.59[b]	−0.58[b]
	(0.26)	(0.25)	(0.25)	(0.25)	(0.25)
Quit recently		−0.39[b]	−0.47[b]	−0.58[b]	−0.47[b]
		(0.18)	(0.18)	(0.19)	(0.18)
College now			0.40[b]	0.40[b]	0.39[b]
			(0.18)	(0.18)	(0.18)
Female				0.06	
				(0.18)	
Income					−0.00
					(0.00)
Max bid for 0.3 mg cigs	0.09	0.13	0.20	0.20	0.20
	(0.20)	(0.20)	(0.20)	(0.20)	(0.20)
Max bid for nicotine-free cigarettes	−1.79[a]	−1.71[a]	−1.66[a]	−1.65[a]	−1.66[a]
	(0.34)	(0.33)	(0.33)	(0.33)	(0.33)
R^2	0.05	0.09	0.12	0.13	0.13

Notes: Dependent variable is the difference between bids for the regular brand and the most preferred Quest brand (N = 112). Standard deviations in parentheses.

[a] Coefficient is statistically significant at the 1% level using a two-sided t-test.

[b] Coefficient is statistically significant at the 5% level using a two-sided t-test.

istics influenced bids for the Quest cigarettes. Table 4 presents the results of these regressions. The intercept is large, positive, and statistically significant in all specifications, indicating that, after controlling for independent variables, participants discount Quest cigarettes relative to their usual brand. To test for treatment effects, we included dummy variables for treatments A, B, and D: (A) no GE label with no marketing information, (B) no GE label with marketing information, and (D) GE label with marketing information. Treatment (C), GE label with no marketing information, is the excluded variable.

The dummy variables for the three treatments are all negative. These coefficients are all statistically significant at either the 1% or 5% level. Our prior unconditional results, along with the fact that the dummy variable for treatment A is negative and statistically significant, allow us to reject hypothesis 1. We find evidence that, in the absence of marketing information, consumer bids for GE-labeled cigarettes are lower than bids for non-GE-labeled cigarettes. Some researchers have hypothesized that, when products are GE to change the consumption characteristics of the product to benefit consumers instead of just for agronomic purposes, consumer acceptance of GE products would increase (Hoban). For participants that received no marketing information, our auction results do not support this view.[7]

The dummy variables for treatment D are negative and statistically significant at the 5% level using a two-sided t-test. Those who bid on GE cigarettes and also received information were willing to pay more (or had a smaller discount) for the Quest cigarettes relative to those who only bid on the GE-labeled ciga-

[7] Note that our discussion of the benefits from GE does not imply all consumers will prefer the low-nicotine GE products. Rather, because the consumption characteristics have changed, consumers are more likely to see legitimate reasons for using GE.

rettes. Marketing information increased bid prices. This observation allows us to reject hypothesis 3 because those who receive marketing information bid more for GE-labeled cigarettes.

The dummy variables for treatments B and D are similar. Along with the unconditional statistical tests, the bulk of the evidence indicates we cannot reject hypothesis 2, which states that bids for GE-labeled cigarettes and non-GE-labeled cigarettes are identical in the presence of marketing information. The fact that, at a minimum, we find no evidence that consumers will bid less for the GE-labeled cigarettes when presented with marketing information is important. This result suggests that marketing information concerning product attributes may be a useful tool for companies that are considering using genetic engineering to create new second-generation GE products. One explanation for these findings is that consumers may have been skeptical that the cigarettes were really low nicotine (or nicotine free). Further, if the cigarettes were low nicotine (nicotine free), consumers may have been skeptical that these new cigarettes tasted the same as cigarettes that have nicotine. The label indicating the product was genetically engineered may have added credibility to the product by explaining to consumers how the product came to be nicotine free.

The general results from the model estimated in the first column (1) in Table 4 were found to also hold when we controlled for other factors, such as age, whether the participant had recently tried to quit smoking, if the participant was a college student, and the participant's income level. Three background characteristics seem to affect demand for Quest cigarettes relative to conventional cigarettes. First, those who attempted to quit smoking recently bid relatively more for the Quest cigarettes compared with their regular brand. It appears that these consumers viewed reduced nicotine cigarettes as a potential cessation aid. This has important implications, as it is seems some smokers who view Quest cigarettes as a cessation aid have higher demand. Those who were currently in college bid less for the Quest cigarettes, indicating that college students may place more value on nicotine than noncollege students. Finally, those whose maximum bid among the Quest cigarettes was for the nicotine-free cigarettes bid considerably more for the Quest cigarettes, indicating that these smokers saw significant value in nicotine-free cigarettes.

Conclusion and Discussion

Using data from field experimental auctions, we examined consumer demand for the solitary second-generation GE product on the U.S. market: cigarettes for which tobacco is genetically engineered to reduce nicotine levels. In the absence of marketing information, we found that consumers bid less for GE-labeled cigarettes relative to bids for the exact same cigarettes without a GE label. This finding confirms a general result observed in studies that have examined first-generation GE foods. When a label indicates that a food product was produced with GE, there is a general decline in preference toward that good. This result is intriguing when one considers that people who smoke are less likely to be health conscious (in a general sense) and are likely turned off by an aversion to the process of genetic engineering rather than any perceived health risk. Regardless of exactly why consumers bid less, our evidence does not support the hypothesis that genetic engineering will be more readily accepted when second-generation GE foods are sold.

When consumers received marketing information, however, GE labeling did not decrease demand. This result is surprising given the level of apprehension many consumers have toward GE food products. In our study, the GE label seemed to reassure consumers that the process of removing nicotine was legitimate, perhaps lending credence to the claim that the GE cigarettes "taste the same" as conventional cigarettes. These results, while preliminary given our limited sample, raise an interesting question for companies considering the production of second-generation GE food products: should companies voluntarily label their products as GE? The answer could depend on the level of marketing. We find strong evi-

dence that consumers who did not receive marketing information decreased their demand with a GE label, whereas we find mild evidence that consumers who received marketing information increased demand. If a company decides to market a new, second-generation GE product, it should not ignore the possibility that labeling its product "genetically engineered" might increase demand.

[Received September 2004; Accepted May 2005.]

References

Becker, G.M., H.H. DeGroot, and J. Marschak. "Measuring Utility by a Single Response Sequential Method." *Behavioral Science* 9(July 1964):226–36.

Chern, W.S., K. Rickertsen, N. Tsuboi, and T.-T. Fu. "Consumer Acceptance and Willingness to Pay for Genetically Modified Vegetable Oil and Salmon: A Multiple-Country Assessment." *Agbioforum* 5(2002):105–12.

Cherry, T., T. Crocker, and J.F. Shogren. "Rationality Spillovers." *Journal of Environmental Economics and Management* 45(2003):63–84.

Corrigan, J.R., and M. Rousu. "Posted Prices, Affiliated Values, and the Top-Dog Effect: Evidence from Experimental Auctions." RTI working paper, 2003a.

———. "The Effect of Initial Endowments in Experimental Auctions." *American Journal of Agricultural Economics* 2006, in press.

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

Frewer, L.J., J. Scholderer, and L. Bredahl. "Communicating about the Risks and Benefits of Genetically Modified Foods: The Mediating Role of Trust." *Risk Analysis* 23(2003):1117–33.

Friends of the Earth. "The Need for Labeling Genetically Engineered Foods." Internet site: http://www.foe.org/safefood/factshtgelabel.htm (Accessed March 2001).

Greenpeace International. "We Want Natural Food!" Internet site: http://www.greenpeace.org/~geneng/ (Accessed March 2001a).

———. "7. Public Concern." Internet site: http://www.greenpeace.org/%7Egeneng/reports/food/intrfo07.htm (Accessed March 2001b).

———. "11. The Potential for Allergic Reactions." Internet site: http://www.greenpeace.org/%7Egeneng/reports/food/intrfo11.htm (Accessed March 2001c).

Grimsrud, K., J.J. McCluskey, M.L. Loureiro, and T.I. Wahl. "Consumer Attitudes Toward Genetically Modified Food in Norway." IMPACT Center technical working paper. Pullman, WA: International Marketing Program for Agricultural Commodities and Trade, 2003.

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

Hoban, Thomas J. "Trends in Consumer Attitudes about Agricultural Biotechnology." *Agbioforum* 1(1998):3–7.

Huffman, W.E., M. Rousu, J.F. Shogren, and A. Tegene. "Consumer Willingness to Pay for Genetically Modified Food Labels in a Market with Diverse Information: Evidence from Experimental Auctions." *Journal of Agricultural and Resource Economics* 28(December 2003a): 481–502.

———. "The Public Good Value of Information from Agribusinesses on Genetically Modified Foods." *American Journal of Agricultural Economics* 85(December 2003b):1309–15.

List, J.A., and J.F. Shogren. "Price Information and Bidding Behavior in Repeated Second-Price Auctions." *American Journal of Agricultural Economics* 81(November 1999):942–9.

Lusk, J.L. "Effects of Cheap Talk on Consumer Willingness-to-Pay for Golden Rice." *American Journal of Agricultural Economics* 85(November 2003):840–56.

Lusk, J.L., M.S. Daniel, D.R. Mark, and C.L. Lusk. "Alternative Calibration and Auction Institutions for Predicting Consumer Willingness to Pay of Nongenetically Modified Corn Chips." *Journal of Agricultural and Resource Economics* 26(July 2001a):40–57.

Lusk, J.L., J.A. Fox, T.C. Schroeder, J. Mintert, and M. Koohmaraie. "In Store Valuation of Steak Tenderness." *American Journal of Agricultural Economics* 83(August 2001b):539–50.

Lusk, J.L., L.O. House, C. Valli, S.R. Jaeger, M. Moore, B. Morrow, and W.B. Traill. "Effect of Information about Benefits of Biotechnology on Consumer Acceptance of Genetically Modified Food: Evidence from Experimental Auctions in the United States, England, and France." *European Review of Agricultural Economics* 31(2004):179–204.

Lusk, J.L., M. Jamal, L. Kurlander, M. Roucan, L. Taulman. "A Meta Analysis of Genetically

Modified Food Valuation Studies." *Journal of Agricultural and Resource Economics* 30 (2005):28–44.

Melton, B.E., W.E. Huffman, J.F. Shogren, and J.A. Fox. "Consumer Preferences for Fresh Food Items with Multiple Quality Attributes." *American Journal of Agricultural Economics* 78(November 2003):916–23.

Noussair, C., S. Robin, and B. Ruffieux. "Do Consumers Really Refuse to Buy Genetically Modified Food?" *The Economic Journal* 114(2004): 102–20.

Rousu, M., and W.E. Huffman. "GE Food Labeling Policies of the U.S. and Its Trading Partners." Ames, IA: Iowa State Department of Economics Staff Paper, Number 344, September 2001.

Rousu, M., W.E. Huffman, J.F. Shogren, and A. Tegene. "Are United States Consumers Tolerant of Genetically Modified Foods?" *Review of Agricultural Economics* 26(February 2004a):19–31.

———. "Estimating the Public Value of Conflicting Information: The Case of Genetically Modified Foods." *Land Economics* 80(February 2004b):125–35.

Scholderer, J., and L.J. Frewer. "The Biotechnology Communication Paradox: Experimental Evidence and the Need to a New Strategy." *Journal of Consumer Policy* 26(2, 2003):125–57.

Shipman, D.R. "Marketing of Grains in Today's Evolving Markets." Paper presented at the meeting of Strategies for Coexistence of GEO, Non-GEO, and Organic Crop Production, Minneapolis, MN, November 28, 2001.

Shogren, J.F., S. Cho, C. Koo, J. List, C. Park, P. Polo, and R. Wilhelmi. "Auction Mechanisms and the Measurement of WTP and WTA." *Resource and Energy Economics* 23(April 2001b): 97–110.

Shogren, J.F., J.A. List, and D. Hayes. "Preference Learning in Consecutive Experimental Auctions." *American Journal of Agricultural Economics* 82(November 2000):1016–21.

Shogren, J.F., M. Margolis, C. Koo, and J.A. List. "A Random *n*th-Price Auction." *Journal of Economic Behavior and Organization* 46(December 2001a):97–109.

Shogren, J.F., S.Y. Shin, D.J. Hayes, and J.B. Kliebenstein. "Resolving Differences in Willingness to Pay and Willingness to Accept." *The American Economic Review* 84(March 1994):255–70.

Teisl, M.F., L. Halverson, K. O'Brien, B. Roe, N. Ross, and M. Vayda. "Focus Group Reactions to Genetically Modified Food Labels." *Agbioforum* 5(2002):6–9.

U.S. Food and Drug Administration. "Guidance for Industry: Voluntary Labeling Indicating Whether Foods Have or Have Not Been Developed Using Bioengineering." Internet site: http://vm.cfsan.fda.gov/~dms/biolabgu.html (Accessed January 2001).

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

Wooldridge, J.M. *Econometric Analysis of Cross Section and Panel Data.* Cambridge, MA: MIT Press, 2002.