Estimating the Public Value of Conflicting Information: The Case of Genetically Modified Foods

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ABSTRACT. *Environmental groups have become the chief antagonists toward agricultural biotechnology innovations. They demonstrate and disseminate private information with the objective of changing the behavior of consumers and producers. We use experimental auctions with adult U.S. consumers and show that this information reduces significantly the demand for genetically modified (GM)-food products and that it has significant public good value—an average of 3 cents per product purchased, or roughly $2 billion annually. We also show that the dissemination of independent third-party information about agricultural biotechnology dissipates most of the public good value of negative GM-product information.* (JEL D83, Q18)

I. INTRODUCTION

Some people hail the use of biotechnology to create genetically modified (GM) products as a major new revolution in product innovation.[1] However, not everyone views these products favorably. Environmental groups like Greenpeace and Friends of the Earth have become the main antagonists against the use of genetic engineering for development of new products. They demonstrate and disseminate information, representing their self-interest, with the goal of affecting consumers' (and possibly producers') behavior. Greenpeace, for example, claims that the unknown effects of using GM products could be disastrous to the environment and human health, that multinational agribusiness companies control genetic modification, and that GM foods pose a risk of allergens spreading to food products other than those that normally carry allergens (See Friends of the Earth 2001; Greenpeace International 2001). Through press releases, web sites, and protests, environmental groups have been successful at publicizing their negative views on GM foods and affecting consumers' and producers' behavior.[2]

Environmental groups share the costs of producing negative GM information.[3] Their members benefit collectively from reductions in demand for GM products that result from this information. Because the negative information and outcomes are not specifically excluded from nonenvironmental groups in society, they may also benefit (or harm) others, and this is the sense in which the information has potential public good attributes across groups in society (Cornes and Sandler 1996; Andreoni 1990). If those not in environmental groups could be effectively excluded from

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the benefits, the negative information would be a club good to the environmental group (Cornes and Sandler 1996).[4]

In this paper, we postulate that negative GM information supplied by an environmental group has public good value. We estimate this public good value *through the eyes of an environmental group member* by quantifying the "perceived public good" value to consumers who participated in experimental laboratory auctions. The perceived value (henceforth public good value) is obtained from individuals who changed their behavior after receiving information from environmental groups.

Our results lead to two conclusions. First, a relatively large public good value exists for negative GM information—about 3 cents per product purchased per consumer or $2 billion nationally. Second, if a third party produced and disseminated verifiable, independent information on genetic modification, the public good value of negative information would decrease dramatically—to less than 1 cent per purchased product per consumer.

Treatment	Positive/negative	Third-party
1.	Pro-biotech	No
2.	Pro-biotech, anti-biotech	No
3.	Pro-biotech	Yes
4.	Pro-biotech, anti-biotech	Yes

FIGURE 1
The Four Information Treatments Given to Participants

II. EXPERIMENTAL DESIGN

To examine the value of information from environmental groups, we use the data from the experimental auctions described in Rousu et al. (2002). These experiments were designed using an array of experimental methods developed by Smith (1976), including the "induced valuation method," where auction participants receive monetary rewards for making good decisions. In our design, three types of information about GM and biotechnology were defined (1) the industry perspective—provided by a group of leading biotechnology companies, including Monsanto and Syngenta; (2) the environmental group perspective—from Greenpeace, a leading environmental group or biotech antagonists; and (3) the third-party, verifiable perspective—from a neutral third-party group of scientists, professionals, religious leaders, and academics, none with a financial stake in GM foods. For this study, the information was organized into four treatments that are summarized in Figure 1. A participant could receive the following: (1) only pro-biotechnology information, (2) both pro- and anti-biotech-

[1] As currently used, genetic modification has a specific and somewhat narrow meaning—the application of the basic technique of recombinant DNA or gene-splicing technology. The process is sometimes referred to as genetically engineered, genetically modified, or bioengineered. Cohen and Boyer discovered the technique of recombinant DNA in 1973, and were awarded a patent on gene splicing technology in 1980. This technology facilitates the transfer of genes across species. It built on the 1953 discovery by Watson and Crick of the structure of DNA and of their suggestion about how it replicates.

[2] These groups have also influenced legislation. The European Union, where the anti-GM lobby is relatively strong (Hayes et al. 1995), enacted a moratorium on new GM foods in April 1998. In addition, those GM foods approved for consumption now must be labeled "genetically modified." Environmental groups have also helped influence other countries like Japan, Australia, and New Zealand (Rousu and Huffman 2001) to enact mandatory labeling of GM foods.

[3] There is a fixed cost to the initial preparation, but the Internet has made the marginal cost of distribution essentially zero.

[4] Ambiguity exists over whether information from environmental groups should formally be defined as a public good or a club good. A club good, as defined in Sandler and Tschirhart (1980), is a "voluntary group deriving mutual benefit from sharing one or more of the following: production costs, the members' characteristics, or a good characterized by excludable benefits." Environmental groups share the production costs of information—so one might consider their information to be a club good. Their information is disseminated to nonmembers, and there is limited exclusion to those who are not environmental group members, which is why we call this information an impure public good.

nology information, (3) both pro-biotechnology and verifiable (third-party) information, or (4) pro-biotechnology, anti-biotechnology, and verifiable (third-party) information. These four information treatments, each with two replications, were randomly assigned to eight experimental units, each containing 13 to 16 participants. The data collected from participants in the experiment provide a unique data set that allows us to examine how consumer behavior towards GM food changed when information from environmental groups is introduced.

The experiment can be summarized in ten steps.[5] When participants arrived at the lab, they signed consent forms agreeing to participate in the auction. After they signed the forms, they were given $40 for participating and an ID number to use in order to preserve their anonymity. The participants then read a brief set of instructions and filled out a questionnaire.

Step 2 introduced the auction. We used a random *n*th price auction in this experiment (Shogren et al. 2001). The advantages of the random *n*th price auction are that it is demand revealing in theory and the auction attempts to engage bidders at all locations along the demand curve.[6] The random *n*th price works as follows: each of k bidders submits a bid for one unit of a good; then each of the bids is rank-ordered from highest to lowest. The auction monitor then selects a random number that is drawn from a uniform distribution between 2 and k, and the monitor sells one unit of the good to each of the $(n - 1)$ highest bidders at the *n*th price. For instance, if the monitor randomly selects $n = 5$, the four highest bidders each purchase one unit of the good priced at the fifth-highest bid. Ex ante, bidders who have low or moderate valuations now have a nontrivial chance to buy the good because the price is determined randomly. This auction increases the odds that insincere bidding will lead to a loss. Participants were given detailed instructions on the random *n*th price auction, including an example written on the board. After the participants learned about the auction, a short quiz was given to ensure that everyone understood how the auction worked.

Step 3 was the first practice round of bidding, where participants bid on a brand-name candy bar. The participants were asked to examine the product and then place a (sealed) bid on the candy bar. The bids were collected and the first round of practice bidding was over. Throughout the auction, when the participants were bidding on items in a particular round, they had no indication of what other items they may be bidding on in future rounds or if additional rounds would occur.

Step 4 was the second practice round of bidding. In this round, the participants bid separately on three different items. The three products were the same brand-name candy bar, a deck of playing cards, and a box of pens. The consumers were asked to examine the three products in practice round two and make bids on the products. Then the bids were collected. Only one of the two rounds was chosen as binding (valid), so that participants would not take home more than one of any product. The reason was to eliminate price reduction due to the consumer buying a larger quantity because of diminishing marginal utility of these products (i.e., lower prices due to a consumer's negatively sloped demand curve). Participants were informed that only one of the two rounds would bind before Step 3 and were reminded of this again before Step 4.

After the two practice auction rounds were completed, the binding round and the binding *n*th prices were revealed in Step 5. All of the bids were written on the blackboard, and the *n*th prices were circled for each of the three products. Participants could see immediately what items they won and the market-clearing price. The participants were notified that all purchases of goods would take place after the experiment was over, so that all exchanges

[5] The complete set of information given to participants is available upon request from the authors.

[6] For a more detailed description of the benefits of the random *n*th-price auction (see Shogren et al. 2001).

of money for goods would take place at the end of the session.

In Step 6, information about biotechnology was released to the participants. The possible types of information a participant could receive were as follows: (1) the industry perspective—a collection of statements and information on genetic modification provided by a group of leading biotechnology companies, including Monsanto and Syngenta; (2) the environmental group perspective—a collection of statements and information on genetic modification from Greenpeace, a leading environmental group; and (3) the third-party, verifiable perspective—a statement on genetic modification approved by a third-party group, consisting of a variety of individuals knowledgeable about GM goods, including scientists, professionals, religious leaders, and academics, none of whom have a significant financial stake in GM foods. To help the participants understand these different sources of information, the volume of information released of each type was limited to one 8 1/2" × 11" page, and it was organized into five categories—general information, scientific impact, human impact, financial impact, and environmental impact—to ease the information processing load on participants. The exact sheets given to participants are available in Rousu et al. (2002) or from the authors on request.

The information was randomized to create four treatments of information combinations: pro-biotechnology information; both pro- and anti-biotechnology information;[7] pro-biotechnology and third-party, verifiable information;[8] and pro-biotechnology, anti-biotechnology, and third-party, verifiable information. These four combinations were randomized among all eight experimental units, with each information combination going to two experimental units.

Two auction rounds followed the distribution of information. One of the two rounds had the participants bid on three food products with just a standard food label.[9] The other round had participants bid on the same food products with the same label, except there was a sentence added indicating that the food had been genetically engineered. We used three different food products: vegetable oil (made from soybeans), tortilla chips (made from yellow corn), and russet potatoes. These products were chosen because both GM and non-GM versions of these products were obtainable; they are neither strong complements nor substitutes, so an increase in the probability of purchasing one product should have little or no effect on bids for the other products; having three products ensures that, if a consumer has no demand for one or two products, we can still get information on his/her preference for genetic modification on the other item(s); and these products have different properties, as it is plausible that consumers would view genetic modification differently with respect to these different products.

The labels for these products were made as plain as possible to avoid any influence on the bids from the label design. The sequencing of GM labels was randomized across experimental units. Each combination of information was given to two experimental units, that is, two replications. One of these experimental units bid on food with the standard label in round one and on food with the label indicating genetic modification in round two. The other experimental unit bid on food with the label indicating genetic modification in round one and on food with the standard label in round two. For each experimental unit, only one of the two food rounds was chosen as the binding round. This avoided the problem of bid prices being reduced as consumers moved along their demand curve.

[7] When a participant received both pro-biotechnology and anti-biotechnology information, the order was randomized so that some participants received the pro-biotechnology information first, and others received the anti-biotechnology information first.

[8] When third-party information was distributed, it always was distributed after the other information types.

[9] The exact labels are available for viewing in Rousu et al. (2002) or are available from the authors upon request.

In Step 7, participants bid on three different food products: a bag of potatoes, a bottle of vegetable oil, and a bag of tortilla chips. The participants were instructed to examine the three products and then write down their (sealed) bid for each of the three goods. Participants bid on each good separately. Then the bids were collected from the individuals, and the participants were informed that they were about to look at another group of food items.

Step 8 had participants examine the same three food products, but with the different labels (the second trial). After the participants examined the products, they were instructed to bid on the three products. Each good was bid on separately. The bids were then collected from all of the participants. Once again, before Step 7, consumers were informed that only one of the two trials or bidding rounds would bind and they were told this again before Step 8.

In Step 9, we selected which of the two trials would be chosen as binding, along with the binding *n*th prices. After the binding round and binding *n*th prices were revealed, the winners were notified, and the participants were asked to complete a brief post-auction questionnaire. In Step 10, the participants who did not win any products were informed that they were free to leave, and the participants who won products exchanged money for their goods, and then they were free to leave.

Although our experimental design follows standard procedures (e.g., Shogren et al. [1994]), we made several refinements to better reflect consumer purchases. First, subjects submitted only one bid per product to avoid any question of creating affiliated values. Affiliation exists when the bid of a high-value bidder signals commonly perceived, but unknown, characteristics of a product, which increases the odds that other bidders will also put a high value on the good (see Milgrom and Weber [1982]). In effect, independent private values are transformed into affiliated values, which can affect the demand-revealing nature of the Vickrey-style random *n*th-price auction (see, for example, List and Shogren, [1999]). Second, we do not endow our subjects with a food item and then ask them to "upgrade" to another food item; rather participants are paid $40 and then bid on different foods in only two trials. This avoids the risk of an in-kind endowment effect or an increase in valuation to an individual that occurs when he/she is given a product. This effect is reflected in an individual's willingness to pay for a particular good being significantly less than his/her willingness to accept, given the endowment. An endowment effect is of concern because it might distort a participant's bidding behavior (e.g., Lusk and Shroeder 2002 or Corrigan and Rousu 2003). In addition, by paying each person a $40 participation fee we virtually eliminate the possibility that someone will not have adequate resources to place a bid on a product (i.e., we eliminate the credit constraint). Third, we randomly assigned treatments to the experimental units, so estimating the treatment effect is simply the difference in means across treatments (see Wooldridge 2002).

Fourth, we use adult consumers over 18 years of age from two different midwestern metropolitan areas that were chosen using a random digit dialing method. Table 1 summarizes their demographic characteristics. The demographics of our sample do not perfectly match the U.S. census demographic characteristics for these regions (U.S. Census Bureau 2002), but they are similar and provide a sufficient representation for our initial probe into labeling and information for GM products. In addition, we use common food items that are available to shoppers in grocery stores and supermarkets. Furthermore, we use adults rather than students to better reflect a typical household of consumers. Although several studies have used college undergraduates in laboratory auctions of food items (Lusk et al. 2001; Hayes et al. 1995), they are not the best choice for participants when the items being auctioned are ones sold in grocery stores or supermarkets.

Using a national random sample of grocery store shoppers, Katsara et al. (2001) showed that the share of college-age (18 to 24) shoppers falls far below their share in the population (8.5% of shoppers versus

TABLE 1
Characteristics of the Auction Participants (n = 114)

Variable	Definition	Mean	St. Dev
Gender	1 if female	0.61	0.49
Age	Participant's age[a]	51.1	17.1
Married	1 if the individual is married	0.69	0.46
Education	Years of schooling	14.67	2.30
Household	Number of people in participant's household	2.64	1.68
Income	Household income level (in thousands)[b]	57.6	32.2
White	1 if participant is white	0.93	0.26
Read_L	1 if never reads labels before a new food purchase	0.01	0.01
	1 if rarely reads labels before a new food purchase	0.13	0.34
	1 if sometimes reads labels before a new food purchase	0.31	0.46
	1 if often reads labels before a new food purchase	0.37	0.48
	1 if always reads labels before a new food purchase	0.18	0.39
Informed	1 if an individual considered themselves at least somewhat informed regarding genetically modified foods	0.45	0.50

[a] The median age of participants is 54 years old.
[b] The median income of participants is $55,000.

12.8% in the U.S. Census of Population). College students obtain a large share of their food from school cafeterias and a small share from grocery stores and supermarkets compared to older shoppers (Carlson, Kinsey, and Nadav 1998). Although our participants are slightly skewed toward women, Katsara et al. (2001) showed that women make up a disproportional share of grocery store shoppers (83% of shoppers versus 52% in the U.S. Census of Population). A sample primarily of grocery store shoppers also weakens the sometimes-stated need for having students participate in several rounds of bidding to stabilize bids for food items. We also minimize Hawthorne effects in bidding, that is, an individual's behavior changes because they participate in an experiment with a particular objective (see Melton et al. 1996).

III. EMPIRICAL MODEL

Following Foster and Just (1989), we determine the public value of information in three steps (also see Rousu et al. 2002; Teisl, Bockstael, and Levy 2001). First, introducing new information does not change the situation, only the consumer's knowledge. More information cannot make consumers worse off.[10] Second, assuming consumers maximize their utility subject to a budget constraint, one computes the expenditure function when the consumer has and does not have the new information. Third, once the new information is provided, if a consumer's purchases do not change, the information is treated as having no value—clearly a lower-bound estimate. If the consumer purchases a different bundle, he/she is presumed to be better off with the new information. Conceptually, the value of information is the difference in the expenditure function for a given utility with and without new information. This occurs because, if a consumer changes his/her behavior after receiving the new information, this information allowed him/her to make "better" purchasing decisions and spend less money to reach any given level of utility.[11]

Formally, information from environmental groups causes some consumers to switch

[10] This concept is similar to the concept behind the LaChatelier Principle. With more information, one has the opportunity to adjust his/her behavior to an optimal purchasing bundle. Consumers can maintain the status quo or change, and they cannot be made worse off.

[11] Other procedures could be used to obtain an estimate of the value of information. Different methods might lead to different results, but we believe that our approach leads to one plausible and defensible estimate.

from GM-labeled to plain-labeled foods because they realize they receive higher surplus from consuming plain-labeled foods than they receive from consuming GM-labeled foods:[12]

$$\text{surplus}^{j}_{\text{plain-labeled}} = \text{WTP}^{j}_{\text{plain-labeled}} - \text{P}^{j}_{\text{plain-labeled}} \quad [1]$$

$$\text{surplus}^{j}_{\text{labeled}} = \text{WTP}^{j}_{\text{labeled}} - \text{P}^{j}_{\text{labeled}} \quad [2]$$

The value of information to each person who switches is estimated by the difference in consumer surplus between the plain-labeled and GM-labeled foods:[13]

$$\text{PREMGAIN}^{j}_{\text{plain-labeled}} = \text{surplus}^{j}_{\text{plain-labeled}} - \text{P}^{j}_{\text{labeled}} \quad [3]$$

All consumers who purchased plain-labeled foods obtain the premium as defined in equation [3]. But, this premium only represents increased welfare (i.e., the public-good value of information) for consumers who *switched* to plain-labeled foods from GM-labeled foods after receiving information from environmental groups.[14]

The aggregate value of information is the sum of the value of information for all individuals who changed their purchases because of the information from environmental groups:

$$\text{SUMVAL} = \sum_{j \in \text{switched}} \text{PREMGAIN}^{j}_{\text{plain-labeled}}. \quad [4]$$

To determine the *average* value of information from environmental groups to a consumer who *switched* from GM-labeled to plain-labeled foods, we divide the total value of information by the number of consumers who switched purchases:

$$\text{switchervalue} = \frac{\text{SUMVAL}}{\text{N}^{\text{buy} - \text{switchedproduct}}}. \quad [5]$$

We obtain the average value of information per consumer by dividing the total value of information by the total number of consumers:

$$\text{valueperson} = \frac{\text{SUMVAL}}{\text{N}^{\text{pop}}}. \quad [6]$$

We apply this framework to our experimental auction data to calculate the percentage of consumers who switch to plain-labeled foods in two information settings: those consumers initially receiving positive information or those consumers initially receiving both positive and verifiable information. We then compute the average public-good value of information from environmental groups per consumer who switches for each product. Finally, we estimate the average public-good value of information from environmental groups per consumer in the population for each product. We suggest that these procedures provide a lower-bound estimate of the value of information.

IV. RESULTS

The percentage of participants who purchased GM-labeled foods both with and without information from environmental groups are reported in Table 2. Part A shows the percentage of consumers who bought GM foods when they initially received only the industry perspective. Part B shows the percentage of consumers who bought GM-labeled foods when they initially received information from biotech-

[12] Prices for the GM-labeled and plain-labeled foods are assumed to be the mean bid prices from the auction.

[13] If consumer *j* ate GM-labeled foods before receiving environmental information, he/she perceived $\text{surplus}^{j}_{\text{labeled}} > \text{surplus}^{j}_{\text{plain-labeled}}$ and thus consumed GM-labeled foods. If after receiving information from environmental groups, consumer j switches to plain-labeled foods, his/her perception of the surplus changes such that $\text{surplus}^{j}_{\text{labeled}} < \text{surplus}^{j}_{\text{plain-labeled}}$. The difference in surplus represents the change in consumer *j*'s welfare—the value of information from environmental groups. This does not imply the consumer assigns no weight to past information, or views previously received information as worthless. It reflects the idea that new information may change consumers' prior perceptions of the surplus they receive from various products.

[14] Our experimental auction data allow us to estimate the percentage of consumers who switch from GM-labeled to plain-labeled foods because of the information from environmental groups.

TABLE 2
The Percentage of Participants Who Purchase GM-Labeled Foods with and without Information from Environmental Groups

Part A—Participants who originally received information only from agribusiness companies

	Percentage Who buy GM-Labeled without Information from Environmental Groups	Percentage Who Buy GM-Labeled with Information from Environmental Groups	Percentage Difference
Tortilla Chips	83.3	73.9	9.4
Vegetable Oil	76.9	58.3	18.6
Potatoes	85.2	57.7	27.5

Part B—Participants who originally received information from both agribusiness companies and an independent, third-party group

	Percentage Who Buy GM-Labeled without Information from Environmental Groups	Percentage Who Buy GM-Labeled with Information from Environmental Groups	Percentage Difference
Tortilla Chips	80.0	82.6	−2.6
Vegetable Oil	92.3	73.9	19.4
Potatoes	88.5	79.2	9.3

nology companies and the third-party sources. Our results show that a smaller percentage of consumers purchase GM-labeled foods when they receive GM-information from environmental groups.

The public-good value of information from environmental groups is reported in Table 3. Part A reports the value to consumers who initially received industry information on agricultural biotechnology only. For tortilla chips, almost 10% of participants changed their purchase to plain-labeled food products from GM-labeled ones after receiving the environmental group information on agricultural biotechnology. The average public value of information to each consumer who switched purchases is 18 cents per bag, and the average public value to each consumer in society is 1.7 cents per bag. For vegetable oil, environmental group information caused over 18% of consumers to switch, with an average value of almost 38 cents per bottle per person who switched. The average public value is 7 cents per bottle per person in society. For GM-labeled potatoes, 27% of participants switched when they received new environmental group information; the average public value per person who switched is 15 cents per bag; and the average public good value is 4 cents per bag. On average, the mean public-good value of information from environmental groups is approximately 3 to 4 cents per person per purchased product that is potentially GM.[15]

Part B of Table 3 shows the value of environmental group information for consumers who initially received both biotechnology industry and third-party information. Here the value of environmental information is significantly lower—averaging less than half of a cent for tortilla chips and potatoes and about 2 cents for vegetable oil. Across the three commodities, information from environmental groups is worth on average less than 1 cent per per-

[15] Recall we established market prices to obtain these values, and we used the sample mean bids as the market price. Using alternative market prices, one with a higher premium and one with a lower premium for plain-labeled foods, we find the average value is approximately 3 cents and 4 cents, respectively. The values appear robust to assumptions about market prices.

TABLE 3
The Public Good Value of Information from Environmental Groups

Part A—Value for participants who initially receive positive information

	Percentage Who Switch from GM	Value Per Switcher	Average Value Per Person
Tortilla Chips	9.4	$0.180/bag	$0.017/bag
Vegetable Oil	18.6	$0.378/bottle	$0.070/bottle
Potatoes	27.5	$0.151/bag	$0.041/bag

Part B—Value for participants who receive both positive and third party information

	Percentage Who Switch from GM[a]	Value Per Switcher	Average Value Per Person
Tortilla Chips	−2.6	$0.002/bag	$0.000/bag
Vegetable Oil	19.4	$0.132/bottle	$0.024/bottle
Potatoes	9.3	$0.032/bag	$0.003/bag

[a] In the market with both positive and third-party information, adding information from environmental groups caused some people to switch to GM-labeled tortilla chips. More participants purchased the plain-labeled varieties of the vegetable oil and the potatoes when environmental information was provided.

son per product. Hence, the value of information from environmental groups is considerably lower when participants initially received information from both agribusiness companies and third-party groups. This result suggests that consumers who received third-party information on agricultural biotechnology gave less weight to environmental group information, which decreased its public-good value to the GM antagonists.

V. CONCLUDING REMARKS

Our results suggest that negative GM-product information supplied by environmental groups can significantly reduce consumer demand for GM products, and the public-good value of this information from environmental groups was about 3 cents for each of the three products purchased by the consumers in our sample. If we were to take the bold step and aggregate these findings to the national level, we would obtain the following result. Assume the anti-biotechnology information reached every person in the United States, then the value of negative GM information would be roughly $2 billion annually for U.S. consumers.[16] Although large, the aggregate value does not seem unrealistic.[17] The av-

16. We obtain this value by first taking the smaller value of 3 cents per product for those who did *not receive third-party information* on agricultural biotechnology. Because the prices for these products range between $1.50 and $2.50, verifiable information has a value of about 1.5% of the purchase price. Second, using a lower estimate that only one-third of all foods contain some GM material and U.S. citizens spent $390 billion for food at home in 1997 (Putnum and Allshouse 1999), Americans spent roughly $130 billion on foods that could be GM. The aggregate public value of environmental information is roughly $1.95 billion annually in the United States.

17. One could argue that this estimate underestimates the value for two reasons. First, we presume participants who did not change their habit of consuming GM products obtain no public-good value from information from environmental groups. This is a conservative assumption because some participants may feel better about their consumption decision when it is informed by material from environmental groups, relative to their preferences. Second, we are considering the aggregate value from U.S. consumers only. However, this information would also be freely available to consumers in foreign countries who make up 19/20 of the world population, which implies additional aggregate public-good value for negative GM information.

erage value would be about $7.00 *per year* per person, which is considerably less than Foster and Just's value of information for contaminated milk of $10.00 *per month* per person (or $120.00 per year). We have also shown that the distribution of independent third-party information dissipates most of the public good benefit of negative GM-product information. Because the experimental data were obtained from consumers in two midwestern U.S. cities (not a hotbed of environmental group activity), it would be instructive to test consumer reactions in other regions of the United States. In addition, because some groups (e.g., agribusinesses) view information from environmental groups as a cost it would also be useful to determine the "cost" of information from environmental groups to these parties.

APPENDIX A

Demographic Characteristics of Polk County, Iowa, including Des Moines area, and Ramsey County, Minnesota, including St. Paul area

Variable	Definition	Polk	Ramsey	Average
Gender	1 if female	0.52	0.52	0.52
Age	Median age	45.7	45.7	45.7
Married	1 if the individual is married[a]	59.5	51.4	55.5
Education	Years of schooling[b]	13.52	13.76	13.64
Income	Median household income level (in thousands)	46.1	45.7	45.9
White	1 if participant is white	0.9	0.8	0.85

Note: All variables are for individuals of all ages, except for married, which is for individuals 18 or older; education, which is for individuals 25 or older; and age, which is for individuals 20 or older.

[a] The estimate of the number of married people who are 18 or older was obtained by taking the number of people married over 15 and assuming that the number of people were married at ages 15, 16, and 17 were zero—this gives the percentage of people who are married who are 18 or older.

[b] The years of schooling was estimated by placing a value of 8 for those who have not completed 9th grade, 10.5 for those who have not completed high school, 12 for those who have completed high school but have had no college, 13.5 for those with some college but no degree, 14 for those with an associate's degree, 16 for those with a bachelor's degree, and 18 for those with a graduate or professional degree.

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