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## **THE PUBLIC GOOD VALUE OF INFORMATION FROM AGRIBUSINESSES ON GENETICALLY MODIFIED FOODS**

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AND ABEBAYEHU TEGENE**

Some people hail using biotechnology to create genetically modified (GM) food products as a major revolution in product innovation. Some, however, do not view these products favorably. International environmental groups like Greenpeace and Friends of the Earth have become the main antagonists against the use of genetic engineering for developing new products. Through press releases, websites, and protests, these environmental groups publicize their views on GM foods and how these products affect consumers and producers. They demonstrate and disseminate information, with the goal of affecting consumer (and possibly producer) behavior. Greenpeace, for example, argues 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 (Greenpeace International 2001a,b,c; Friends of the Earth).

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In contrast, the agribusiness community, led by Monsanto and Syngenta, has been extremely optimistic about the potential of GM technologies and GM foods. For example, they suggest that GM plants and animals have the potential to be one of the greatest discoveries in the history of farming. GM technology is reducing the cost of food and fiber production, reducing the rate of application of chemical pesticides, and reducing the rate of farm worker poisoning. In the future, GM crops will contain enhanced vitamins (e.g., Vitamin A) and protein content and reduced saturated fat content. Furthermore, agribusinesses claim that GM foods can help end world hunger. Recently the agricultural biotechnology industry formed a public information arm called the Council for Biotechnology Information (Council for Biotechnology Information). This coalition was designed in large part to counteract the negative information on agricultural biotechnology being disseminated by environmental groups.

Agribusiness companies and the Council for Biotechnology Information release private information through news releases, websites, television commercials, annual reports, and even children's coloring books. These companies expect this information to increase consumer and producer demand for GM products above what it would be otherwise. They anticipate that the market demand for new GM products will be large enough to recover R&D and advertising costs and earn at least a normal rate of return on their investment.

Also, in some cases, company advertising serves an educational role. Advertising may bring information on agricultural biotechnology to consumers. In fact, drug companies often boast that their advertisements on new drugs help inform consumers of new treatment

options before busy doctors become aware of pharmaceutical advances (Steyer). The value of agricultural biotechnology information released by the agricultural biotechnology companies has yet to be analyzed.

The agribusiness members who contribute to this advertising benefit collectively to the extent that the demand for GM products is increased. Because the positive information and outcomes are not specifically excludable from nonagribusiness members, this information may also benefit (or harm) others. Hence, this information has potential public good attributes across groups in society (Cornes and Sandler; Andreoni). If nonagribusiness members could be effectively excluded from the benefits, the negative information would be a club good to the agribusinesses (Cornes and Sandler).<sup>1</sup>

In this paper, we postulate that positive GM information supplied by agribusinesses has public good value. We estimate this public good value *through the eyes of an agribusiness* by quantifying the “perceived public good” value of information from agribusinesses to consumers who participated in laboratory experimental auctions. The perceived public good value of information is obtained from participants who changed their behavior after receiving information from agribusinesses.

Our results lead to two conclusions. First, a relatively large public good value exists for positive GM information—about 5 cents per product purchased per consumer or almost \$3 billion nationally. Second, if a third party produced and disseminated verifiable, independent information on genetic modification, the public good value of positive industry-provided biotechnology information would decrease dramatically—to less than 1 cent per product purchased per consumer.

## Data

We use data from the laboratory experiments in Rousu et al. (2002), which examined the

<sup>1</sup> Ambiguity exists over whether information from agribusinesses should formally be defined as a public good or a club good. A club good, as defined in Sandler and Tschirhart, 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.” Agribusinesses 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 agribusiness members, which is why we call this information a public good.

willingness to pay of consumers from two major metropolitan areas for GM-labeled and plain-labeled potatoes, vegetable oil, and tortilla chips under six different information treatments. We use the random *n*th-price auction, which has been shown to be superior in eliciting an auction participant’s demand curve (Shogren et al., 2001). This study used adult consumers over 18 years of age from two different Midwestern metropolitan areas that were chosen using a random digit dialing method. For the full description of the experimental design see Rousu et al.

In the design, three types of information about GM and biotechnology were defined: (a) *the industry perspective*—provided by a group of leading biotechnology companies, including Monsanto and Syngenta; (b) *the environmental group perspective*—provided by Greenpeace, a leading environmental group or biotech antagonists; and (c) *the third-party perspective*—from a neutral third-party group of scientists, professionals, religious leaders, and academics, none of whom have a financial stake in GM foods. For this study, the information was organized into four treatments: a participant could receive (a) only anti-biotechnology information; (b) both pro- and anti-biotechnology information;<sup>2</sup> (c) anti-biotechnology and verifiable information; or a participant could receive (d) pro-biotechnology, anti-biotechnology, and verifiable information. These four information treatments, each with two replications, were randomly assigned to eight experimental units, each containing thirteen to sixteen participants. The data collected allows estimating how consumer behavior towards GM food changes when information from agribusinesses is introduced.

We summarize five key elements of the experimental design. First, subjects submit only one bid per product to avoid any question of creating affiliated values, which can affect the demand-revealing nature of the employed Vickrey-style auction (e.g., see List and Shogren). 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; then they bid on different foods in only two trials. This avoids the risk that an in-kind endowment effect distorts participant’s bidding behavior (e.g., see Lusk and

<sup>2</sup> 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.

**Table 1. Characteristics of the Auction Participants (N = 114)**

Variable	Definition	Mean	Standard Deviation
Gender	1 if female	0.64	0.48
Age	Participant's age	49.0	18.1
Married	1 if the individual is married	0.61	0.49
Education	Years of schooling	14.64	2.27
Household	Number of people in participant's household	2.75	1.78
Income	Household income level (in thousands) <sup>a</sup>	52.1	31.7
White	1 if participant is white	0.86	0.35
Read_L	1 if never reads labels before a new food purchase	0.02	0.13
	1 if rarely reads labels before a new food purchase	0.11	0.31
	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 <sup>b</sup>	0.20	0.40
Informed	1 if an individual considered themselves at least somewhat informed regarding GM foods	0.40	0.49

<sup>a</sup>The median income of participants is \$55,000.

<sup>b</sup>These five rows do not add to 1 because of rounding.

Shroeder or Corrigan and Rousu) and of any credit constraint. Third, each consumer bids on three unrelated food items, such that if he or she did not have positive demand for one or two products, we could still obtain information from them on their preference for genetic modification based on the second and (or) third product. Fourth, we randomly assign treatments to the experimental units, so the estimation of the treatment effect is simply the difference in means across treatments (see Wooldridge).

Fifth, 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 differ from the U.S. census demographic characteristics for these regions, but they are similar and provide a sufficient representation for our initial probe into labeling and information for GM products (see U.S. Census Bureau). In addition, we use common food items that are available to shoppers in grocery stores and supermarkets and 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 (including Lusk et al. and Hayes et al.), 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, Katsaras et al. showed that the share of college-age (18–24 years) shoppers

falls far below their share in the population (8.5% of shoppers vs. 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). Although our participants are slightly skewed toward women, Katsara et al. 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. This experimental design also minimizes Hawthorne effects in bidding (Melton et al.).

### Empirical Model

Following Rousu et al. (2002, in press), we define the value of information in three steps.<sup>3</sup> First, introducing new information does not change the situation, only consumer's knowledge. More information cannot make consumers worse off.<sup>4</sup> Second, assuming a consumer maximizes his utility, one computes the expenditure function when the consumer has

<sup>3</sup> Similar methods to value information from nonexperimental data have been used by Foster and Just and by Teisl, Bockstael, and Levy.

<sup>4</sup> 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.

and does not have the new information. Third, once the new information is provided, if a consumer's purchases do not change, the information has no value. If the consumer purchases a different bundle, they are presumed to be better off with the new information.

Formally, information from agribusinesses would cause some consumers to switch from plain-labeled to GM-labeled foods because they realize they receive higher *surplus* from consuming GM-labeled foods than they receive from consuming plain-labeled foods. The surplus for consumer  $j$  is defined as the difference in consumer  $j$ 's willingness to pay ( $WTP^j$ ) minus the price ( $P^j$ ) she would face for the product in the marketplace:<sup>5</sup>

$$(1) \quad \text{surplus}_{\text{plain-labeled}}^j = WTP_{\text{plain-labeled}}^j - P_{\text{plain-labeled}}^j$$

$$(2) \quad \text{surplus}_{\text{labeled}}^j = WTP_{\text{labeled}}^j - P_{\text{labeled}}^j$$

The value of information to each person who switches is estimated by the difference in consumer surplus between the GM-labeled and plain-labeled foods:<sup>6</sup>

$$(3) \quad \text{PREMGAIN}_{\text{labeled}}^j = \text{surplus}_{\text{labeled}}^j - \text{surplus}_{\text{plain-labeled}}^j$$

All consumers who purchase GM-labeled foods obtain the premium ( $PREMGAIN$ ) as defined in equation (3). But this premium only represents increased welfare (i.e., the public-good value of information from agribusinesses) for consumers who *switched* to GM-labeled foods from plain-labeled foods after receiving information from agribusinesses.<sup>7</sup>

<sup>5</sup> We used "market" prices that we paid for plain-labeled vegetable oil, yellow tortilla chips and russet potatoes as the market price for plain-labeled product: \$1.65 for the 32 ounce bottle of vegetable oil, \$2.99 for the 16-ounce bag of tortilla chips, and \$1.79 for the 5-pound bag of potatoes as the prices for the plain-labeled products. For market price of GM-labeled product, we adjusted the market price of plain-labeled price for the average GM-discount in our experiment.

<sup>6</sup> If consumer  $j$  purchased plain-labeled foods before they received agribusiness information, they perceived  $\text{surplus}_{\text{plain-labeled}}^j > \text{surplus}_{\text{labeled}}^j$ , and thus consumed plain-labeled foods. If after receiving information from agribusinesses, consumer  $j$  switches to GM-labeled foods, his perception of the surplus changes such that  $\text{surplus}_{\text{plain-labeled}}^j < \text{surplus}_{\text{labeled}}^j$ . The difference in surplus represents the change in consumer  $j$ 's welfare—the value of information from agribusinesses.

<sup>7</sup> Our experimental auction data allow us to estimate the percentage of consumers who would switch from GM-labeled to plain-labeled foods because of the information from agribusinesses.

The aggregate value of information,  $SUMVAL$ , is the sum of the value of information for all individuals who changed their purchases as a result of the information from agribusinesses:

$$(4) \quad \text{SUMVAL} = \sum_{j \in \text{switched}} \text{PREMGAIN}_{\text{labeled}}^j$$

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

$$(5) \quad \text{switchervalue} = \frac{\text{SUMVAL}}{N_{\text{buy-switchedproduct}}}$$

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

$$(6) \quad \text{valueperson} = \frac{\text{SUMVAL}}{N_{\text{pop}}}$$

We apply this framework to our experimental auction data to calculate the percentage of consumers who would switch to GM-labeled foods in two information settings: those consumers initially receiving only negative information from environmental groups, or those consumers initially receiving both negative information from environmental groups and verifiable information from financially disinterested sources. We then compute the average public-good value of information from agribusinesses per consumer who switches for each product. Finally, we estimate the average public-good value of information from agribusinesses per consumer in the population for each product.

## Results

Table 2 reports the estimate of the percentage who would purchase GM-labeled foods both with and without information from agribusinesses. The top portion of table 2 shows the percentage of consumers who buy GM foods when they initially received only information from environmental groups; the bottom portion of table 2 shows the percentage of consumers who buy GM-labeled foods when they initially received information from both environmental groups and the third-party sources. Our results show that a larger percentage of consumers purchase GM-labeled foods when they receive positive information from agribusinesses.



**Table 2. The Percentage of Participants who Purchase GM-Labeled Foods with and without Information from Agribusinesses**

Initial Information the Consumer Received	Food Product	Percentage Who Would Buy GM-Labeled Food without Information from Agribusiness Companies	Percentage Who Would Buy GM-Labeled Food with Information from Agribusiness Companies	Difference
Environmental group information only	Tortilla chips	41.4%	73.9%	32.5%
	Vegetable oil	38.5%	58.3%	19.8%
	Potatoes	37.9%	57.7%	19.8%
Environmental group and verifiable information	Tortilla chips	60.0%	82.6%	22.6%
	Vegetable oil	66.7%	73.9%	7.2%
	Potatoes	63.0%	79.2%	16.2%

**Table 3. The Public Good Value of Information from Agribusiness Companies**

	Percentage Who Would Switch to GM	Value Per Switcher	Average Value per Person
Value to participants who originally received information only from environmental groups			
Tortilla chips	32.5	\$0.188/bag	\$0.061/bag
Vegetable oil	19.8	\$0.378/bottle	\$0.075/bottle
Potatoes	19.8	\$0.105/bag	\$0.021/bag
Value to participants who originally received information from both environmental groups and an independent, third-party group			
Tortilla chips	22.6	\$0.002/bag	\$0.000/bag
Vegetable oil	7.2	\$0.153/bottle	\$0.011/bottle
Potatoes	16.2	\$0.031/bag	\$0.005/bag

Table 3 shows the public-good value of GM information from agribusinesses. The top part of table 3 reports the value to consumers who initially received only information from environmental groups. For tortilla chips, over 32% of participants would change their purchase to GM-labeled food products from plain-labeled ones after they received the agribusiness information. The average public value of information to each consumer who switched purchases is 19 cents per bag, and the average public value to each consumer in society is estimated to be 6 cents per bag. For vegetable oil, GM information from agribusinesses causes almost 20% of consumers to switch, with an average value of almost 38 cents per bottle per person who switched. The average public value is 7.5 cents per bottle per person in society. For GM-labeled potatoes, almost 20% of participants switched when they received agribusiness information; the average public value per person who switched is 10.5 cents per bag; and the average public good value is 2 cents per bag. On average, the public-good value of GM information from agribusinesses is approximately 5

cents per person per purchased product that could be GM.<sup>8</sup>

The bottom part of table 3 shows the value of agribusiness information for participants who initially received both industry and third-party information. Here the value of agribusiness information is significantly lower—0.5 cents or less for tortilla chips and potatoes and to approximately 1 cent for the vegetable oil. Across the three commodities, this information is worth on average less than 1 cent per person per product. Hence, the value of GM information from agribusinesses is largely dissipated when information from third-party verifiable information is introduced. This result suggests that participants who received verifiable information viewed agribusinesses as a less credible source of information, which

<sup>8</sup> Recall we used the mean discount for GM-labeled food products to estimate the price for GM-labeled food products. Using alternative discounts for the GM-labeled food product, one with a higher discount and one with a lower discount, we find similar values to agribusiness information. The values appear robust to assumption about market prices. These and any other nonpublished results are available from the authors upon request.

decreases the public good value of information from the GM proponents.

## Conclusion

Using data from laboratory auctions conducted on a sample of adult consumers in the Des Moines, Iowa, and St. Paul, Minnesota, areas, we estimate the public-good value of GM information from agribusinesses. Consumers bid on GM-labeled and plain-labeled food products using the random  $n$ th-price auction, with each of four experimental units receiving different information treatments. There were two replications. We find that the average public good value of GM information from agribusinesses is approximately 5 cents per person for each product that could be GM, and the aggregate value of information is approximately \$3 billion annually. With a value this large, agribusiness companies can boast that their information not only helps their bottom line, but by providing information they are making consumers better off. The large public-good value of information from agribusinesses practically vanishes, however, in the presence of independent third-party information. When third-party information on genetic modification is available to participants, they bid as if they give much less weight to agribusiness information. This indicates value for verifiable information in reducing participant reliance on information from interested parties.

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