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Evaluating Consumer Response to GM Foods: Some Methodological Considerations

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The Issue

In 1998 the European Union placed a moratorium on the planting of transgenic crops within its borders. The resulting ban on biotech crops has led to the current trans-Atlantic trade dispute between the United States and the EU. At the heart of this dispute is the issue of consumer acceptance. The EU's current position is predicated on perceived public concerns about biotech foods which found a voice in numerous opinion polls conducted during the late 1990s (e.g., European Commission, 1997, 2000). Such concerns have also been amplified by intense media coverage and resulting political activism.

Given the pivotal role that consumer opinion has played in recent EU policy, an understanding of how consumers value biotech foods is critical to informed policy

making. To date three main approaches have been used to gauge how consumers might respond to genetically modified (GM) foods if they were labeled as such. Opinion or attitudinal surveys are one approach. Two other approaches that are also being used are choice experiments and experimental (auction) market methods. This paper provides a brief overview of each approach, their predictions regarding consumer willingness to pay (WTP) for biotech foods, and their potential advantages and pitfalls in predicting actual consumer behavior in the market place.

Implications and Conclusions

While numerous opinion surveys have been conducted about consumer attitudes towards biotech foods, a smaller number of experimental (choice and auction market) studies have been undertaken. Based on this small number of studies, evidence suggests that a minority segment of U.S. and European consumers would avoid biotech foods if given the choice. Limited direct market evidence is even more difficult to obtain but suggests that an even smaller minority of consumers would avoid such products. As most products containing GM ingredients are unlabeled at this time (both in the United States and Europe), direct market evidence will remain limited. For the foreseeable future, therefore, researchers will need to use non-market and experimental approaches in order to predict how consumers might behave if faced with such GM food choices. We argue that experimental auction markets are typically more revealing of actual purchasing intentions on the part of consumers than attitudinal surveys or choice methods, and that further such studies are needed.

Introduction

Genetically modified foods and agricultural biotechnology have generated considerable attention, as well as controversy, since their introduction in the mid-1990s. While some would argue that the technology is extremely beneficial, others have questioned its potential impact on the environment and raised concerns about its safety for human health (The Pew Initiative on Food and Biotechnology [PIFB], 2002). A recent string of highly publicized food safety crises in Europe coincided with the commercialization of GM crops in the United States. These crises raised consumer awareness and concerns about food safety issues in general and GM foods in particular. In response, the European Union (EU) introduced a series of legislation requiring the mandatory labeling of GM foods. A repercussion of the labeling policy has been a five-year ban on the planting of GM crops. The ban has yet to be lifted.

Much of the policy response by the European Union has been driven by attitudinal surveys which consistently show a majority of the European public opposed to the introduction of GM foods. As a result, the question of consumer opinion and intentions – not just in Europe but also in the United States and elsewhere – continues to be the focus

of intense study by researchers, pollsters, biotechnology firms, and regulatory agencies alike. Attitudinal surveys are one approach to gauging consumer response to GM foods. Two other approaches that are being used are choice experiments and experimental (auction) market methods. This paper provides a brief overview of these approaches, their predictions regarding consumer willingness to pay (WTP) for biotech foods, and their potential advantages and pitfalls in predicting actual consumer behavior in the market-place.

Attitudinal Surveys

Opinion and attitude surveys about GM foods range from the in-depth studies carried out by various academics, government agencies, and research institutes (see, for example, Durant, Bauer, and Gaskell, 1998; European Commission, 2000; Gaskell et al., 1999; Hoban, 1996, 1998; Hornig Priest, 2000) to up-to-the-minute polls that ask specific questions and are carried out by specific media and other organizations and interest groups (see, for example, MSNBC, 2000; Walsh, 1999; Center for Science in the Public Interest [CSPI], 2001; PIFB, 2001). A range of questions has been asked in different formats, locations, and points in time. Responses vary considerably depending on how questions are framed and the kind of sample used (e.g. size, demographics, location), as well as over time.

A recent Pew Initiative on Food Biotech (PIFB) (2001) survey concluded that "most Americans (58 percent) oppose the introduction of genetically modified foods into the food supply." Yet this result can be contrasted with another survey, conducted at the same time by the International Food Information Council (IFIC) (2001), which found that 64 percent of Americans were supportive of biotechnology. This support had increased from 59 percent in the previous year. Hornig Priest (2000), at a slightly earlier point in time, found that a majority of U.S. consumers (60 percent) were "supportive of GM foods" and that the "production of such foods should be encouraged."

Even within the same survey instrument, with the same set of respondents, responses can be inconsistent depending on how the question is asked. For example, when consumers in the IFIC (2001) survey were presented with a question stating that biotechnology critics desire to label all foods produced through biotechnology, even if the safety and nutritional content of those foods are unchanged, more than 50 percent of consumers polled sided with the critics and only 37 percent remained supportive of the current FDA policy of voluntary labeling. This result was inconsistent with that of a preceding question that asked whether the very same consumers supported the current FDA policy of voluntary labeling – 70 percent said they supported the policy. And when respondents are asked to rank biotech foods relative to other food safety risks, responses again vary depending on how the question is asked. Unprompted, 5 percent of European respondents (table 1) and zero percent of U.S. respondents (table 2) list biotech foods as a

food safety concern. However, when prompted, anywhere from 16 to 34 percent of U.S. and 21 percent of EU respondents, respectively, say they are concerned.

More specific questions regarding purchasing intentions, which arguably attempt to gauge willingness to purchase, also reveal inconsistencies in response. A study conducted by Prosper International (2001) found that only 23 percent of U.S. respondents said they would eat GM foods. However, a study conducted at the same time by CSPI (2001) found that 46 percent of respondents would purchase genetically engineered foods (8 percent yes, 38 percent indifferent). Hence, wording is important. The biannual Eurobarometer (2003) survey asked respondents whether they agreed/disagreed with the statement "I would buy **GM foods** if they taste better." The question in the 2000 survey was phrased slightly differently – do you agree/disagree with the statement "I would buy **GM fruit** if it tastes better." Such differences in wording may appear subtle. Yet a study by Hallman (1996) found that U.S. respondents distinguished between different types of biotech foods (apples vs. milk vs. baby food) as well as by the process from which they are made. In practice, choices about whether to purchase (or not) on the basis of GM content are likely to depend on the product's other attributes and its end use (Am I purchasing this just for me or for my kids as well?). At a minimum the potential for such differential responses should be taken into account in survey and experimental approaches.

Biases inherent in survey instruments can be minimized but not eliminated through careful design and statistical analysis. How questions are framed, the order in which information is presented, the degree of knowledge and understanding of the respondent, are just some of the potential sources of bias and error (Kahnemann & Tversky, 1984; Tolley & Randall, 1983).

Choice Experiments

While the bulk of current research has focused on attitudinal surveys, some researchers are beginning to extend the concept of willingness to pay using choice experiments (table 3). Theoretically, consumers should be willing to pay more for GM foods exhibiting desirable attributes (e.g., foods made with organoleptic properties) (Boccaletti & Morro, 2000). Alternatively, consumers might be willing to pay more to avoid them altogether (Moon & Balasubramanian, 2001). Contingent valuation (CV) is the best known, most frequently used willingness-to-pay method.

Willingness-to-pay measures are estimated from direct consumer responses to a set of hypothetical questions. Consumers are given a hypothetical situation or scenario in which to make a hypothetical choice. Surveys usually also gather socioeconomic data about the respondent, ask additional attitudinal questions, and ask follow-up questions to evaluate whether the consumer understood the scenario presented. Efforts to enhance the reliability of willingness-to-pay measures have focused on improving the design and execution of CV surveys and statistical analysis of the results (Freeman, 1993; Prato, 1998).

A criticism of willingness-to-pay measures is that they result from hypothetical questions. This criticism is often stated as follows: if you ask a hypothetical question you get a hypothetical answer. Hypothetical-questioning approaches run the risk of giving unreliable results, particularly when respondents are not well informed about the subject enough to state their willingness to pay or understand the question being asked. This criticism is particularly pertinent to GM food studies where consumers can exhibit a high level of unawareness about the technology.

The approach is also susceptible to two other important types of bias – strategic bias and hypothetical bias. Strategic bias can occur when consumers deliberately understate or overstate the true value they place on an attribute – for example, if they believe that by so doing they might influence a policy outcome. Hypothetical bias, on the other hand, typically occurs when consumers are unable to accurately assess their willingness to pay. Hypothetical bias is possible even in well-designed surveys, particularly when consumers have limited prior experience with the attribute (in this case GM vs. non-GM). Lack of actual purchasing choices can make it very difficult for consumers to become aware of their own preferences so that that they can place a value on changes in price, quantity, and quality (Prato, 1998, p. 26). Finally, some studies have shown that the order in which questions are asked can affect willingness-to-pay measures by a significant magnitude (Tolley & Randall, 1983).

Experimental Auction Studies

Several recent studies have used experimental (auction) markets to elicit consumer response for changes in food attributes or food health risks (see for example, Menkhaus et al., 1992; Melton et al., 1996; Hayes et al., 1995; Kim & Chern, 1995; Shogren et al., 1999; Stegner, 2000; Huffman et al., 2001, 2002; Noussair, Robin, and Ruffieux, 2002). Experimental markets are usually run in a laboratoy environment, which allows researchers to collect detailed information about the participants in the experiment, introduce different types of information shock, and observe changes in participants' behavior (Shogren et al., 1999). Participants are often asked to bid for different goods, paying "real" money for the purchase of "real" goods at the end of the experiment.

Such bidding behavior is typically more revealing of actual purchasing intentions on the part of consumers than are the responses gathered using other methods. A sizable minority to majority (42 percent to 91 percent) of European respondents indicate that they would *not* purchase GM foods based on survey and choice experiment approaches (tables 1 and 3). However, in an experimental laboratory setting (Noussair, Robin, and Ruffieux, 2002)[1] a smaller minority (35 percent) of French consumers initially boycotted GM-labeled biscuits after learning that they contained GM ingredients, while 40 percent were willing to purchase them if they were sufficiently inexpensive, and 25 percent of the participants were indifferent and would purchase regardless. Hence, 65 percent of these

consumers were willing to purchase GM foods. When the French consumers were given information on thresholds (ranging from 0.1 to 1.0 percent GM content), fully 89 to 95 percent were willing to accept some level of GM ingredients. Ninety-one percent of the same respondents, surveyed prior to completing the experiment, indicated they would not purchase foods containing GM ingredients. Noussair, Robin, and Ruffieux also found that subjects who had previously discounted their bids for GM biscuits were reassured by the brand identity after the brand of the GM-labeled product was revealed.

Similar results have been found in the United States. Surveys and choice experiments indicate that anywhere from 14 percent to 61 percent (tables 2 and 3) of U.S. respondents would *not* purchase GM foods. However, evidence from experimental auction markets (table 4) suggests that such avoidance behavior is overstated. Only 13 to 24 percent of U.S. consumers were unwilling to purchase GM foods in the more realistic laboratory settings. Indeed, Buhr et al. (1993) found that 87 percent of U.S. consumers were willing to pay a premium for leaner GM pork with fewer calories produced using porcine somatotropin (PST) (table 4). This result contrasts with early opinion surveys that indicated that consumers would avoid such products (Hoban & Burkhardt, 1991).

Experimental retail and auction markets provide a more realistic environment than stated-preference approaches for eliciting consumer preferences. And economists have developed propositions from theory and experimental analyses to aid in predicting which auctions will yield a stable market price and provide incentives for consumers to bid their true reservation value (Menkaus et al., 1992). Likewise, experimental auction markets allow researchers to ask attitudinal questions of consumers. They can monitor the impact of information on consumers to determine how their attitudes change (or not) as a result.

There are some limitations to experimental approaches. Generally, the range of items for purchase is much more limited than in an actual retail store. In addition, participants may fall afoul of what is known as the "Hawthorne effect" – asking people to bid for new products makes people feel useful, so they inflate the bids to please the monitor of the experiment (Shogren et al., 1999, p.1192). In addition, such approaches cannot be readily applied to a random sample of the population (Cropper, 1995) because they are geographically (and, therefore, demographically) limited in scope. To expand such an approach to the aggregate level would be prohibitively expensive. Accordingly, the results of such studies are not easily (directly) generalizable.[2]

Suggestions for Future Research

While numerous opinion surveys have been conducted about consumer attitudes towards biotech foods, a smaller number of experimental (choice and auction market) studies have been undertaken. Based on this small number of studies, evidence suggests that only a minority segment of U.S. *and* European (French) consumers would avoid biotech foods in supermarkets. Moreover, a recent study by Marks,

Kalaitzandonakes and Vickner (forthcoming) found no evidence of avoidance behavior on the part of Netherlands consumers when confronted with products sold in national supermarkets and labeled as containing GM ingredients. Keisel, Buschena, and Smith (2002) have found a similar response among U.S. consumers purchasing milk from cattle treated with rBST (recombinant bovine somatotropin). Only a very small segment of U.S. consumers are purchasing milk labeled as rBST-free, nine years after its introduction. Ideally, more direct market evidence is needed. However, as most products containing GM ingredients are unlabeled at this time (in both the United States and Europe), such direct market evidence will remain limited. For the foreseeable future, therefore, researchers will need to use non-market and experimental approaches in order to predict how consumers might behave if faced with such choices.

In the absence of direct market evidence, experimental auction market methods are arguably the more promising approach for predicting *actual* consumer behavior. We would argue that survey and choice experimental evidence should be interpreted with caution for making predictions beyond stated preferences. That said, such studies can yield important information about individual consumer attitudes and usefully combine such information with demographic, socio-economic and psychometric information.

Table 1 Willingness to Pay for Biotech Foods Based on Selected Attitudinal Surveys (European Union)

Study	Country	Survey date	Question asked	Stated preference	
				Agree	*Disagree*
European Commission 2003	EU	2002	I would buy GM foods if they contained less pesticide residues	41%	49%
			I would buy GM food if more environmentally friendly	40%	50%
			I would buy GM foods if they taste better	32%	58%
			I would buy GM foods if they were cheaper	23%	66%
European Commission 2000	EU	1999	If all traces of GM were eliminated from GM sugar cane, I would be happy to eat this sugar	33%	42%
			I would be willing to buy cooking oil containing a little genetically modified soya	22%	62%
			I would buy GM fruit if tastes better	22%	66%
			I would be willing to eat the eggs of hens fed on GM maize	19%	66%
			I would pay more for non-GM foods	53%	36%
European Commission 2000	EU	1996/ 1999	To what extent do you agree or disagree that using modern biotechnology in the production of foods, for example to make them higher in protein, keep longer or change the taste, benefits society?	54%/43%	
			To what extent do you agree or disagree that using modern biotechnology in the production of foods, for example to make them higher in protein, keep longer or change the taste, involves risks for society?	61%/59%	
Noussair, Robin & Ruffieux	Grenoble, France	2000	If the French fries made from GM potatoes contained less fat, I would buy them…	8.3%	91.7%
			If GM corn lowered the risk of polluting the environment, I would purchase products that contained GM corn…	21.1%	78.8%
			If I found that GM tomatoes tasted better or lasted longer without spoiling, I would buy them…	8.7%	91.3%
			I would like to be able to find products without GMOs even though I have to pay more for them…	75.1%	24.9%
Food Standards Agency	UK	2001	Which foods, if any, do you have concerns about?	Foods containing GM ingredients – 5% (spontaneous) 21% (prompted)	

Table 2 Willingness to Pay for Biotech Foods Based on Selected Attitudinal Surveys (United States)

Study	Country	Survey date	Question asked	Stated preference
International Food Information Council (IFIC), 2003	US	2003	Biotechnology has also been used to enhance plants that yield foods like cooking oils. If cooking oil with reduced saturated fat made from these new plants was available, what effect would use of biotechnology have on your decision to buy this cooking oil? Would this have a positive effect, a negative effect, or no effect on your purchase decision?	39% (positive effect) 14% (negative effect) 41% (no effect)
Prosper International, 2001	US	May 2001	Would you eat genetically modified food products?	23% (yes) 30% (no)
CSPI, 2001	US	March/ April 2001	If you had a choice between two boxes of Wheaties, where the label on the box indicated that it contains GE ingredients and the label on the other box indicated that it does not contain GE ingredients, which would you choose, or would you not care?	8% labeled GE 52% labeled non-GE 38% indifferent 3% don't know
			If corn flakes were labeled "does not contain GE corn," would you think the corn flakes were (better than, the same as, worse than/worse than, the same as, better than) corn flakes without such labels?	35% better 42% same 8% worse 15% don't know
			If corn flakes were labeled "made from GE corn," would you think the corn flakes were (better than, the same as, worse than/worse than, the same as, better than) corn flakes without such labels?	12% better 42% same 30% worse 17% don't know
Hallman, 1996	US	1996	How willing would you be to purchase genetically engineered…?	Apples 55% (very/somewhat) 43% (not very/not at all) Milk 32% (very/somewhat) 61% (not very/not at all) Baby food 27% (very/somewhat) 63% (not very/not at all)
Hoban, 1999 / PFIB, 2001	US	1999	What do you feel is the greatest threat to the safety of the food you eat? (Hoban, 1999)	Biotechnology – 0% (unprompted) 16% (prompted) GM Foods – 34% (prompted)
		2001	When it comes to food safety, what are you most concerned about…? (PFIB, 2001)	

Table 3 Willingness to Pay for Biotech Foods Based on Choice Experiments

Study	Hypothetical product/country	Attributes compared	Willingness to pay	Market segment
Chern, Rickertsen, Tsuboi, & Fu, 2003	Salmon / Norway, the United States*	• GM and non-GM *fed* salmon • GM and non-GM salmon	Norwegian consumers WTP US $5.43 (54%) premium for non-GM fed salmon; US $6.75 (67%) for non-GM salmon US consumers WTP US $2.45 (41%) premium for non-GM fed salmon; US $3.15 (53%) for non-GM salmon	80% of Norwegian market chose non-GM and non-GM *fed* salmon over GM salmon. 59.2% of US market chose non-GM *fed* salmon over GM *fed* salmon 68.9% of US market chose non-GM over GM salmon
Lusk, Roosen, & Fox, 2003	Beef ribeye steaks / France, Germany, UK and US	• Marbling / Tenderness • Produced w/o (with) growth hormone • Non GM (GM) corn animal feed used • Price (varied)	From US $7.29 / lb to US $9.94 depending on country for non-hormone beef From US $3.31 / lb to US $9.32 depending on country for non-GM beef	NA NA
Burton & Pearse, 2002	Beer / Australia	• GM and non-GM barley and/or non-GM or GM yeast modified to reduce cost of brewing • Non-GM or GM yeast modified to increase antioxidants • Price (varied)	A $-0.72 to A $-0.40 (discount) A $0.80 (premium)	30% of total market refused GM over non-GM; 70% traded off GM vs. non-GM with a significant discount or premium
Moon & Balasubramanian 2001	Breakfast cereal / US and UK	• Non-GM and GM corn ingredients • Price set equal to $4.00	NA	44 % of US consumers preferred non-GM, 71% of UK consumers 6% of US consumers preferred GM, 2% of UK consumers 22% of US consumers indifferent, 23% of UK consumers
Boccaletti & Moro, 2000	Generic GM products / Italy	• Generic GM product • Longer shelf life GM product • Improved organoleptic properties • Improved nutritional properties • Reduced use of pesticides • Premium (varies)	NA NA <5% price premium 6-10% price premium 6-10% price premium	NA NA NA NA NA

NA = not available from published study. *Only the results of the nationally implemented surveys are reported here for comparison purposes.

Table 4 Willingness to Pay for Biotech Foods Based on Expermental Auction Markets

Study	Hypothetical product	Country	Attributes compared	Willingness to pay	Market segment
Van Wechel et al., 2003	Muffins, potato chips, cookie	US	• GM-free (labeled) • Conventional (unlabeled) • Price (bids)	Discount of 3% for conventional unlabeled products	NA
Rousu et al., 2002	Bag of potatoes Vegetable oil Bag of tortilla chips	US	• GM-free • GM • Price (bids)	Average WTP for 3 non-GM products $1.14 Average WTP for 3 GM products $0.98 (about 16% discount)	NA NA
Noussair, Robin & Ruffieux, 2001	Biscuit varieties	France	• GM-free • Contains <0.1% GM • Contains <1% GM • Contains GM (unspecified) • Price (bids)	1.18FF to 2.28FF (8% to 15% premium) -0.06FF to 0.73FF (0% to 4% discount) -0.18FF to -1.57FF (1% to 9% discount) -6.95FF to -6.04FF (34% to 39% discount)	0% boycotted 4.4% boycotted 10.7% boycotted 34.9% boycotted
Lusk et al., 2001	Corn chips	US	• Non-GM • GM • Price (bids)	Average WTP $0.070/oz for non-GM chips	24% WTP for non-GM 76% not WTP for non-GM corn chips
Buhr et al., 1993	Pork sandwich	US	• Non-GM/higher fat	Average WTP ranged from $0.03 to $0.90 per sandwich depending on experimental design and trial	13% (2/15 respondents) were WTP for non-GM pork sandwich*
			• 10-20% leaner GM • Price (bids)	Average WTP ranged from $0.22 to $1.45 per sandwich depending on experimental design and trial	87% (13/15 respondents) were WTP for GM (lean) pork sandwich*

NA = not available from published study. *Based on experiment III (considered the most robust) of study.

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Endnotes

[1] At the time of publication the authors are aware of only one published study conducted in European markets using the experimental auction market method. While it is difficult to generalize beyond France to Europe on the basis of just one study, France is one of the most negative countries regarding GM foods; therefore, one might expect even less avoidance in some of the other European countries.

[2] The Noussair, Robin, and Ruffieux and the Rousu et al. studies were less limited than other experimental designs as the populations were randomly drawn from more demographically representative samples.