Sentiments and acts towards genetically modified foods

Nicholas Kalaitzandonakes*

Department of Agricultural Economics,
University of Missouri-Columbia,
125A Mumford Hall, Columbia, MO 65211, USA
Fax: +(573) 882-3958 E-mail: KalaitzandonakesN@missouri.edu
*Corresponding author

Leonie A. Marks

Department of Agricultural Economics,
University of Missouri-Columbia, 125D Mumford Hall, Columbia,
MO 65211, USA
Fax: +(573) 882-3958 E-mail: MarksLA@missouri.edu

Steven S. Vickner

Department of Economics, Utah State University, 3530 Old Main Hill,
Business Building, Room 612, Logan, UT 84322, USA
Fax: +(435) 797-2701 E-mail: svickner@econ.usu.edu

Abstract: Hundreds of studies have elicited consumer stated preferences towards genetically modified foods at various countries around the world. Customarily, consumer stated preferences have been viewed as adequate proxies of potential response towards such products. As we have argued here, however, there are theoretical and methodological reasons as to why stated and revealed consumer preference could diverge. In this study we provide empirical evidence of consumer revealed preferences towards branded processed products containing ingredients labelled as genetically modified. Our empirical results allow insights into the behaviour of a population of knowledgeable, informed, high-income consumers over a long period of time, across multiple products and suggest that in the Netherlands a majority of consumers did not shift away from genetically modified foods even in the presence of alternatives.

Keywords: genetically modified foods; biotechnology; consumer acceptance; consumer behaviour; Europe; the Netherlands.

Reference to this paper should be made as follows: Kalaitzandonakes, N., Marks, L.A. and Vickner, S.S. (2005) 'Sentiments and acts towards genetically modified foods', *Int. J. Biotechnology*, Vol. 7, Nos. 1/2/3, pp.161–177.

Biographical notes: Nicholas Kalaitzandonakes is a Professor of Agribusiness in the Department of Agricultural Economics and the Director of the Economics and Management of Agrobiotechnology Center (EMAC) at the University of Missouri-Columbia. His research and teaching focus on the management and strategy of innovation and biotechnology.

Copyright © 2005 Inderscience Enterprises Ltd.

Leonie A. Marks is a Research Assistant Professor of Agribusiness and a Program Director at the Economics and Management of Agrobiotechnology Center (EMAC) at the University of Missouri-Columbia. Her research and teaching focus on the interdependencies of agrifood innovation and consumer behaviour.

Steven S. Vickner is an Associate Professor in the Department of Economics at Utah State University. His research and teaching interests focus on the economics of the global food industry.

1 Sentiments and acts towards genetically modified foods

Since their commercial introductions in the mid-1990s, most genetically modified crops have been quickly embraced by farmers in countries where production has been allowed (Kalaitzandonakes, 2003). At the other end of the agrifood chain, however, consumers have often seemed less enthusiastic towards Genetically Modified Foods (GMFs).

European consumers have been the most negative towards GMFs. While many hypotheses have been advanced to explain their stance, the ones most broadly accepted can be summarised as follows: European consumers, skittish about modern intensive farming methods in light of the BSE or 'mad cow' crisis, have been unwilling to accept the perceived risks of GMFs. They consider these risks to outweigh potential benefits, as they see little utility in a technology which increases an already over-abundant food supply, and which does not fit their culture, beliefs, and heritage. It has also been postulated that European regulators and other government agencies, enjoying low public trust, could do little to ease consumer fears. Public opinion and attitude surveys have generally confirmed these stylised facts.

Within this context, it has been assumed that European consumers would avoid GMFs when confronted with the choice. In this paper, we investigate whether this assumption is valid and whether such avoidance can be observed in the marketplace. In particular, we provide evidence of actual consumer behaviour towards GMFs in the Netherlands over an extended period of time. Public opinion surveys show that a large percentage of Dutch consumers had indicated over the period of analysis that they would not purchase GMFs if they were sold in retail stores. Our data reveals that when Dutch consumers were faced with the choice of purchasing GMFs (labelled as such and sold side-by-side with conventional foods) they did not avoid them. This behaviour was rather unexpected and certainly inconsistent with stated intentions. Could public opinion research have misjudged consumer purchasing intentions? Are there any other cases where divergence between consumer attitudes and behaviour has been observed?

2 Purchasing behaviour towards GMFs: what do we know?

Evidence on consumer purchasing behaviour towards GMFs is extremely limited and rather informal. The only recorded case where European consumers were confronted with a choice of a food labelled as 'GM' occurred in UK from 1996 to 1999. Prior to its removal from UK store shelves in 1999, a labelled GM tomato puree was sold side-by-side with non-GM brands, at the same price, although the GM product was in a

10% bigger can to pass on the process cost savings to consumers. Although attitude surveys indicated at that time that a significant segment of the British public was unreceptive to GMFs, the GM tomato puree out-sold competing non-GM brands by a large margin (Nunn, 2000). A lower relative price and, an alleged, improved taste could explain the divergence between 'stated' and 'revealed' preferences of British consumers.

Some additional evidence on consumer behaviour towards GMFs is also available from Japan. In early 2001, executives of the Japanese supermarket chain Jusco reported that after one year of offering a number of labelled GMFs in their stores, no significant impact on their sales could be detected (Hur, 2001). This was despite public opinion and attitude surveys consistently finding a majority of Japanese consumers to be negatively predisposed towards GMFs at that time.

Similarly, as bovine somatotropin (rBST) was being introduced in the US in mid-1990s, various surveys indicated that almost 75% of US consumers expressed concerns about the long term health effects of consuming milk from dairy cows treated with the bioengineered hormone and were reluctant to purchase it. After market introduction, however, a majority of US consumers continued to purchase milk from bovine somatotropin (rBST) treated cattle when offered side-by-side with 'non-rBST' milk (Runge and Jackson, 2000; Keisel, Buschena and Smith, 2004). Indeed, non-rBST milk sales make up a tiny fraction of the total US milk market concentrated in certain regions of Wisconsin, Minnesota, California, and Vermont.

Admittedly, such market evidence is limited and mostly anecdotal. However, the discrepancies between consumer behaviour in the marketplace and perceived consumer attitudes are stark and beg the question whether they may generalise beyond these few instances. Could elicited public opinion and attitudes consistently fail to anticipate consumer purchasing intentions? As we discuss next, there might be good theoretical and methodological reasons to expect so.

3 Public perceptions and attitudes

Over the years, hundreds of studies have elicited public attitudes in an attempt to gauge consumer preferences towards GMFs. Most of these studies have typically reduced consumer preferences to GMF 'acceptance'. While rarely defined, 'acceptance' seems to be a catchall term for everything that has to do with public sentiments towards GMFs. As Durant *et al.* (1998, p.9) argue, however, 'acceptance' as a concept is both semantically and pragmatically flawed. It implies that consumers have only a discrete choice to make (accept or reject). Yet such 'lexicographic' consumer preferences are rare. Consumers typically display complex food preferences with choices that are responsive to changes in prices, income, information, social norms, and a variety of other factors. At best, Durant *et al.* argue, acceptance is 'a euphemism for a mixed bag of people's enthusiasm, discontents, worries, imaginations, fears, anticipations and resistances' (Durant, Bauer and Gaskell, 1998, p.10) towards new technologies such as biotechnology.

Durant *et al.* (1998) prefer to measure 'public perceptions' instead or the ideas, interest in, understanding of, and attitudes towards biotechnology that the public holds. They define the term 'perception' to include the processes that lead to a 'particular structure of imagination about a new technology at any moment in time' (Durant, Bauer and Gaskell, 1998). This is one definition. But the concept of 'perceptions' can also vary

with the focus of the study. For example, Pennings *et al.*, (2002) define perception as a 'consumer's interpretation of the chance to be exposed to the content of a risk and as a consumer's assessment of the risk inherent in a particular situation'. 'Attitude', on the other hand, is defined as 'a consumer's general predisposition to (the risk)'. Marketers define attitudes as 'a person's overall evaluation of a concept', (Peter and Olson, 1996, p.157) where concept can mean 'risk', 'behaviour', 'product', 'brand' and so on. Clearly, consumer attitudes and perceptions can be defined somewhat differently from one study to another. Irrespectively, all such notions imply limited conceptions of, and potentially limited overlap with, consumer preferences. Unfortunately, empirical measurement of perceptions and attitudes can further limit their overlap with underlying consumer preferences.

4 Attitudinal surveys

Opinion and attitude surveys about GMFs range from the in-depth studies carried out by various academics, government agencies, and research institutes (Durant, Bauer and Gaskell, 1998; EC, 1997; 2000; 2003; Gaskell *et al.*, 1999; Hoban, 1996; 1998; Hornig Priest, 2000) to up-to-the-minute polls carried out by mass media and other organisations and interest groups (MSNBC, 2000; Walsh, 1999; CSPI, 2001; PIFB, 2001). A range of questions have been asked in different formats, locations, and points in time. Importantly, responses also vary considerably depending on how questions are framed, the kind of sample used (e.g., size, demographics, location), and over time.

So for instance, the recent Pew Initiative on Food Biotech (PIFB) (2001) survey concluded that most Americans (58%) oppose the introduction of biotechnology into the food supply. Yet this result can be contrasted with another survey, conducted at the same point in time, by the International Food Information Council (IFIC) (2001), which found that 64% of Americans were supportive of food biotechnology. Hornig Priest (2000) at a slightly earlier point in time, found that a majority of US consumers (60%) 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 questions are asked. For example, when consumers in the IFIC (2001) survey were presented with a question stating that biotechnology critics demanded mandatory labelling of all foods produced through biotechnology, even if the safety and nutritional content of those foods are unchanged, more than 50% of consumers polled sided with the critics. This result was inconsistent with that of a preceding question that asked the respondents whether they supported the current FDA policy of voluntary labelling – 70% said they supported the policy. Similarly, measures of public concerns about the safety of GMFs vary drastically, depending on how the question is asked. Unprompted, 5% of European respondents and 0% of US respondents list GMFs as a food safety concern. However, when prompted, anywhere from 16 to 34% of US and 21% of EU respondents, respectively, say they are concerned.

5 Do perceptions and attitudes predict behaviour?

The inherent volatility of measured public opinion and attitudes towards GMFs is somewhat troubling and raises questions on how effectively they might represent

consumer preferences or anticipate potential consumer behaviour. This is especially so since a number of prior studies have determined that sentiments expressed in opinion and attitude surveys are often poor predictors of behaviour (Deutscher, 1973; McFadden, 1999; Smith, 1991; Kahneman, Ritov and Schkade, 1999; La Piere, 1935). In his classic book on the subject, Deutscher (1973, p.2) notes that, "the problem of what we say (versus) what we do is endemic". Attitudes elicited through surveys, he observes, have been assumed to measure 'tendencies to act' and therefore social scientists have frequently proceeded to draw conclusions about behaviour based on what respondents say; in effect, assuming that verbal responses reflect behavioural tendencies (Deutscher, 1973, p.12). Yet, the link between elicited attitudes and actions is often a weak one (Kahneman, Ritov and Schkade, 1999; Ajzen and Fishbein, 1977).

A number of studies have pointed out that surveys place consumers in 'symbolic situations' that do not require any follow up action, and may not equate with actual decision contexts that change from one time to the next (Deutscher, 1973; Smith, 1991; La Piere, 1935). Furthermore, public opinion and attitude surveys do not distinguish between an individual's role as a consumer from their role as a citizen (Nyborg, 2000). In the role of citizen, individuals may be more focused on public interest. In their role as consumers they may be more focused on their personal goals (Sagoff, 1988, p.8). Every individual may have two distinct and possibly conflicting preference orderings over social status therefore – one associated with each role. Choices made (or stated) in one context may not be replicated in the other (Nyborg, 2000).

Finally, cognitive biases can also distort how information is received and processed in a number of decision contexts (Kahneman, Ritov and Schkade, 1999). How questions are framed, the order in which information is presented, the degree of knowledge and understanding of the respondent, are all potential sources of bias and error (Kahneman and Tversky, 1984; Tolley and Randall, 1983). Such cognitive biases can further obscure the relationship between elicited attitudes and behaviour.

6 Using choice experiments to gauge consumer preferences

While the bulk of current research has focused on attitudinal surveys, some researchers have elicited consumer preferences towards GMFs through choice experiments. Theoretically, consumers should be willing to pay more for GMFs exhibiting desirable attributes (e.g., foods with improved organoleptic properties) (Boccaletti and Morro, 2000). Alternatively, some consumers might be willing to pay more to avoid them altogether (Moon and 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. CV surveys usually also gather socioeconomic data about the respondent, ask additional attitudinal questions, and 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 common 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 incomplete knowledge about the technology.

The approach is also susceptible to other important types of bias – strategic bias, hypothetical bias, and anchoring effects among others. 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 they can place a value on changes in price, quantity, and quality. Anchoring effects occur when consumers are induced to consider dollar amounts; their response is strongly biased toward any value, even if it is arbitrary that they are induced to consider as a candidate answer (Kahneman, Ritov and Schkade, 1999). In such instances, one might expect to observe discrepancies between stated WTP and actual behaviour where such cognitive biases are present.

7 Experimental auction studies

Several recent studies have used experimental (auction) markets to elicit consumer response for changes in food attributes or food health risks (Menkhaus *et al.*, 1992; Melton *et al.*, 1996; Hayes *et al.*, 1995; Kim and Chern, 1995; Fox *et al.*, 1998; Shogren *et al.*, 1999; Stegner, 2000; Huffman *et al.*, 2002; Huffman *et al.*, 2001; Noussair, Robin and Ruffieux, 2004). Experimental markets are usually run in a lab environment, which allows researchers to collect detailed information about the participants in the experiment, to introduce different types of information, and to observe changes in participants' behaviour (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 behaviour is typically more revealing of consumer purchasing intentions.

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 that predict which auctions will yield a stable market price and provide incentives for consumers to bid their true reservation value (Menkhaus *et al.*, 1992). Likewise, experimental auction markets allow researchers to ask attitudinal questions of consumers. Within this context, they can monitor the impact of information on consumers to determine how their attitudes change (or not) as a result.

It is interesting to note that a few studies utilising experimental auction markets have arrived at conclusions different from those derived from attitude studies and choice experiments. For instance, most attitude surveys in France have found a large majority of

consumer would not purchase GMFs. However, in an experimental laboratory setting (Noussair, Robin and Ruffieux, 2004)[1] a minority (35%) of French consumers initially boycotted GM labelled biscuits after learning that they contained GM ingredients while 65% of these consumers were willing to purchase them. Specifically, 40% were willing to purchase them at a specific price and 25% of the participants were indifferent and would purchase regardless. Noussair, Robin and Ruffieux (2004) also found that subjects who had previously discounted their bids for a selected GM food item were reassured by the brand identity after the brand of the GM-labelled product was revealed. It is also interesting to note that the participating consumers were asked to complete a survey prior to conducting the experiments. In this prior survey, 91% of them indicated they would not purchase foods containing GM ingredients.

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

There are, however, some limitations to experimental auction market approaches as well. The range of items for purchase is much more limited than in an actual retail store. In addition, participants may fall foul of what is known as the 'Hawthorne effect' – where respondents 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. Accordingly, the results of such studies are not directly generalisable[2].

Of course, opinion polls, attitude surveys, choice experiments, and experimental auction markets, all attempt to forecast what consumers would do when confronted with actual choices of GM and non-GM foods at their local supermarket. We offer here the first case of documented consumer behaviour towards foods labelled for GM content and sold over an extended period of time in supermarkets across the Netherlands. Our observations are national in scope and based on the actions of a whole population rather than a sample.

8 Gauging consumer behaviour towards GMFs in the Netherlands

The Netherlands is a small, highly industrialised, high-income nation within the European Union. Its current population is approximately 16 million. It has a net trade surplus and is an important exporter of food.

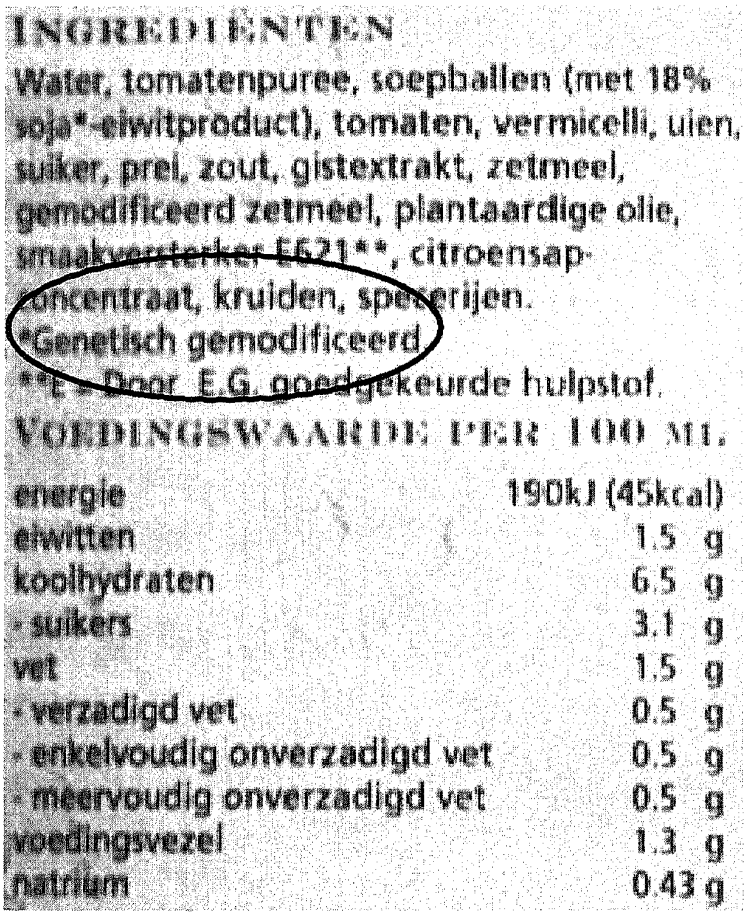
The first biotech food product to be considered for marketing in the Netherlands was the growth hormone bovine somatotropin (BST) in 1987. However, BST was never allowed in the Dutch market because of an EU moratorium that came into effect in 1990. The next product to be marketed was the rDNA cheese rennet chymosin which was approved in 1990. This was followed by the arrival of genetically modified soybeans in

1996, approved by the Ministry of Health. In April 1997, the ministry issued within the framework of the Food Law, a labelling directive on the use of genetically modified soybeans and maize products (Midden *et al.*, 1998). However, in October 1997 this ruling was revoked by the courts in compliance with EU regulations, and from November 1997 onwards the labelling of genetically modified soybeans was directed by the European Union.

Because the Netherlands was one of the first EU countries to enact mandatory labelling, it provides an excellent case study for examining European consumer response. Figure 1 provides an example of the type of label carried by processed food products in the late 1990s[3]. The labels were included in the ingredients list where 'soja' (soya) was either asterisked with an explanatory label underneath stating 'genetisch gemodificeerd' (genetically modified) or a general statement was included under the ingredients list as follows 'geoproduceerd met genetisch gemodificeerde soja', that is, 'made from genetically modified soya'. It is estimated that about two hundred prepared and processed foods carried such labels in the Dutch market during the late 1990s.

How did Dutch consumers feel about GMFs at that time? How well informed were they about biotechnology and the availability of GMFs in the marketplace? And, importantly, what did they do when they were confronted with a choice at the supermarket shelves?

Figure 1 Typical label indicating GM ingredients on processed foods sold in the Netherlands (1997–2000)



INGREDIENTEN

Water, tomatenpuree, soepballen (met 18% soja*-eiwitproduct), tomaten, vermicelli, uien, suiker, prei, zout, gistextrakt, zetmeel, gemodificeerd zetmeel, plantaardige olie, smaakversterker E621**, citroensap-concentraat, kruiden, specerijen.

*Genetisch gemodificeerd.

**E = Door E.G. goedgekeurde hulpstof.

VOEDINGSWAARDE PER 100 ML

energie	190kJ (45kcal)
eiwitten	1.5 g
koolhydraten	6.5 g
- suikers	3.1 g
vet	1.5 g
- verzadigd vet	0.5 g
- enkelvoudig onverzadigd vet	0.5 g
- meervoudig onverzadigd vet	0.5 g
voedingsvezel	1.3 g
natrium	0.43 g

9 Public understanding of biotechnology and attitudes towards GMFs

Over the years, Dutch citizens have seemed informed about biotechnology and GMFs (Hoban, 1997; Hamstra, 1993; Hamstra and Smink, 1996). The Dutch have consistently scored higher than the European average in terms of their technical knowledge about biotechnology (6.25 on a scale of 1 to 10, as opposed to the European average of 5.46) (EC, 2003). Furthermore, the Dutch are generally considered informed food consumers as the Netherlands has had a long history of active consumer involvement in food and nutrition policy. Over 10% of Dutch households belong to consumer organisations (Hillers and Lowik, 1998).

While Dutch consumers have been consistently informed about biotechnology and GMFs, their attitudes towards such foods have varied over time. In 1996, 56% of Dutch respondents indicated that GMFs should be encouraged (EC, 1997), and 87% indicated that they supported the use of biotechnology in foods. Much like the rest of Europe, however, only 32% of Dutch consumers indicated that they 'would buy genetically modified foods' at that time (EC, 1997, p.52). The number of Dutch consumers indicating that they would purchase GMFs, dropped further to 30% by 1999 (EC, 2000, p.60). By 2002, the number of consumers willing to purchase GMFs had trended up again with 56% indicating some willingness to purchase (EC, 2003)[4].

Temporal changes in attitudes could be related to changes in the amount and tone of information on GMFs received by consumers. Information about biotechnology and GMFs is typically event-driven and tends to vary over time. Spikes in coverage around events and technological controversies can raise public awareness about an issue, and in turn affect perceptions. Studies have also found a link between food safety information and consumer purchasing behaviour (van Ravenswaay and Hoehn, 1991; Dahlgran and Fairchild, 2002; Wessels, Miller and Brooks, 1995). It is therefore important to look at the kind of information Dutch consumers were exposed to during 1997–2002.

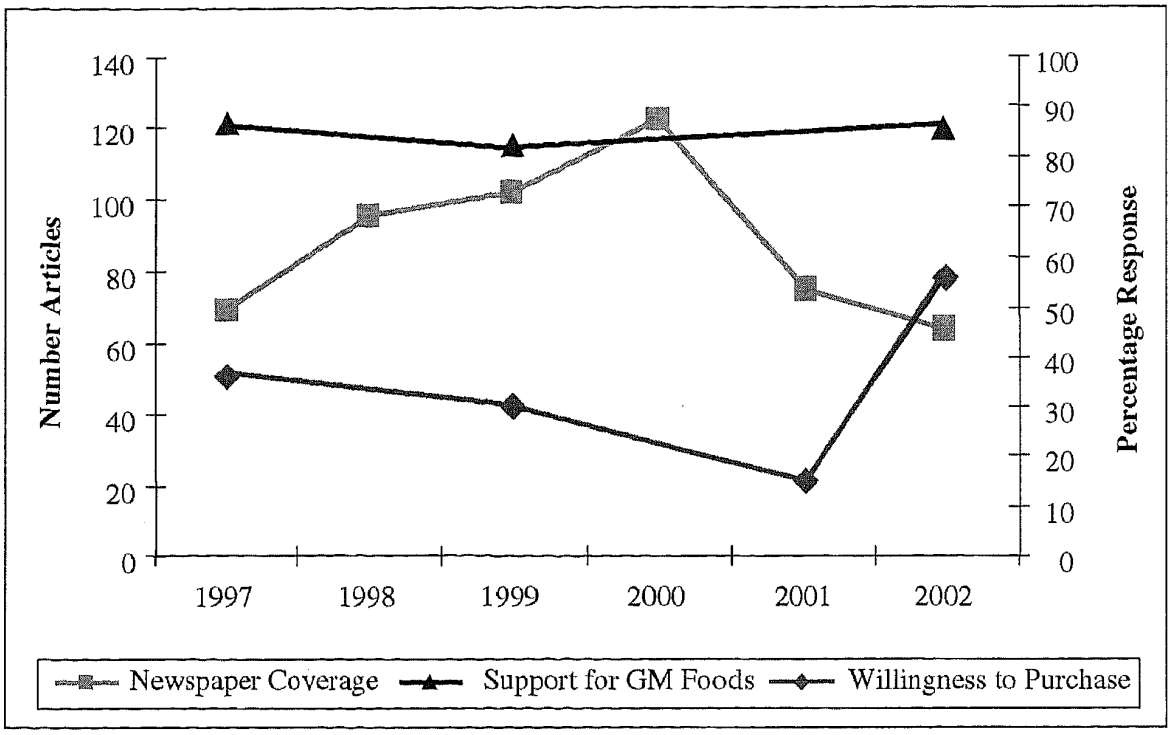
Most consumers get their information about biotechnology from the media. The average person in the Netherlands spends half-an-hour a day reading at least one newspaper (Midden *et al.*, 1998, p.105). Ninety-two percent of the Netherlands' public thinks that newspapers do good work for society (EC, 2000).

Dutch press can be distinguished by the type of information that is published. There are popular general interest papers, such as *Telegraaf* and *Algemeen Dagblad* which emphasise human interest stories, entertainment and sports. The quality press includes papers such as *De Volkskrant* which are more policy oriented, provide science coverage, and cater to middle to upper class, more educated public (Midden *et al.*, 1998). There is also the *Algemeen Nederlands Persbureau* (ANP) which is a national press agency, similar to the *Associated Press*, and provides newspapers, media, and television with domestic and international news.

In order to examine the degree to which Dutch consumers were exposed to coverage of issues related to GMFs in the late 1990s and early 2000, we measured the frequency of such coverage in the *Algemeen Nederlands Persbureau.* Article frequency is indicative of the salience of an issue or the 'news value' of a particular development[5]. It is also indicative of the intensity of media attention. Some mass communication scholars argue that as media coverage intensifies, public opinion on an issue becomes more negative (regardless of the tone of such coverage) (Leahy and Mazur, 1980).

Figure 2 details our findings. Consistent with the earlier work of Midden *et al.* (1998) (who examined media coverage of biotechnology from 1972–1996) we also find that the salience of the issue of GMFs was high at the end of the 1990s, peaking in 2000. Hence, during the period of interest when GM labels were in place (1997–2000), Dutch consumers were exposed to increasingly intense media coverage on the issue. We also overlay such coverage with the public opinion data and we find that the frequency of such coverage is negatively correlated with consumer attitudes ($\rho = -0.42$) when measured by willingness to purchase GMFs (EC, 1997; EC, 2000; EC, 2003; Emmott, 2001). When such sentiments are measured by the 'level of support' for GMFs (EC, 1997; EC, 2000; EC, 2003) the degree of negative correlation increases to $\rho = -0.85$.

Figure 2 Salience, willingness to purchase and support for GM foods in the Netherlands, 1997–2002



Note: 'Willingness to purchase' and 'Support' from the Eurobarometer surveys (EC, 1997; EC, 2000; EC, 2003). The 2001 WTP figure is based on a survey conducted by the NIPO Research Bureau (Emmott, 2001).

Based on the results of the various attitude surveys carried out during the period of interest, one would expect a sizeable market segment (anywhere from 44% to 85% of Dutch consumers) to avoid GMFs if confronted with the choice. Likewise, one would expect Dutch consumers to be armed with information about GMFs based on their high level of awareness, knowledge, and intense media coverage. As indicated earlier, Dutch consumers were indeed confronted with such choice for a meaningful number of processed foods. The question then is how they actually chose?

10 Consumer response to GM labels in the Netherlands

In order to examine consumer response to GMFs in the Netherlands we use national-level, syndicated point-of-purchase grocery store scanner data. The data was collected

from supermarkets with sales exceeding $2 million across the Netherlands. The data set was acquired from a commercial marketing research vendor. Four product categories are included in the dataset: frozen processed meat, frozen pizza, frozen processed fish, and canned soup. Hence, the data reflects the purchases of the entire population of Dutch consumers that shopped for products in the selected four product categories.

The data set spans 260 consecutive weeks, from the Sunday ending April 27, 1997 to the Sunday ending April 14, 2002 and includes products that contained GM ingredients as well as products that did not. Across those relevant products containing GM soybean ingredients, labels were introduced in the ninth week, the week ending on Sunday June 22, 1997. The labels remained on relevant products for 151 consecutive weeks and were removed the week ending Sunday May 14, 2000 as non-GM ingredients were sourced by food manufacturers.

Figures 3–6 illustrate the sales (in total equivalent units) for the processed foods that carried positive GM labels during 1997–2000. From these illustrations, it is easy to see that, in aggregate, Netherlands consumers did not significantly change their purchasing behaviour towards foods that received labels indicating the presence of GM ingredients. Nor did they alter their purchasing behaviour towards such foods after the labels were removed nearly three years later. There are no abrupt adjustments or gradual shifts away from GMFs[6]. Of course, in order to strengthen these conclusions one should explicitly test consumer behaviour within the context of a statistical model that incorporates the role of information (Wessels, Miller and Brooks, 1995; Smith, van Ravenswaay and Thompson, 1988; Swartz and Strand, 1981; Piggott and Marsh, 2004), changes in relative prices, real per capita expenditure, seasonality and any other relevant factors. Given the focus of the journal we do not expand on the technicalities of the relevant econometric model here[7], however, statistical analysis of our data does support the conclusion that consumers did not 'vote with their wallets' when they had the opportunity to do so – both when the labels went on and when they came off.

Figure 3 Quantity of GM Labelled soup sold

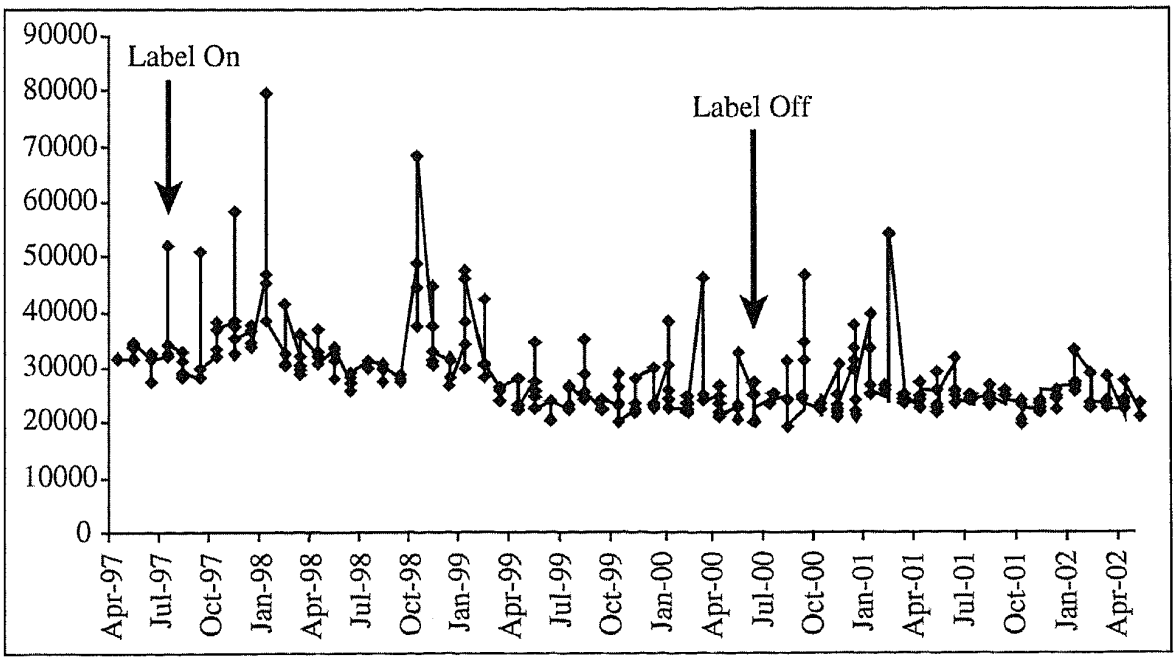


Figure 4 Quantity of GM labelled frozen fish sold

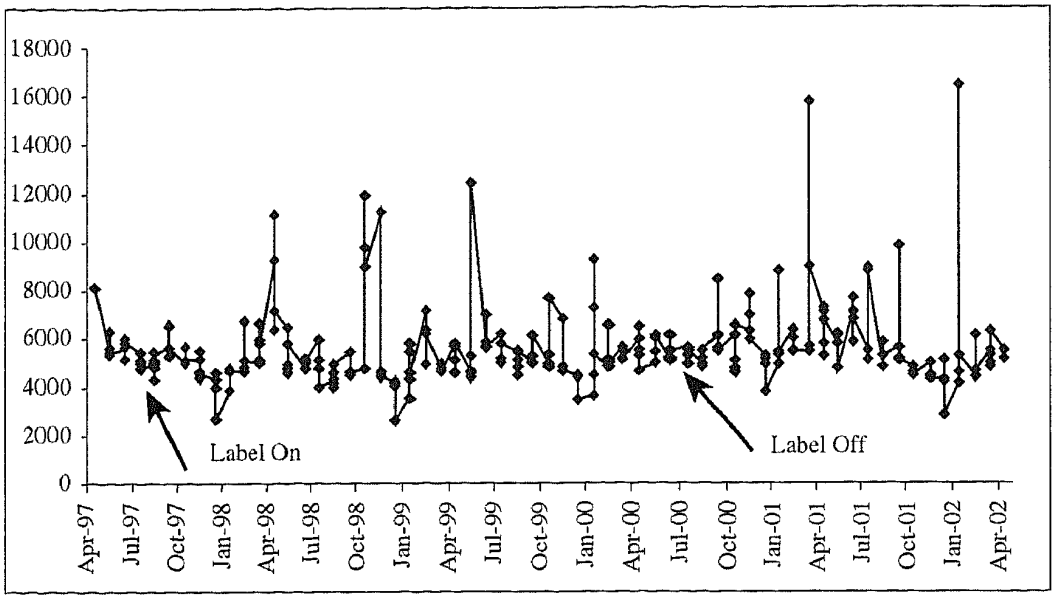


Figure 5 Quantity of GM labelled frozen pizza sold

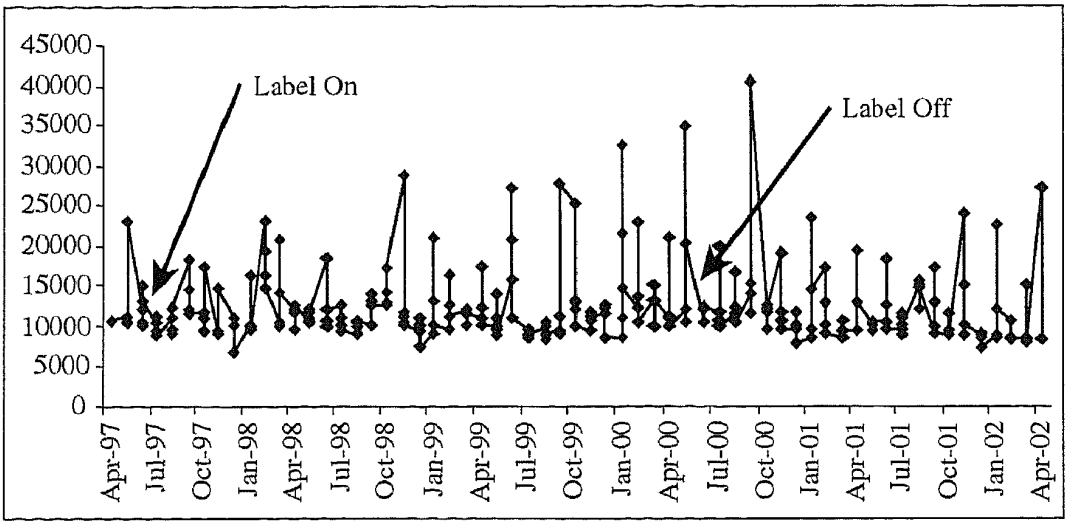
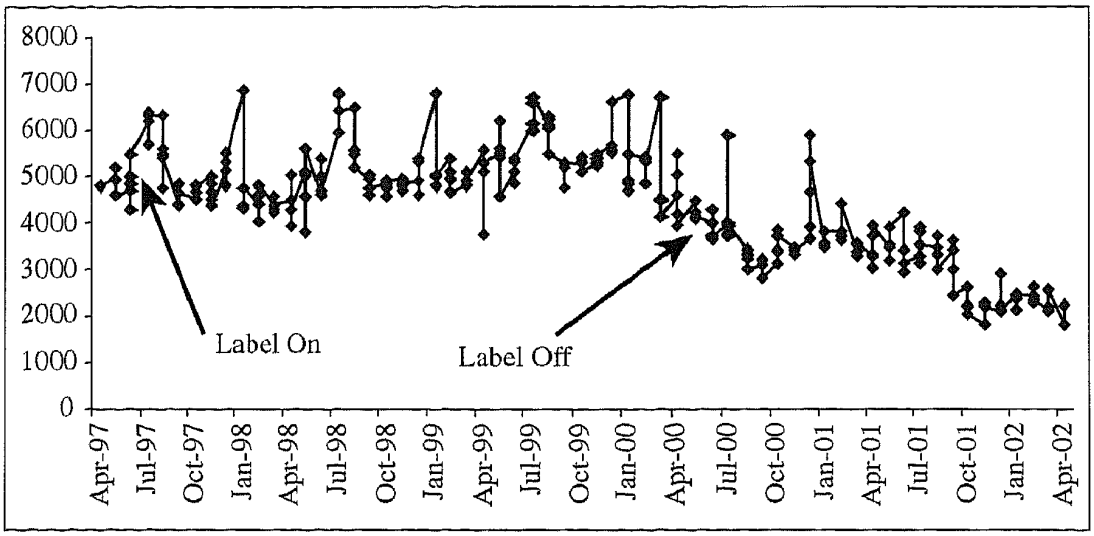


Figure 6 Quantity of GM labelled frozen meatballs sold



11 Implications and concluding comments

Hundreds of studies have elicited consumer stated preferences towards GMFs in various countries around the world. Customarily, stated preferences have been viewed as adequate proxies of potential response towards such products. As we have argued here, however, there are theoretical and methodological reasons as to why stated and revealed consumer preferences could diverge. Unfortunately, little attention has been paid to the potential for such divergence and little effort has been devoted to assessing actual consumer behaviour towards GMFs.

In this study we provide empirical evidence of consumer revealed preferences towards branded processed products carrying GM labels. Our empirical evidence allows insights into the behaviour of a population – not a sample – of knowledgeable, informed, high-income consumers over a long period of time, across multiple products. Our results suggest that at least in the Netherlands, a majority of consumers did not shift away from GMFs in the presence of alternatives. This finding stands in stark contrast to findings based on opinion surveys. We do not know why Dutch consumers did not react to GM labels. It could be that Dutch consumers were reassured by trust in their food supply (Hamstra, 1993) or by the brand identity of each of the labelled products (Noussair, Robin and Ruffieux, 2004). In other words, it is possible that a majority of consumers read the labels, understood them, and kept on purchasing them regardless of anything. Alternatively, it could be that Dutch consumers did not read the labels (Noussair, Robin and Ruffieux, 2004).

Irrespectively, the key result is that Dutch consumers, in aggregate, did not change their behaviour towards positively labelled foods with GM soybean ingredients in the four segments of the processed food market over the study time period. Protecting consumers' 'right to know' and the 'right to choose' is advanced as the main reason for the current European policy stance. In principle, there can be little objection to the argument that consumers need relevant information so that they can consistently act on their preferences. Market transparency is the linchpin of well functioning markets. However, mandatory labelling is not the only option that would allow consumers a choice. Indeed, given that mandatory labelling systems are costly to implement (Kalaitzandonakes, Maltsbarger and Barnes, 2001) costs and benefits associated with such labelling regimes must be carefully weighed in order to decide their optimality (Kalaitzandonakes, 2004; Giannakas and Fulton, 2002). In this context, the proportion of consumers that effectively discriminate between GM and conventional foods in the marketplace is a key parameter (Giannakas and Fulton, 2002). Indeed, Caswell (2000; 1998) and Giannakas and Fulton (2002), have argued that a voluntary labelling programme may better serve a country where only a minority of the population is interested in separating GM from non-GM foods.

Understanding whether a majority of consumers, irrespective of motives, would discriminate against GMFs in the marketplace is essential for effective policy decisions. Our results raise questions about the existing conventional wisdom on potential consumer behaviour, which is based on stated preferences, and suggest the need for further research on revealed consumer preferences and actual behaviour. Of course, while such research is applicable to both developed and developing countries, data and empirical methods of analysis must be appropriately adapted to local market realities. Hence, while investigation of consumer response to positively or negatively labelled products in

supermarkets might be appropriate for developed countries, alternative methods might be necessary for developing countries where consumer response must be observed in fragmented and informal markets. Research that examines more closely the degree to which brands and label formats affect consumer response towards GMFs, could also be useful.

References

Ajzen, I. and Fishbein, M. (1977) 'Attitude-behavior relations: a theoretical analysis and review of empirical research', *Psychological Bulletin*, pp.888–918.

Boccaletti, S. and Morro, D. (2000) 'Consumer willingness to pay for GM food products in Italy', *AgBioForum*, http://www.agbioforum.org, Vol. 3, No. 4, pp.259–267.

Buhr, B.L., Hayes, D.J., Shogren, J.F. and Kliebenstein, J.B. (1993) 'Valuing ambiguity: the case of genetically engineered growth enhancers', *Journal of Agricultural and Resource Economics*, Vol. 18, No. 2, pp.175–184.

Caswell, J. A. (2000) 'Labeling policy for GMOs: to each his own?', http://www.agbioforum.org, *AgBioForum*, Vol. 3, No. 1, pp.53–57.

Caswell, J.A. (1998) 'Should use of genetically modified organisms be labeled?', http://www.agbioforum.org, *AgBioForum*, Vol. 1, No. 1, pp.22–24.

Center for Science in the Public Interest (CSPI) (2001) *National Opinion Poll on Labeling Genetically Modified Foods*, CSPI, http://www.cspinet.org/new/poll_gefoods.html, Washington, DC.

Cropper, M.L. (1995) 'Valuing food safety: which approaches to use?', in Caswell, J.S. (Ed.): *Valuing Food Safety and Nutrition*, Westview Press, Boulder, CO, pp.207–210.

Dahlgran, R.A. and Fairchild, D.G. (2002) 'The demand impacts of chicken contamination publicity-a case study', *Agribusiness*, Vol. 18, No. 4, pp. 459–474

Deaton, A. and Muellbauer, J. (1980) 'An almost ideal demand system', *American Economic Review*, Vol. 70, pp.312–326.

Deutscher, I. (1973) *What We Say / What We Do: Sentiments and Acts*, Scott, Foreman and Company, Glenview, Illinois.

Durant, J., Bauer, M.W. and Gaskell, G. (Eds.) (1998) *Biotechnology in the Public Sphere: A European Source Book*, Science Museum Press, London, UK.

Emmott, R. (2001) 'Senator takes GM foods to the people', *Het Financieele Dagblad*, March, p.12.

European Commission (EC) (1997) 'The Europeans and modern biotechnology', *Eurobarometer*, The European Commission, Brussels, Vol. 46, No.1.

European Commission (EC) (2000) 'The Europeans and modern biotechnology', *Eurobarometer*, The European Commission, Brussels, Vol.52, No.1.

European Commission (EC) (2003) 'Europeans and biotechnology in 2002', *Eurobarometer*, The European Commission, Brussels, Vol. 58, No.0.

Fox, J.A., Shogren, J.F., Hayes, D.J. and Klibenstein, J.B. (1998) 'CVM-X: calibrating contingent values with experimental auction markets', *American Journal of Agricultural Economics*, Vol. 80, pp.455–465.

Freeman, A.M. (1993) *The Measurement of Environmental and Resource Values: Theory and Methods*, Resources for the Future, Washington, DC.

Gaskell, G., Bauer, M.W., Durant, J. and Allum, N.C. (1999) 'Worlds apart? the reception of genetically modified foods in Europe and the US', *Science*, Vol. 285, pp.384–387.

Giannakas, K. and Fulton, M. (2002) 'Consumption effects of genetic modification what if consumers are right?', *Agricultural Economics*, Vol. 27, pp.97–109.

Hamstra, A.M. (1993) *Consumer Acceptance of Food Biotechnology: The Relation Between Product Evaluation and Acceptance Research Report 137*, SWOKA, Leiden, the Netherlands.

Hamstra, A.M. and Smink, C. (1996) 'Consumers and biotechnology in the Netherlands', *British Food Journal*, Vol. 98, No. 4, pp.34–38.

Hayes, D.J., Shogren, J.F., Shin, S.Y. and Kliebenstein, J.B. (1995) 'Valuing food safety in experimental auction markets', *American Journal of Agricultural Economics,* Vol. 77, pp.40–53.

Hillers and Lowik (1998) 'Incorporation of consumer interests in regulation of novel foods produced with biotechnology: what can be learned from the Netherlands?', *Journal of Nutrition Education*, Jan/February, pp. 2–7.

Hoban, T.J. (1996) 'Trends in consumer attitudes about biotechnology', *Journal of Food Distribution Research*, Vol. 27, No. 1, pp.1–10.

Hoban, T.J. (1997) 'Consumer acceptance of biotechnology: an international perspective', *Nature Biotechnology*, Vol. 15, pp.232–234.

Hoban, T.J. (1998) 'Trends in consumer attitudes about agricultural biotechnology', *AgBioForum*, Vol. 1, No. 1, pp.3–7, http://www.agbioforum.org.

Hoban, T.J. and Burkhardt, J. (1991) 'Biotechnology control of growth and product quality in meat production: implications and acceptability', in *Proceedings of Determinants of Public Acceptance in Meat and Milk Production: North America Conference*, Van der Wal, P. (Ed.): Wageningen Agricultural University, The Netherlands.

Hornig Priest, S. (2000) 'US public opinion divided over biotechnology?', *Nature Biotechnology*, Vol. 18, No.9, pp.939–942.

Huffman, W.E., Rousu, M., Shogren, J.F. and Tegene, A. (2002) *Should the United States Initiate a Mandatory Labeling Policy for Genetically Modified Foods*?, Paper Presented at the 6th International Consortium on Agricultural Biotechnology Research (ICABR) Meetings, Ravello, Italy.

Huffman, W.E., Shogren, J.F., Rousu, M. and Tegene, A. (2001) *The Value to Consumers of GM Food Labels in a Market With Asymmetric Information: Evidence from Experimental Auctions,* Paper Presented at the 5th International Consortium on Agricultural Biotechnology Research (ICABR) Meetings, Ravello, Italy.

Hur, J. (2001) 'New GMO rules may curb Japan's Appetite for US corn', *Reuters* News, 28th March.

International Food Information Council (IFIC) (2001) *IFIC Background Report: More US Consumers See Potential Benefits to Food Biotechnology,* http://www.ific.org.

Kahneman, D. and Tversky, A. (1984) 'Choices, Values, and Frames', *American Psychologist*, Vol. 39, No. 4, pp.341–350.

Kahneman, D., Ritov, I. and Schkade, D. (1999) 'Economic preferences or attitude expressions?: an analysis of dollar responses to public issues', *Journal of Risk and Uncertainty*, Vol.19, No.1–3, pp.203–235.

Kalaitzandonakes, N. (2000) 'Agrobiotechnology and Competitiveness', *American J of Agricultural Economics,* Vol. 82, No. 5, pp.1224–1233.

Kalaitzandonakes, N. (2004) 'Labeling biotech foods: another look at Europe's regulations', *Regulation*, Vol. 27, No. 2, pp. 44-50.

Kalaitzandonakes, N. (Ed.) (2003) *Economic and Environmental Impacts of Agbiotech: A Global Perspective*, Kluwer-Plenum Academic Publishers, New York.

Kalaitzandonakes, N. and Bijman, J. (2003) 'So who's driving biotech acceptance?', *Nature Biotechnology*, Vol. 21, No. 4, pp.336–339.

Kalaitzandonakes, N., Maltsbarger, R. and Barnes, J. (2001) 'Global identity preservation costs in agricultural supply chains', *Canadian Journal of Agricultural Economics*, Vol. 49, pp.605–615.

Keisel, K., Buschena, D. and Smith, V. (2004) 'Consumer acceptance and labeling of biotech in food products: a study of fluid milk demand', in Evenson, R.D. and Santaniello, V. (Eds.): *Consumer Acceptance of Biotechnology Foods*, CABI Publishers, New York, pp.9–22.

Kim, D. and Chern, W.S. (1995) 'Health risk concern of households vs. food processors: estimation of hedonic prices in fats and oils', in Caswell, J.S. (Ed.): *Valuing Food Safety and Nutrition*, Westview Press, Boulder, CO, pp.257–286.

La Piere, R.T. (1935) 'Attitudes versus Actions', *Social Forces*, Vol. 13, pp.230–237.

Leahy, P.J. and Mazur, A. (1980) 'The rise and fall of public opposition in specific social movements', *Social Studies of Science*, Vol. 10, pp.259–284.

Marks, L.A., Kalaitzandonakes, N. and Vickner, S.S. (2004) 'Consumer purchasing behavior towards GM foods in the Netherlands', in Evenson, R.D. and Santaniello, V. (Eds.): *Consumer Acceptance of Biotechnology Foods*, CABI Publishers Ltd, Wallingford, UK, pp.23–39.

McFadden, D. (1999) 'Rationality for Economists?', *Journal of Risk and Uncertainty*, Vol. 19, No. 1–3, pp.73–105.

Melton, B., Huffman, W.E., Shogren, J.S. and Fox, J.A. (1996) 'Consumer preferences for fresh food items with multiple quality attributes: evidence from an experimental auction of pork chops', *American Journal of Agricultural Economics*, Vol. 78, pp.916–923.

Menkhaus, D.J., Borden, G.W., Whipple, G.D., Hoffman, E. and Field, R.A. (1992) 'An experimental application of laboratory experimental auctions in marketing research', *Journal of Agricultural and Resource Economics*, Vol. 17, No. 1, pp.44–55.

Midden, C., Hamstra, A., Gutteling, J. and Smink, C. (1998) 'The Netherlands', in Durant, J., Bauer, M.W. and Gaskell, G. (Eds): *Biotechnology in the Public Sphere: A European Sourcebook*, London: Science Museum, pp.103–117.

Moon, W. and Balasubramanian, S.K. (2001) 'Public perceptions and Willingness-to-pay a premium for Non GMO foods in the US and UK', *AgBioForum*, http://www.agbioforum.org, Vol. 4, No. 3,4, pp.221–231.

MSNBC. (2000) *MSNBC Live Vote Results*, January, http://www.msnbc.com.

Noussair, C., Robin, S. and Ruffieux, B. (2004) 'Do consumers really refuse to buy genetically modified food?', *The Economic Journal*, Vol. 114, No.492, pp.102–120.

Nunn, J. (2000) 'What lies behind the GM label on UK foods', *AgBioForum*, http://www.agbioforum.org, Vol. 3, No. 4, pp.250–254.

Nyborg, K. (2000) 'Homo economicus and homo politicus: interpretation and aggregation of environmental values', *Journal of Economic Behavior and Organization*, Vol. 42, pp.305–322.

Pennings, J.M.E., Wansink, B. and Meulenberg, M.T.G. (2002) 'A note on modeling consumer reactions to a crisis: the case of the mad cow disease', *International Journal of Research in Marketing* Vol. 19, No. 91–100.

Peter, J.P and Olson, J.C. (1996) *Consumer Behavior and Marketing Strategy, Fourth Edition*, Chicago, Irwin.

Piggott, N.E. and Marsh, T.L. (2004) 'Does food safety information impact US meat demand?', *American Journal of Agricultural Economics*, Vol. 86, No. 1, pp.154–174.

Prato, T. (1998) *Natural Resource and Environmental Economics*, Iowa State University Press, Ames, IA.

Runge, C.F. and Jackson, L.A. (2000) 'Negative labeling of genetically modified organisms (GMOs): the Experience of rBST', *AgBioForum*, http://www.agbioforum.org., Vol. 3, No.1, pp.58–62.

Sagoff, M. (1988) *The Economy of the Earth*, Cambridge University Press, Cambridge, England.

Shogren, J.F., Fox, J.A., Hayes, D.J. and Roosen, J. (1999) 'Observed choices for food safety in retail, survey, and auction markets', *American Journal of Agricultural Economics*, Vol. 81, No.5, pp.1192–1199.

Smith, M.E., van Ravenswaay, E.O. and Thompson, S.R. (1988) 'Sales loss determination in food contamination incidents: an application to milk bans in Hawaii', *American Journal of Agricultural Economics*, Vol. 70, No. 3, pp.513–520.

Smith, V.L. (1991) 'Rational choice: the contrast between Economics and Psychology', *The Journal of Political Economy*, Vol. 99, No. 4, pp.877–897.

Stegner, A. (2000) 'Experimental evaluation of food safety application to sewage sludge', *Food Policy*, Vol. 25, pp.211–218.

Swartz, D.G. and Strand Jr., I.E. (1981) 'Avoidance costs associated with imperfect information: the case of Kepone', *Land Economics*, Vol. 57, No. 2, pp.139–150.

The Pew Initiative on Food and Biotechnology (PIFB). (2001) *Public Sentiment About Genetically Modified Foods,* http://pewagbiotech.org/research/.

Tolley, G.S. and Randall, A. (1983) 'Establishing and valuing the effects of improved visibility in the Eastern United States', *Report of the US Environmental Protection Agency*, Washington, DC.

Van Ravenswaay, E.O. and Hoehn, J.P. (1991) 'The impact of health risk information on food demand: a case study of Alar in apples', in Caswell, J.A. (Ed.): *Economics of Food Safety*, Elsevier Science Publishing Co. Inc., pp.155–174.

Walsh, J. (1999) 'Brave new farm', January 11, *Time Magazine*.

Wessels, C.R., Miller, C.J. and Brooks, P.M. (1995) 'Toxic algae contamination and demand for shellfish: a case study of demand for mussels in Montreal', *Marine Resource Economics*, Vol. 10, pp.143–159.

Notes

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 generalise beyond France to Europe on the basis of just one study – France is one of the most negative countries regarding GM foods.

2 The Noussair *et al.* study was less limited than other studies as their sample was randomly drawn and more demographically representative.

3 GM labels were removed from the products identified in this case study by the food manufacturers in 2000 as non-GM ingredients were sourced (Kalaitzandonakes, 2000; Kalaitzandonakes and Bijman, 2003).

4 It is worth noting that such measured attitudes placed Dutch consumers in the middle of Europe in terms of overall acceptance above countries such as France, Austria, Greece and Italy but below countries such as Portugal, the UK, Spain and Ireland.

5 Full text media series is available on Lexis Nexis for the five years (1997 – 2002). Articles were counted only if they were related to all agricultural (plant, animal, and food) applications of biotechnology.

6 Market shares of GM labelled and unlabelled conventional products could also have been illustrated here. Econometric analysis detailed in (Marks, Kalaitzandonakes and Vickner, 2004) suggests that such shares were unaffected by the introduction and removal of GM labels over the period of analysis.

7 The interested reader can find our theoretical approach and empirical results reported in (Marks, Kalaitzandonakes and Vickner, 2004).