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GMOs: The Economics of Consumer Food Safety Issues

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The Issue

The controversy over genetically modified (GM) foods has swept across Europe and is beginning to make inroads into the North American consumer market. It is set to become a thorny trade issue between the European Union (EU) and the United States. The issue is important, not least because of the potential scale of the problem. There has been a rapid adoption of GM crops by U.S. corn and soybean and Canadian canola producers. Approximately 57 percent of the U.S. soybean harvested acreage in 1999 was in herbicide-tolerant GM varieties (ERS). Soya is a staple in food processing, with approximately 60 percent of processed foods containing soya or soya derivatives. Canola is an important crop on the Canadian prairies. Although estimates vary, the percentage of canola seeded to GM varieties may have been 60 percent in 1999 (Western Producer, 1999). The entire canola industry has lost its access to the EU market because GM canola is not approved for entry to that market. This paper explores the nature and origins of the GM food safety concerns of consumers, assesses the problem within a theoretical framework and discusses some public policy solutions.

Implications and Conclusions

At the heart of the issue are the problems of information asymmetry and uncertainty. Voluntary or mandatory labelling of GM foods to reduce information asymmetry increases transaction costs for downstream firms, strengthening motivations for closer supply chain relationships. A zero tolerance of GM material may be a sub-optimal requirement for a mandatory labelling policy. The implications of uncertainty are harder to determine. Tort liability law is an ineffective safeguard against unknown long-run negative health consequences.

More research is required to understand differences in consumer preferences, supply chain implications and the relative costs and benefits of alternative policy options.

The Nature and Origin of Consumer Concerns

What are the Concerns?

Clearly, part of the debate surrounding GM crops relates to potential environmental externalities; however, this paper focuses on consumer food safety concerns. (A more detailed discussion of some of these issues can be found in Hobbs and Plunkett, 1999.) In a sense, society has been "genetically modifying" foods for decades through traditional plant breeding methods which enhance desirable genetic traits. More recently, however, scientists have developed the ability to go beyond what can be accomplished through selective breeding and directly introduce the genes from one unrelated organism into another—a process known as "transgenics." This new development lies at the heart of the consumer concerns, which can be separated into three groups. The first group is *specific health concerns.* These include the potential for allergenic responses to GM foods, for example, if a peanut gene were to be inserted into another crop. This is strictly regulated, with extensive testing and various regulatory hurdles to be overcome should biotechnology companies wish to use potential allergens. Another specific health concern relates to the use of antibiotic-resistant marker genes that are used to track the presence of a modified gene. Some consumer groups have expressed concerns that this practice contributes to the growth of antibiotic resistance in humans and animals.

A second, and more fundamental, objection to GM foods is an *ethical* one, involving the notion that genetic engineering is unnatural and may harbour unforeseen side-effects. Further, the patenting of genetic material raises controversies over the "right to own life."

The third group of consumer concerns is *unknown long-run health impacts*—questions of food safety that revolve around scientists' perceived inability to predict the long-run impacts of biotechnology and the cumulative effects of consuming GM foods over a long period of time (House of Lords, 1998). Essentially, this is a fear of the "unknown."

Is there scientific evidence to support these concerns? In the case of food safety concerns, generally the answer is "No," particularly given the rigorous approval processes through which GM foods must pass before being released onto the market. However, there have been contradictory studies, with one group of scientists appearing to demonstrate that there may be health risks from specific GM foods, only to have the research results declared flawed by subsequent peer review of the work. These contradictory findings have done little to re-assure consumers. Of course, the ethical question is harder to answer with science, since it is an objection to a scientific process on moral, rather than on safety, grounds.

European vs. North American Reactions

There has been a noticeable difference in consumer reactions to this issue in the EU compared with Canada and the United States. A number of consumer polls reflect the general distrust

which some EU consumers feel toward the science of biotechnology, the biotechnology industry itself, and the regulatory system set up to protect the public. For example, in the UK a MORI poll conducted in June 1998 reported that 77 percent of those surveyed favoured a ban on growing GM crops, with 61 percent stating they did not want to eat GM food (Perdikis et al.).

In contrast, Canadian and U.S. consumers have been more passive. A March 1998 survey by Industry Canada revealed only 12 percent of those surveyed felt that the government was doing a poor job with respect to biotechnology (Industry Canada, 1998). However, only 6 percent considered themselves familiar with biotechnology. The contradictory scientific studies regarding the safety of GMOs can only serve to add to consumer confusion, given the acknowledged lack of understanding of the science. More recently, the GMO issue has begun to receive attention in the Canadian media, although it appears that it has not yet risen to the forefront of consumer thinking to the extent that it has in Europe. There is a need for objective, scientific analysis of consumer preferences in North America and Europe so as to inform this debate.

Even at the regulatory level, philosophically the EU approach to the issue differs from that of Canada and the United States. European Union regulations are process-based; transgenic foods are regulated separately from conventional foods under the 1997 Novel Foods Regulation. Implicit in this regulatory approach is the notion that the risks are different with GMOs than with other foods. Canada and the United States have adopted a product-based regulatory approach. In Canada, the focus is on establishing the safety of the product regardless of how it was produced. Genetically modified foods are judged alongside conventional foods using the principle of "substantive equivalence"; that is, it must be shown that any risks from GM canola are substantially equivalent to the risks from conventional canola.

Origins of the Concerns

Information and Complexity

The origins of consumer concerns are interrelated. First, there is an information problem. The science behind GMOs is complex and there is a lack of understanding and general mistrust of biotechnology among some consumers. Consumer demand for agri-food products is not homogeneous; increasingly, consumers require differentiated products with specific characteristics. In addition to taste, texture and price, some consumers are interested in food safety, farm animal welfare, environmentally friendly production practices, etc. This puts the agri-food sector under far more scrutiny than has been the case in the past. *How* the product was produced has become an important product characteristic for some consumers. When the answer to that question involves complex scientific procedures, consumers are faced with information costs in determining whether this characteristic is present and in evaluating its desirability.

Food Scares

A related cause of consumer unease is a number of food safety scares that preceded the GMO issue. Of particular significance was the Bovine Spongiform Encephalopathy (BSE) cri-

sis in the British beef industry. After years of assuring British (and export market) consumers that the "mad cow disease" afflicting British cattle could not be transmitted to humans, in March 1996 the British government reversed its position and admitted a possible link between BSE and a new strain of Creutzfeld-Jacob Disease in humans. Consumer confidence in the ability of scientists and the regulatory system to protect human health was seriously eroded by this crisis. Widely publicized outbreaks of E. coli food poisoning in the United States and Europe have heightened consumer concerns, as did the scandal over dioxin-tainted animal feed in the Belgian food industry in 1999. In August 1998, the UK House of Commons banned GM foods from its dining room, further adding to consumer suspicions over the safety of GM foods (Perdikis et al., 1999).

Producer vs. Consumer Focus

The initial GM products adopted by the agricultural sector have been producer- rather than consumer-focused, that is, input-trait enhanced products which increase pest resistance, reduce the need for herbicides and enhance yields, rather than output-trait enhanced products, for example, nutriceuticals or "functional foods" with positive health benefits. While there may be indirect benefits to consumers from input-trait GM products (lower prices, less chemical use in food production, etc.), in general, they have little direct consumer appeal.

Interest Groups

Finally, the GMO issue has become a lightning rod for a coalition of interest groups concerned about food safety, the environment and the influence of multinational "life-science" corporations. The issue has been inflamed by sensationalist media stories that have made it difficult for consumers to access credible information on either side of the debate.

Conceptual Framework

Information Asymmetry

What contribution can economics make to this debate? Information asymmetry and uncertainty are the key concepts. Information asymmetry arises when information is unevenly distributed, such that one party to the transaction has more information than the other party. Genetically modified foods are "credence goods." Unlike search goods, whose quality can be determined prior to purchase, or experience goods whose quality can be determined after purchase through use, the "GMO" characteristic of a food cannot be detected by a consumer.

Information asymmetry begins at the farmer-processor level of the supply chain because of the credence nature of the GMO. Currently technology is not available to allow buyers to detect the presence of GMOs when purchasing from farmers. Similarly, retailers cannot determine whether they are purchasing foods containing GMOs from processors. This is particularly complex in the case of further processed products that may contain a number of different GMOs, for example, frozen pizza, ready meals, etc.

Uncertainty

With respect to consumer concerns regarding unforeseen long-run health side-effects, the problem is uncertainty. It is not "risk" in its strict economic definition because this requires attaching statistical probabilities to different outcomes. The consumer concern is a fear of the unknown; one cannot attach statistical probabilities to the occurrence of something that currently is unknown. Uncertainty arises when there is insufficient information to establish probabilities (Knight, 1921).

Solutions

Voluntary Labelling

There are a number of possible private market responses and public policy solutions to the problems of information asymmetry and uncertainty. A private market response to information asymmetry is voluntary labelling of products as "genetically modified" by food processors and retailers. This is the approach favoured by the U.S. and Canadian governments. It would allow a "market test" of consumer acceptance by labelling the products and letting the market decide whether there is a demand for them. Consumers with an ethical objection to the technology would signal their preferences by avoiding these foods; those with no objection could consume them. Critical to making this a credible solution is the extent to which firms have an incentive to label GM foods honestly. This incentive will be severely weakened if firms expect a consumer backlash against GM products. Even if the majority of firms were honest and did not opportunistically mislabel their products, given bounded rationality (the limited cognitive ability of individuals) it is not possible to determine *ex ante* which firms would act opportunistically. In other words, market failure sets in because of the very information asymmetry problem we were attempting to solve.

If there is sufficient consumer mistrust of GM foods, processors of non-GM products have an incentive to use a "GM-free" label. Here too, there is an information problem. In order to provide this assurance, the food processor would either have to test all products for the presence of GMOs—something which is not technically feasible given current technology—or monitor upstream suppliers to ensure that all inputs were GMO free. In either case, the non-GM food processors incur high transaction costs. This would put those firms wishing to label their products as "GM-free" at a commercial disadvantage relative to producers of genetically modified foods, as it is more costly to substantiate the absence, rather than acknowledge the possible presence, of GMOs (Kerr, 1999). This suggests a role for third-party private market players in providing or verifying credible product information.

Tort Liability Law

Typically, a private market solution to the problem of uncertainty over the long-term safety of a product is provided by tort liability law. The risk of damage to the firm's reputation and the prospect of large compensatory payments if found liable under a civil legal case provide the

incentive for firms to act in the best interests of consumers. For this to be an effective incentive requires that there be a clearly provable link between the "defective" product and the harm it has caused. Proving direct liability in the case of a health problem caused by long-term consumption of GM foods would be extremely difficult given the time lapse involved and the complexity. For example, it might require proving that a single modified gene within a complex processed food product containing multiple genes was the cause of a subsequent health problem. Private market responses alone are probably inadequate for dealing with the problem of long-term uncertainty.

Mandatory Labelling

Two public policy solutions are apparent: a mandatory labelling policy or an outright ban on GM foods. Mandatory labelling of all GM foods is the approach adopted by the EU and will come into effect during the year 2000 with a 1 percent threshold (all products containing more than 1 percent GMOs will be labelled as genetically modified). Japan, Australia and New Zealand have introduced, or will be introducing, mandatory labelling. In 1999, the UK government introduced regulations requiring restaurants to notify their customers if their food contained GM soya or corn.

Mandatory labelling provides a solution to information asymmetry that allows consumers to express their preferences, yet avoids the market failure problem. However, the costs of this solution are likely to be non-trivial. As with a voluntary labelling policy, firms incur increased transaction costs in monitoring upstream suppliers to determine whether GMOs are present and to what magnitude. The transaction costs of occasional spot market transactions will increase and closer forms of vertical coordination, such as long-term contractual relationships, strategic alliances or full vertical integration, may be more transaction-cost efficient. Further, it is not yet clear the extent to which the traditional bulk grain handling system in Canada will be able to segregate GM and non-GM crops efficiently and effectively.

Additional administrative costs would be incurred by the government in policing and enforcing a mandatory labelling policy. A joint public policy–private market solution to the information asymmetry problem might include a role in the supply chain for third party independent "verifiers" of product labelling information.

In introducing a mandatory labelling policy, the threshold levels of GMO "contamination" allowable under a "GM-free" or a "contains GMOs" label must be determined. While the EU has set this threshold at 1 percent, other countries are considering a 5 percent threshold. The costs of moving to zero tolerance for GMOs are likely substantial. As suggested above, in addition to increased transaction costs of monitoring supply chain partners, there would be the segregation costs of ensuring that GM and non-GM material did not come into contact at any point during the production, transportation, processing and distribution stages. For example, segregation procedures might include ensuring that grain hoppers or rail transportation cars did not contain even slight traces of GM material when shipping non-GM grains.

Figure 1 illustrates that the optimal level of GMO "contamination" resulting from a labelling policy may not be zero. Curve AA represents the costs to society of GMO content in non-GM grains. This cost includes the dis-utility to consumers with a food safety or ethical objection to GMOs, as well as the potential loss in markets to producers of non-GM products. At zero tolerance levels for GMO contamination, the costs of GMO content are also zero. As the threshold level of GM content is increased, the loss in consumer utility and the opportunity cost of markets foregone for non-GM producers rises. Curve BB represents the (transaction and segregation) costs to society of reducing GMO content to comply with labelling regulations. These costs approach zero as the proportion of a product or shipment that can contain GM material approaches 100 percent. Conversely, the costs rise exponentially as labelling requirements approach a zero tolerance threshold. Curve CC is the vertical sum of curves AA and BB, representing the total cost of the labelling policy to society.

Figure 1 Optimal GMO "Contamination" Thresholds for a GM Labelling Policy

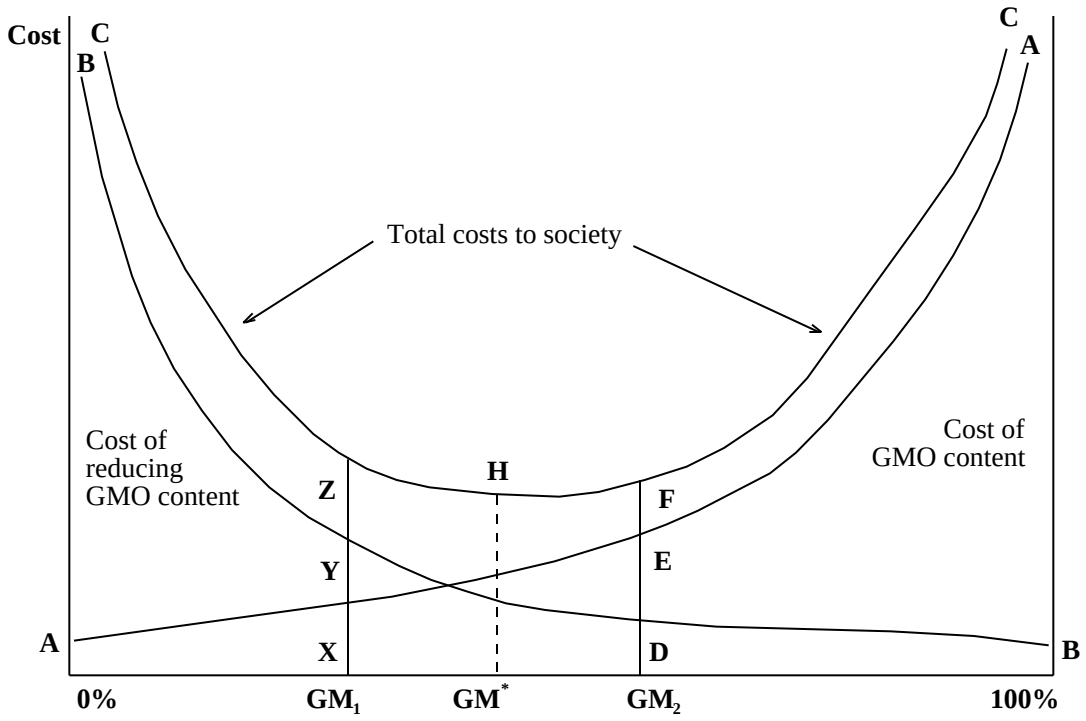

Figure 1 suggests that the optimal level of GMO "contamination" commensurate with a mandatory labelling policy is GM*, where the total costs to society are minimised at point H on curve CC. At GM content thresholds above GM* (e.g., GM_2), although the costs of

achieving that level of GM content are lower (GM_2-D), the costs to society of having a higher GM content rise (GM_2-E). Thus, total costs to society are higher, at point F.

At lower GMO threshold levels (e.g., GM_1), while costs in terms of consumer dis-utility and foregone markets are lower (GM_1-X), the costs of achieving this lower threshold are higher (GM_1-Y); this results in a higher total cost to society (Z). A shift downwards and to the right of the AA curve would increase the GM contamination threshold at which costs to society were minimised. This might be achieved, for example, through public policy initiatives to provide consumers with access to credible, objective, scientific evidence on the relative safety of GM foods.

Finally, a mandatory labelling policy does not solve the problem of long-term uncertainty. Simply labelling a product as "genetically modified" does not provide consumers with any additional information about the *known* safety of the product, since under the principle of "substantive equivalence" it will only have reached the Canadian market if it has the same level of known safety as a non-GM food.

A Ban

An alternative policy solution to both the information asymmetry and uncertainty problems is to ban the production and/or sale of GM food altogether. Adoption of this policy would suggest either that policy makers have no confidence in the efficacy of their domestic regulatory system to protect consumers or that the information, monitoring and segregation costs involved in enforcing a mandatory labelling policy are too high. Clearly, this would appear to be a policy that distorts market signals, preventing consumers from signalling through the marketplace their preferences for GM versus non-GM foods. However, if the net social costs of administering a mandatory labelling policy, plus the increased transaction and segregation costs it would impose along the supply chain, outweigh the net social costs of an outright ban on GM foods, then it could be the economically efficient solution—a "second-best optimum." This is an empirical question. A further consideration is whether banning GM foods will inhibit investment in biotechnology, leading to the possibility of large foregone consumer benefits.

Further Research

The literature dealing with the economics of information provides important insights into the GM food debate. Evidently, some consumers—particularly in the EU—have grave misgivings about GM foods. Whether or not these concerns can be validated scientifically, if we base our neoclassical micro-economic theory on the notion of consumer sovereignty then we must respect those preferences. A simplifying assumption of traditional neoclassical theory is a homogeneous consumer demanding a homogeneous product. Clearly, this assumption does not hold where GM foods are concerned. First, there may be GM and non-GM versions of the same food. Second, consumers are heterogeneous in their preferences. A fruitful avenue of research is to explore the nature and cause of different attitudes towards GM foods, identify

consumer segments, and establish the willingness-to-pay for GMO-free products or GM products with positive consumer-oriented characteristics such as functional foods with proven health benefits.

Mandatory labelling has important implications for the structure of agri-food supply chains that bear further investigation. Important questions include: how the transaction costs of the system will be affected; who bears the burden of any increase in these costs; the impact on supply chain relationships; the costs of segregating GM and non-GM crops; the optimal threshold for allowable GM material if labelling is adopted; and whether there is a role for third parties in the supply chain to provide credible product information.

Finally, a cost-benefit analysis of the various policy options is warranted so that welfare-maximizing policies are implemented. This is no small undertaking, since policies implemented in the retail market (for example, labelling of GM foods) have knock-on effects throughout the vertical market system, complicating the analysis of changes in producer and consumer welfare.

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