Regulating Biotechnology: GM Food Labels

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Discussions of appropriate regulatory norms for foods derived through modern biotechnology date back to the early 1980s. Almost 20 years later, agreement among key trading countries on what such norms should be remains elusive. Some countries, including the United States and Canada, consider biotech or genetically modified (GM) foods substantially equivalent to conventional counterparts and regulate them similarly. Others, including the European Union (EU) and Japan, scrutinize and require mandatory labeling of GM foods.

Opponents of mandatory labeling have argued that it is unwarranted and costly. Proponents have argued that it is necessary to safeguard the informed consumer choice. Both such arguments have found acceptance in different parts of the world, raising questions about the optimal regulatory approach to GM-food labels and the factors that influence regulatory decisions. I address these questions in this paper.

GLOBAL LABELING REGULATION OF GM FOODS

Labeling regulations for GM foods around the world are highly fragmented—a patchwork of country-specific initiatives that continue to evolve. In 1986, the Organization for Economic Cooperation and Development (OECD) recommended that risks associated with organisms derived through modern biotechnology be regarded as the same as those from the conventional and could be assessed in similar ways. This concept of "substantial equivalence" has been mirrored in the United States and Canadian regulatory regimes where new food products derived through modern biotechnology are assessed for safety and nutritional fitness. Accordingly, mandatory labeling is not required unless the novel food products are substantially different from their conventional

counterparts.[1] At the same time, both countries have developed guidelines for use by producers, processors and merchants interested in voluntary labeling to indicate presence or absence of GM ingredients in their food products.[2]

Regulation in some other countries has focused on the process of biotechnology rather than on the product. In the EU, a process-specific regulatory framework was adopted early on and has evolved over time. Specifically, the European Commission decided to regulate biotechnology by newly installed institutions, starting with the deliberate release of genetically modified organisms (GMOs) in 1990. In 1997, the European Commission mandated labeling of GMOs and of food products derived from them. The presence of novel DNA or protein resulting from genetic modification was made the criterion for labeling. A standard was established in 1999 when the mandatory labeling threshold of the novel DNA or protein was set at 1%. Mandatory labeling was extended to food additives and flavorings in 2000.

In 2001, the European Commission adopted two new legislative proposals that sought to broaden mandatory labeling beyond foods and food ingredients. The proposals were adopted by the European Parliament and the Council of Ministers in July of 2003 and were expected to be enacted by year-end. When implemented, the new regulation will require labeling of animal feeds and feed additives as well as highly refined oils, sugars and starches and will affect a significantly increased portion of the market since a large share of GM commodities is used for the production of animal feed (Ballenger *et al.*, 2000; Kalaitzandonakes, 2000). Labeling will be mandatory also of products that are derived from GMOs but do not contain detectable levels of novel DNA or protein (*e.g.* highly refined oils). Under these circumstances, enforcement of mandatory labels can no longer rely on laboratory testing. Instead, the new regulation mandates the implementation of a traceability system that requires chain of custody and accountability for all GM commodities and food ingredients at each point of the European agrifood marketing chain.

Other countries have also mandated labeling of GM foods, but their regulatory regimes are more liberal than that of the EU. For instance, Japan and South Korea have introduced mandatory labeling for food products that contain over 5% and 2% of GM food ingredients, respectively. Mandatory labeling rules in both countries, however, have affected only a very small part of the market as they explicitly exclude animal feeds, highly processed foods and many oils. Similarly, Australia and New Zealand require mandatory labeling for whole foods, processed foods, fruits, and vegetables that contain more than 1% of GM

[1]If a GM food has significantly different nutritional properties from its conventional counterpart, its label must reflect the difference. Similarly, if the new food includes an allergen that consumers would not expect to be present based on the name of the food, the presence of that allergen must be disclosed on the label.

[2]Formal guidelines for voluntary labeling of GM foods in Canada are expected in early 2004.

material. Highly refined foods, such as oils, sugars and starches are again excluded from mandatory labeling.

Labeling regulation levied on GM foods around the world could remain fragmented for some time, as countries continue to go their separate regulatory ways. But what factors drive governments in different parts of the world to intervene so variously in the functions of their markets? And what is an appropriate framework to examine the relevance and optimality of such regulatory interventions?

Why Do Governments Regulate And When Should They?

Since Adam Smith, market economists have argued that perfectly competitive markets yield optimal outcomes and that, given resources and technology, no rearrangement of goods and services can unambiguously improve the welfare of society. Government intervention in the functions of the market then has been justified, principally, on two grounds: (a) equity improvements through more desirable outcomes in the distribution of goods and services, and (b) efficiency improvements when markets fail.

Market failure can occur under a variety of circumstances that can generally be viewed as presence of: (a) market power (including natural monopolies), (b) asymmetries in market information and (c) externalities and public goods (Noll, 1989). Market failure is the predominant justification for regulatory intervention. Market failure, however, does not constitute a mandate for government regulation. It simply suggests that government regulation might be beneficial. The economic literature includes an array of alternatives that often turn out to be preferable to regulation for coping with market failures (*e.g.* relevant use of taxes and subsidies, use of incentives to influence private decisions, and, quite often, "doing nothing"). The standard criteria governments must then confront as they consider alternative regulatory policies are:

- Is there, indeed, a market failure?
- If so, would regulation be efficient? That is, would the social benefits secured through regulatory intervention exceed the costs?
- Would the regulation be cost-effective? In other words, would the regulatory policy of choice be the lowest cost option for achieving the policy goals?

Cost-effectiveness ensures that overall policy goals are achieved at minimum cost, eliminating unproductive alternatives. However, cost effectiveness does not ensure that the regulation is in the best interest of society. For that, the regulation must be shown to be efficient—*i.e.* that it generates more benefits to society than costs.

Clearly, much discussion about the optimality of regulation revolves around social benefits and costs. Clarifying the ways a particular regulation benefits and burdens a society then helps size up the expected net social welfare gains

(social benefits minus costs). In this context, a government's reasoning for intervening in the market is important.

Regulation of GM Foods: Mandatory Labeling

So, what is the reasoning of governments for intervening in their respective markets and mandating the labeling of GM foods? Proponents of mandatory labeling of GM foods have rationalized the need for regulatory intervention on two separate grounds: (a) possible existence of health risks from the consumption of GM foods and (b) presence of informational asymmetries (Hobbs and Plunkett, 2000).

Health Safety Concerns and GM-Food Labels

Two kinds of safety concerns have been raised about GM foods over the years (Hobbs and Plunkett, 2000): specific health concerns (*e.g.* the potential for transferring allergens across foods) and "unknown" long-run health concerns. The latter have been motivated by doubts that scientists can predict the impacts of cumulative GM food consumption over long periods of time. Lack of specific hypotheses and failure to articulate potential hazard mechanisms, however, have led some to dismiss this kind of concern as "fear of the unknown" [*e.g.* the US Food and Drug Administration (FDA)]. Specific health concerns have attracted more attention.

If specific health risks from consumption of GM foods could be substantiated, then market failure could materialize. Individuals with imperfect knowledge of relevant risks would be unable to make sound decisions leading to inefficient market outcomes and market failure. Under such circumstances, regulators could impose outright bans. Alternatively, regulators could choose to mandate labels to serve as hazard warnings. Hazard-warning labels have been used by regulators in cases when the risks are not great enough to warrant the ban of a product, but too troubling to ignore (Viscusi *et al.*, 1986).[3] With increased information through mandated labels, users with different susceptibilities to a particular health risk, different tolerances for risk, and different product needs and usage rates can select a bundle of product attributes—including risk—that corresponds to their preferences and needs. Within this context, mandatory labeling could yield social welfare gains.

In order to increase the market information about potential health risks associated with GM foods, governments around the world have used similar approaches. In the United States, the FDA has published guidelines on the questions that companies need to answer in assessing the safety of GM foods. Test results are submitted to the FDA for evaluation throughout a consultation

[3]Examples of hazard-warning labels in the United States can be found in the use of toxic chemicals, previously unregulated workplace carcinogens, use of consumer products as home insulation and wearing-apparel textiles, and consumption of alcoholic beverages and tobacco products.

process. While consultation with FDA is voluntary, all GM foods that have been approved for commercialization have undergone such a review.[4]

The European Commission requires all GM foods to undergo premarket risk assessment and approval. Each individual product must be subjected to a scientific review to ensure that it poses no risks to public health, animals, or to the environment. A new centralized agency—the European Food Safety Authority—was created and charged with all scientific safety assessments and communication with the public. Following scientific assessment, product-approval decisions rest with the Council of Ministers.

In the premarket risk assessment of GM foods, the European Union has advocated the use of the controversial "precautionary principle." In effect, the principle argues that, when in doubt about the potential environmental or health safety impacts of any GM product, one should err on the side of caution. Critics have countered that the principle advocates an impossible and impractical burden of proof in establishing "absence of harm" with no uncertainty. Irrespectively, the scientific assessment processes in the European Union, the United States, and also in Japan, Australia, and elsewhere, involve similar test regimens and have arrived at similar conclusions: the reviewed GM food products pose health risks similar to their conventional counterparts.

Informational Asymmetries and GM-Food Labels

Despite lack of evidence of any extra health risks from GM foods, consumer preferences towards marketed GM foods might range from complete aversion to indifference.[5] The technical rationality of consumer aversion is not material. Aversion might be associated with consumer values and beliefs, ethical and religious convictions, level of understanding of modern biotechnology, and other personal factors.

Under these circumstances, some consumers could derive differential utility levels from consumption of GM and conventional foods and, accordingly, exhibit differential demand for GM and conventional products. Consumers could encounter difficulties, however, in articulating their, potentially, differential demand for GM and conventional food products in the market-place. Genetically modified and conventional foods are indistinguishable through standard product-inspection practices, before or after consumption. These informational imperfections could lead markets to operate sub-optimally as consumer outlays could be misaligned with their underlying willingness to pay for GM and conventional food products. Supply of relevant information on the GM content of various foods could then provide market efficiencies by

[4]In 2001, the FDA proposed a rule that will make the current consultation process mandatory.

[5]Only first-generation GM food products are considered here, which are assumed to have no distinguishable consumer attributes from those of their conventional counterparts.

causing supply and demand for GM and conventional food products to more closely match.

Labels could be used to inform consumers about the presence or absence of GM ingredients in various food products (Caswell, 2000). Practical implementation of labeling, however, affects the entire agrifood marketing chain in requiring identity preservation (separation) of GM and conventional commodities, ingredients, and processed foods, from seed to the supermarket shelf. Labeling is, therefore, costly. In this market context, producers across the agrifood marketing chain could recognize differential consumer demand for various GM and conventional food products and, after accounting for incremental costs, they could decide to voluntarily label their products in order to differentiate them in the market place and increase their share and profits. Alternatively, informational asymmetries between producers and consumers could be such that supply and demand would not converge, raising the possibility of market failure and the potential need for government intervention.

Confronted with the possibility of market failure, governments could consider whether they should mandate GM labels as a remedy. In this context, mandatory labeling in a given market could be justified as a means of ensuring informed consumer choice and efficient market operation, notwithstanding scientific assurances that GM and conventional foods are equally safe. Of course, regulators must evaluate the merits and relevance of mandatory labeling policy against the standard criteria any regulation must confront: would there, indeed, be a market failure necessitating regulatory intervention? If so, would regulation be efficient and cost-effective?

Given that some governments have mandated labeling of GM foods, they apparently arrived at the conclusion that if markets were left on their own they would fail. They also concluded that specific mandatory labeling policies installed (*e.g.* types of foods to be labeled, thresholds at which requirements for labels are triggered, traceability requirements) are efficient and cost-effective. Six years after the commercial introduction of GM foods in the global market, is there sufficient evidence to support such judgments?

The Economics of GM Labels

Is Market Failure Apparent or Unavoidable?

Miller and Van Doren (2001) argued that market failure would be evident only if food markets were unable to segment despite differentiated consumer demand for GM and conventional products. Put differently, if markets responded to differential consumer demands achieving, so called, separating equilibria, then the case for market failure is undermined. Substantial voluntary "non-GM" and "GM-free" labeling activity as well as other forms of market segmentation for GM and conventional food products would then signal a diminishing prospect of market failure.

Assessment of whether market failure exists is rather difficult in some markets. For instance, in the European Union, mandatory labeling was implemented before any significant commercialization of GM foods and, hence, markets were effectively preempted. One must, therefore, evaluate the counterfactual of whether there would have been market failure (or how well markets would have segmented) in the absence of preemptive regulation. Empirically, this is a difficult assessment as it is difficult to anticipate all the possible ways firms might have attempted to differentiate their products in the marketplace in order to accommodate the preferences of various consumer segments. For instance, while some firms could have voluntarily labeled for GM content (*e.g.* making "non-GM" or "GM-free" claims), others could have used in-store information and could have leveraged their brand equity to assure consumers of product safety and quality.[6] Similarly, it is tricky to, *ex post*, measure what would have been the demand for GM and conventional foods in the absence of regulation. Upfront regulatory requirements for mandatory labeling could have signaled increased product risk for some consumers and could have influenced their preferences towards GM foods.

Despite these and other inherent empirical difficulties, there is evidence that firms have extensively used voluntary "GM-free" or "non-GM" labels to differentiate their products in markets around the world. Kalaitzandonakes and Bijman (2003) have reported significant and strategic voluntary labeling activity in European markets for products that are not covered by current mandatory labeling requirements. Major retail chains—Sainsbury, Tesco, and ASDA in the United Kingdom, Carrefour in France, Delhaize "Le Lion" in Belgium, Migros and Coop in Switzerland, *etc*.—have offered labeled products from animals reared on non-GM feed (*e.g.* meats, eggs, poultry, dairy and various related processed foods). Large food-service chains, like Burger King, have also opted for serving poultry products reared on non-GM feeds. While such chains do not offer both product lines in their stores, many of their competitors have not followed such strategies, thereby allowing market segmentation. A host of small and medium-size manufacturers and retailers in the European Union have also actively participated in the "non-GM" and "GM-free" markets, offering a wide variety of products, from cookies and meats to cotton wool.

In addition to market differentiation through "non-GM" and "GM-free" claims, further segmentation has been achieved in the European Union through broad offerings of products that are considered substitutes to GM commodities and foods. These include organics that explicitly preclude use of GMOs as well as commodities where GM varieties have not been marketed (*e.g.* wheat and sugar beet), thereby guaranteeing, though often implicitly, non-GM status. Organics alone amount to a $9 billion market in Europe with a full range of

[6]Noussair *et al.* (2002), for instance, have determined through experimental auctions that French consumers could readily substitute trust in specific food brands for explicit information on GM content.

products, from dairy, fresh and frozen meats, fruits and vegetables to a variety of drinks, including spirits, and prepared foods.

Active segmentation of GM and conventional commodity, ingredient, and processed food markets can be found in many other parts of the world. For instance, in the United States, the production of an estimated 2.5 million acres of corn and soybean have been identity-preserved and directed to the non-GM market segment every year since the late 1990s. Similarly, there has been active market segmentation and voluntary labeling of processed foods. A few large US manufacturers (*e.g.* Gerber, Heinz, and Frito-Lay) have announced non-GM status while some specialized food manufacturers (*e.g.* Hain Celestial, and Eden Foods) and retailers (*e.g.* Whole Foods, and Wild Oats) offer a wide range of products voluntarily labeled as "non-GM." In most cases, such voluntary labels also claim organic status indicating the close attribute overlap in the preferences of consumers targeted by these products. In recent years, "non-GM" claims in the United States have been increasingly subsumed into organic labels. Sloan (2002) explained that a large percentage of core consumers seek out organics specifically to avoid GM foods. Accordingly, in the United States, the "non-GM" and organic segments have been converging, representing a $6 billion market with extensive offerings in virtually every food-product category.

Probably the most direct case of voluntary labeling in the United States is the small but stable market of milk labeled as "free of rBST"—a bioengineered hormone that induces yield increases in dairy cattle; "rBST-free" milk has been sold side by side with unlabeled milk since 1995 and is currently estimated to represent about 1.5% of the total whole milk market in the United States.

There is also empirical evidence of active differentiation between GM and conventional food products in Japan, Korea, Taiwan, Thailand, and elsewhere. For instance, futures for non-GM soybeans have been actively traded in the Tokyo Grain Exchange since 2000. Similarly, voluntary "GM-free" or "non-GM" labels have been placed on a variety of processed foods in the Japanese market—from soy sauce and tofu to corn snacks and potato chips.

Clearly, the empirical evidence on voluntary market response for GM labels is sketchy. Furthermore, the existence of market failure can be fully examined only through joint analysis of supply and demand conditions. Still, the substantial voluntary labeling activity and product differentiation that exists today through various firm initiatives in markets around the world suggests that market failure is by no means obvious or demonstrated.

Is Mandatory GM-Labeling Regulation Efficient?

Even if economic analysis could demonstrate that markets would indeed fail and that efficiency gains were possible through regulatory intervention in the case of GM foods, only a necessary condition for regulation would have been established. Additional analysis would be needed to demonstrate that selected regulatory policies are both efficient and cost effective.

Cost-benefit analysis is necessary to confirm that these sufficient conditions for regulation hold. Appropriate value must be assigned to the benefits that society derives from mandatory GM-food labels and the relevant costs must be calculated. Giannakas and Fulton (2002) considered the problem and obtained the conditions of optimal labeling regimes for GM foods in markets with differentiated consumer demand. They showed that the relative optimality of mandatory labeling regimes depends chiefly on the level of consumer aversion to GM foods, the costs associated with mandatory labeling, and the extent of mislabeling. Naturally, the desirability of mandatory labeling increases as a society's aversion to GM foods grows, labeling costs decline, and the probability of mislabeling in the specific market is reduced.

The level of aversion to GM foods exhibited by society is determined both by the degree of aversion and by the distribution of aversion among consumers. In a market with widespread and intense aversion towards GM foods, benefits from mandatory labeling would be expected to be substantial. Society's differential willingness to pay for GM and conventional foods provides a proper measure of societal benefits from mandatory labeling. Estimates of willingness to pay may be derived through consumer interviews. But as Viscusi and Gayer (2002) explained, due to their hypothetical nature, such estimates often turn out to be misleading. Instead, economists prefer to turn to actual market behavior for insights.

The Benefits of GM Labeling

What do we know about the degree of aversion of various consumer groups towards GM foods, their differential willingness to pay for GM and conventional foods and relevant interest in GM food labels? We know less than is typically presumed. Despite regular references by the European Commission, for example, to the strong interest of European consumers in GM-food labels and their aversion to GM foods, market evidence for such behaviors is almost non-existent. Indeed, much of what is known today about consumer purchasing intentions towards GM foods and about interest in GM labels in Europe (and elsewhere) is inferred from attitude surveys, such as the Eurobarometer (European Commission, 2003). Indeed, such surveys have long indicated widespread public skepticism towards GM foods and interest in mandatory GM labels. Attitude surveys can capture public sentiment towards GM foods and biotechnologies, but are constrained by their hypothetical structure, especially since they do not account for price and income effects on consumer-stated preferences. Attitude surveys may also engage their subjects as citizens rather than strictly as consumers. Importantly, as Sterngold *et al*. (1994) explained, attitude surveys are subject to significant biases. How questions are framed, the order in which information is presented, and the degree of knowledge and understanding of the respondent are just some of the potential sources of bias and error. Accordingly, attitude surveys may, or may not, provide effective

proxies of consumer-market behavior and willingness to pay for GM and conventional products or relevant GM labels.

While the bulk of existing research has focused on attitudinal surveys, a handful of researchers have utilized willingness-to-pay surveys and experimental auction-market techniques to capture how consumers might respond to GM foods if faced with realistic food choices (*e.g.* Huffman *et al.* 2003; Lusk *et al.*, 2001; Moon and Balasubramanian, 2001; Noussair *et al.* 2002). Some of these studies have arrived at conclusions that are qualitatively different from those obtained through attitude surveys. For instance, Noussair *et al.* (2002) studied the response of a representative sample of ninety-seven consumers to "GM" versus "non-GM" labeled and organic foods in an experimental laboratory setting in Grenoble, France. The authors concluded that 35% of consumers boycotted GM-labeled foods, but the rest were willing to purchase products containing GM ingredients at some prices or were indifferent and would purchase them regardless—a conclusion different from those drawn from attitude surveys in France. Of course, experimental auction market analyses and survey-based willingness to pay studies are still hypothetical in nature. Accordingly, elicited consumer-stated preferences can be different from normal purchasing behavior exhibited by the market.

In the literature on consumer behavior towards GM foods, only a handful of studies have focused on revealed rather than stated preferences (James *et al.*, 2002; Kiesel *et al.*, 2003; Marks *et al.* 2003). Of these three studies, only one has examined consumer response to positively labeled GM products (*e.g.* "this contains GM ingredients") in a market with presumed consumer hostility.[7] Specifically, Marks *et al.* (2003) examined how consumers actually behaved when they could choose between positively labeled GM foods and unlabeled conventional food products in supermarkets across the Netherlands over a 3-year period. Empirical results indicate that, on aggregate, Dutch consumers did not change their purchasing behavior towards processed foods after labels indicating the presence of GM ingredients were placed on them. Hence, consumer avoidance of GM foods was not confirmed.

Divergence between stated preferences and actual purchasing behavior in the case of GM foods has been observed in the past. Aldrich and Blisard (1998) summarized studies on consumer attitudes carried out as rBST was being introduced in the United Staes in 1995. Such surveys indicated that three out of four consumers expressed interest in avoiding milk from rBST-treated cows

[7] James *et al.* (2002) set up a limited market experiment and observed consumers' purchasing patterns towards GM and non-GM sweet corn placed in a few grocery stores in a single US location. Kiesel *et al.* (2003) examined a national dataset of actual consumer purchases of fluid milk produced with rBST and rBST-free milk in the United States. Thus, they examined consumer response to negative ("does not contain") labels. Their results indicated that a small segment of consumers respond positively to such labels.

and in relevant labels that could facilitate choice. Hindsight being 20-20, we now know that such attitudes did not translate into significant changes in purchasing behavior—or avoidance—on the part of US consumers. The vast majority of US consumers purchased milk from rBST-treated cattle even when "non-rBST" milk was offered side-by-side at minimal premiums.

The important point here is that current knowledge on the distribution and intensity of consumer aversion towards GM foods is limited. Accordingly, little is known about the size of the social benefits derived through mandatory labels of GM foods in various markets.

The Costs of GM Labeling

As in the case of social benefits, comprehensive estimates of the regulatory costs associated with GM-food labeling are scarce. A small number of studies, mostly from North America, have measured some of the costs associated with GM labeling. Most such studies have focused exclusively on the compliance costs of the regulation—the incremental costs associated with physically separating as well as preserving, testing, and assuring the identity of various GM or conventional foods across the agrifood marketing chain. Compliance costs are certainly worth close scrutiny as they can be substantial, especially in the case of commodities used in thousands of processed foods, like corn and soybeans. Nevertheless, most existing studies are limited in scope, as they have focused on a small subset of products and limited portions of the agrifood marketing chain. Only a handful of studies have investigated compliance costs across large portions of the agrifood marketing chain. Most such studies indicate that compliance costs can be quite meaningful (KPMG, 2001; National Economic Research Associates, 2001).

While estimates of compliance costs are incomplete, other possible costs from GM-labeling regulation remain entirely unarticulated. Chief among them are bureaucratic monitoring and enforcement costs, costs from loss of trade, and costs associated with potential structural impacts from regulation and potential inefficiencies in implied market structures.

Credibility of GM Labeling

Beyond benefits and costs, the relevance and optimality of mandatory GM labeling are also influenced by the credibility of the system or the probability of mislabeling. Mislabeling refers to cases where producers (by accident or intention) falsely label food products as "non-GM" or fail to label products as "GM" when required. As the incidence of mislabeling increases and consumer trust is eroded, the social benefits from labeling are reduced and its desirability is diminished.

The possibility of mislabeling foods for GM content is not remote. Under most current mandatory labeling regimes, presence or absence of GM ingredients can be assured through laboratory analysis. Given that analytical

testing is based on statistical methods, some testing error (*e.g.* sampling error, array systemic error) must be assumed and accepted. Lack of standardization of sampling and testing protocols, validation procedures or performance criteria in laboratory tests of GM foods amplifies the probability of testing errors, the existence of which has been verified by a number of laboratory ring trials around the world. A recent report published by the Australian Government Analytical Laboratories (2002) is one of several that have documented such errors. Similarly, mislabeling has been confirmed. Most recently, the Irish Food Safety Authority through its 2002 market survey determined that 32% of the surveyed "GM-free" products were mislabeled. The degree of understanding among consumers of mislabeling possibilities and relevant impacts on their purchasing decisions is unclear.

Is Mandatory GM Labeling Cost-Effective?

Even if net welfare gains from GM labeling in any given market could be positive, some attention to the cost-effectiveness of specific mandatory labeling policies would still be warranted. Effectiveness considerations require that alternative policies that could achieve the overall policy goals at lower regulatory costs be explicitly investigated. Alternative policies to mandatory GM labeling, for instance, might include incentives for voluntary labeling and establishment of third-party certification bodies in order to reduce the costs for verification of "non-GM" and "GM-free" claims.

Attention to the standards of mandatory labeling policies is similarly necessary as they affect the efficiency and cost-effectiveness of the policies in question. To clarify, consider the evolution of GM-labeling standards in the European Union and corresponding changes in social welfare. Since the inception of the mandatory labeling policy, the European Commission has incrementally stretched its GM-labeling regulation by continuously broadening the definition of what constitutes a "GM food" and, more recently, by requiring full traceability across the agrifood supply chain. In 2001, a study commissioned by the UK Food Standards Agency included comparative institutional analysis for these alternative GM-labeling policies. The study estimated that compliance costs would increase eight-fold in the United Kingdom—from $140 million to over $1 billion—when the mandatory labeling regime expands from food ingredients to include feeds and oils. This result prompted the authors of the study to conclude that "the extra costs of moving towards the more stringent GM-labeling standards outweigh the extra benefits that can be achieved."

The credibility of the progressively rigid GM-labeling regime in Europe was also called into question. For the bulk of the market, enforcement will no longer rely on analytical laboratory testing but on chain-of-custody certificates and traceability systems, both inside the European Union and in exporting countries. Practical implementation of such systems implies increased

possibilities of fraud and problems with enforcement. These issues prompted the UK Food Standards Agency to conclude that "the (pending regulation) is not practical, proportionate, or enforceable."

While broadening the scope of mandatory GM labeling, the EU government has also sought to tighten the standards (tolerances) in defining GM and conventional foods. Kalaitzandonakes *et al*. (2001) have explained that compliance costs increase non-linearly as tolerances diminish beyond certain low thresholds, like those awaiting implementation in the European Union.

The key point here is that implementation standards matter in determining the efficiency and cost-effectiveness of a given labeling policy. And, based on scant empirical data, the efficiency and effectiveness of certain mandatory labeling policies could prove questionable.

Concluding Comments

Market failure is the predominant justification for regulatory interventions of all kinds. Potential market failure has also been the basic argument behind calls for mandatory labeling of GM foods. This argument is, indeed, theoretically well founded.

As I have argued here, however, there is little empirical evidence to suggest that any of the necessary and sufficient conditions for mandatory labeling of GM foods is satisfied. Indeed, it is possible that mandatory GM-food labeling policies installed in some countries could fail all three standard criteria used to justify regulatory intervention:

- A case has not been made that a market failure actually exists or should be expected. Despite evidence that voluntary labeling and other market-driven solutions emerge to satisfy various consumer segments with differential demands, governments around the world have anticipated market failure, often ahead of any commercial introduction of GM foods in the market, and have pursued mandatory labeling.
- The efficiency of various mandatory labeling regimes has not been sufficiently appraised. Proper methods for measuring consumer behavior and relevant social benefits from mandatory labeling have been ignored. The costs of mandatory labeling policies have been under-scrutinized or brushed aside. And, key uncertainties that undermine the credibility of current and pending mandatory labeling policies continue to be over-looked.
- The cost-effectiveness of current and pending mandatory labeling policies has not been evaluated. Gradual tightening of regulatory standards in some countries promises to further cloud a murky picture of regulatory efficiency by drastically increasing the costs of regulatory restrictions while diminishing their enforceability in return for unspecified consumer benefits.

A positive step out of the current international gridlock on GM-food labeling could involve regulators in various countries articulating what market failures they hope to improve upon and through what regulatory instruments. Such articulation, along with the use of proper methods for the measurement of relevant social costs and benefits, could lead to the clarification of the welfare impacts of various GM-food labeling regimes and improved decision-making. Of course, cost-benefit analysis is neither necessary nor sufficient for designing sensible regulation (Arrow *et al.*). Yet, economic analyses of that kind could: quantify the relevance of regulatory policies; identify incremental benefits and costs associated with different regulatory policies; organize tradeoffs inherent in regulatory policies; illustrate the distributional implications of regulatory policies; increase transparency.

A final comment is necessary on the argument that mandatory labeling is warranted in order to protect the "consumer right to know." This argument often appears self-evident, seemingly detached from more mundane cost-benefit considerations. Yet, the closest that "consumer right to know" has come to a formal legal basis, appears to be in the European Union through an explicit reference in the 1997 Amsterdam Treaty to the "consumer right to information" (Kalaitzandonakes, 2003). Yet the very same article that obligates the European Commission to promote the consumer right to information also obligates it to protect the "economic interests of consumers." Accordingly, considerations on costs and benefits associated with various mandatory labeling policies are relevant even within this context.

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