

Co-existence as a problem of market-making

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Abstract:

Co-existence, as defined by the EU, involves simultaneous GM and GM-free crop and food production, assuming all products have passed regulatory risk evaluation. Much of the recent discussion about co-existence focuses on how governments can create it, or in some cases how to do it more efficiently and effectively. At one level, the issue of co-existence is a problem of market-making. Economic theory and commercial practice suggest that there are challenges with leaving market-making to private initiative. This paper reviews the economic rationale for involvement by governments and other non-market actors and assesses the evidence of the impact of various interventions on practical co-existence.

Key Words:

Co-existence; supply chains; regulation; international trade; product differentiation; identify preservation; segregation; traceability; costs

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1. Introduction

GM products are now extensively produced and permeate much of the global agrifood market (James 2009 and Phillips 2006). Co-existence is replacing ‘precaution’ as the current buzz-phrase defining the relationship between genetically modified foodstuffs and governments, industry, farmers, consumers and citizens. Co-existence, as defined by the EU, involves simultaneous GM and GM-free crop and food production, assuming all products have passed regulatory risk evaluation. In practical terms, it includes such examples as the co-existence of GM, non-GM and organic canola and GM and non-GM wheat in Canada, Australia and the EU, but does not include the adventitious presence of GM crops that have not been fully approved through regulation, such as LLRICE601 and LLRICE604 in 2006 OR CDC Triffid in 2009.

The GMCC asserts “co-existence is about protecting farmers and all stakeholders in the supply chain from the possible economic consequences of accidental mixing of GM and non-GM crops or derived products.” Coexistence strategies are then defined as a mix of science-based technical measures, political directives and economically feasible organizations, involving scientists, policy-makers and stakeholders from across the entire agricultural supply chain. The rationale for the policy is that “failure in achieving practical coexistence will impact diffusion of new technologies in agriculture and potentially global trade in agricultural products.”

Much of the discussion about co-existence in the past half decade has focused on how to ensure we have the right science and processes to effectively and efficiently deliver choice. This paper looks at the problem from the perspective of market-making. Under stringent conditions one might be able to assume that private markets unmediated by the state or other actors might be able to ensure optimal amounts of GM and GM-free crop and food production to satisfy producers and consumers. The reality, however, is that the market is at times not well suited to undertake this task. The state and/or civil authorities may need to provide support and leadership in order to deliver effective co-existence.

Section 2 reviews the history of the concept of co-existence in theory and practice, especially as it is applied to crops and food production, in the US, Canada and the EU. Section 3 offers an assessment of the theoretical and practical capacity of the market to deliver optimal amounts of GM and GM-free produce. Section 4 examines the potential role of the state and civil authorities in constructing markets to remedy the potential failure of unmediated markets.

Section 5 reviews some of the examples of how market and non-market actors have attempted to meet unsatisfied demand for differentiated product and their effect on technological diffusion.

2. Co-existence in theory and practice

The concept of co-existence has been borrowed from a number of other fields, including psychology, international relations and security studies. There, the concept has been at times to simply describe the outcome of individuals, groups or societies existing together in time or place, essentially existing in mutual tolerance of their inherent differences. This can involve either active or passive co-existence, as opposed to violent outcomes. Other definitions go beyond the focus on the outcome to suggest a range of processes desired or needed to meet that goal, including learning to recognize and live with differences, having relationship between persons or groups where none of the parties tries to destroy the other and interacting with a commitment to tolerance, mutual respect and the agreement to settle conflicts without recourse to violence (Khaminwa 2003). Ultimately, this literature suggests a few instructive points for our discussion of technological co-existence—there is a spectrum of outcomes that result from a range of unplanned to well scripted actions.

An early industrial application of the concept of co-existence involved the discussion about the impact of externalities between different co-located industries, such as forests being used simultaneously by loggers, tourists and indigenous peoples, water supplies being used by industrial factories, power plants, crop irrigation and native or sport fisheries and land having multiple demands for public or private use. The development history and economic theory is full of examples of these natural conflicts over a rival, subtractable resource (e.g. Coase 1960).

Against that backdrop, the European Union in 2003 proposed a new policy of ‘coexistence of genetically modified crops with conventional and organic agriculture’ as a policy response to perceived concerns by EU producer and consumer about the role of GM technologies in the food system (2003/556/EC http://ec.europa.eu/agriculture/coexistence/index_en.htm). The EU policy defines coexistence as “the choice of consumers and farmers between conventional, organic and GM crop production, in compliance with the legal obligations for labelling defined in Community legislation.” Suitable measures would be needed during cultivation, harvest, transport, storage and processing to achieve ‘sufficient’ segregation between GM and non-GM production. Importantly, the EU has assumed coexistence always refers to GMOs that have

passed EU authorisation processes related to health or environmental risks, so that co-existence rules do not need to address those aspects of risk management. In effect, the goal is to ensure that adventitious states traces of GMOs stay below the labelling threshold laid down in Regulation (EC) No 1829/2003 and Directive 2001/18/ (Commission Recommendation 2003/556/EC).

On 23 July 2003, the Commission adopted Recommendation (2003/556/EC) to provide guidelines for the development of national strategies and best practices for co-existence. The guidelines state that any Measures should be efficient and cost-effective (not go beyond what is necessary to comply with EU threshold levels for GMO labelling), specific to different types of crop (based on the probability of admixture by crop) and reflect local and regional variables. In March 2006, the Commission reported that by the end of 2005 specific coexistence legislation had been adopted in four Member States (DE, DK, PT, and six Austrian Länder) and that 20 draft acts from seven Member States had been notified under Directive 98/34/EC. A review of these suggested that while many of the provisions were appropriately targeted to manage coexistence during seed multiplication and trade, some exceeded what might be necessary for the management of co-existence. A number of measures addressed concerns related to environmental protection (effectively going beyond the provisions laid out in community legislation), some included case-by-case farm-level approval or notification procedures for GM crop cultivation (which duplicates authorisation for the use of GM crops already authorised for EU cultivation), some proposed or adopted measures that aim to reduce adventitious presence of GMOs below the EU thresholds and some set larger isolation distances between GM and non-GM or organic fields than required to meet the thresholds. In terms of implementation, the general practice was that Member states place responsibility for implementing coexistence measures on the farmers who grow GM crops—farmers engaged in non-GM crop production do not have to change established farming techniques following the introduction of GM crops. But most member states appear to allow neighbouring farmers, on a voluntary basis, to decide amongst themselves not to segregate GM and non-GM production, which means that non-GM production would have to be labelled as GM (Communication from the Commission to the Council and the European Parliament - Report on the implementation of national measures on the coexistence of genetically modified crops with conventional and organic farming, COM/2006/0104 final).

On 2 April 2009, in a second report the Commission reported that 15 Member States have adopted specific legislation on coexistence (AT, BE, CZ, DE, DK, FR, HU, LT, LU, LV, NL, PT, RO, SE, and SK) and three other members have notified of pending legislation. No Member States reported addressing coexistence by means of non-legislative instruments. Generally, the findings from 2006 were reaffirmed. While on average the provisions of the Reg 2003/556/EC were addressed, there are some significant deviations that may have the effect of imposing more stringent than necessary conditions to meet the tolerances for adventitious admixture in the labelling directive (European Commission 2009).

In the US and Canada there are no specific rules that require co-existence. As a result, those seeking to differentiate their crops are left to their own devices to ensure they can meet the tolerances of the market. Both theory and evidence suggest this can be a challenge (Belcher, Nolan and Phillips 2005). This was at the root of the class action launched in 2002 by the Saskatchewan Organic Directorate against Monsanto and Bayer over the introduction of GM canola in Canada and the alleged impact on Western Canadian organic producers. The motion to certify the class was denied, so the issue has never been settled in Canada.

In short, the challenge of co-existence has been assumed and the state has stepped in to remedy the perceived shortfall of rights and obligations, without obviously considering the alternative that the market might be able to develop effective and efficient coexistence. The next section considers the economic and market potential.

3. Efficient markets and co-existence

Generally, markets are assumed by economists to be driven by self-interested efforts to deliver optimal amounts of goods and services. Individuals, operating as producers or consumers, buy or sell labour, other inputs, goods or services based on their own calculations of what is in their own best interests, mediated by market prices of the various factors and goods. These markets are driven by voluntary transactions.² The economic theory of markets suggests that, under certain rigorous conditions, if everyone acts in a self interested way, then we can optimize our economic activities. Economist Paul Seabright notes that the cooperation that delivers existing or new products often appears effortless because people and institutions embody a kind of tunnel

² Benacek, 2005.

vision, by “play(ing) one’s part in the great complex enterprise of creating the prosperity of a modern society without knowing or necessarily caring very much about the overall outcome.”³

Aggregating the actions of individual consumers and producers generally leads to an optimum, where no one can improve their circumstances by further trading. Seabright argues that “one of the great intellectual achievements of modern economics has been to work out very precisely the circumstances under which decentralized systems of market exchange can produce results that are efficient, in the sense of improving the condition of every individual as far as possible whenever this can be done without harming someone else... the pattern of modern life has emerged without ever having been consciously willed by anyone.”⁴

In a perfect world, then, optimal quantities, qualities and prices of goods and services would be produced and consumed. But the optimal outcome (often called ‘perfect competition’) is more of a theoretical construct than an observable reality. Theory clearly shows that it can only be realized if five rigorous and highly unlikely conditions hold. First, all actors must be atomistic—there must be a large number of producers and consumers in a given market, each so small that their actions have no significant impact on others (i.e. both buyers and firms must be price takers and not exert any market power). Second, the goods and services must be homogeneous or perfect substitutes. Third, there must be perfect and complete information—all firms and consumers must have complete information to production technologies, attributes of a product, prices and quantities. Fourth, there must be no barriers to entry or exit for either producers or consumers. Fifth, there must be no external effects of any production or consumption that lie outside the market—both positive externalities (e.g. spillovers from research or public health) and negative externalities (e.g. pollution and congestion) must be known and included in the price of the product.

As different necessary conditions break down, different types of market failures arise. While there is a wide range of concerns that one might have about markets in general, the issue of co-existence presents four specific challenges to markets.

First, the actions of suppliers, farmers, food handlers, food processors, wholesalers and retailers can and often do limit choice in the market. Where new technologies or products yield a higher profit than pre-existing technologies, all other things being equal, older technologies and

³ Seabright, 2004, 15.

⁴ Seabright, 2004, 21.

products tend to be priced out of the market. This process, what Joseph Schumpeter (1954) called ‘creative destruction’, is a natural outcome of technological change (and not always a bad outcome). In the process, some producers may no longer be able to afford to produce as before and some consumers may have absolutely less choice about what to buy and consume. While some superseded technologies or products are priced out of the market, where particular consumers value a superseded technology or product, they at times are willing to pay a premium to sustain the supply of their product—higher prices will usually bring forward the appropriate supply. Some have argued that there is a ‘moral’ obligation to ensure both producers and consumers can choose from all existing options, but economists tend to apply the strictures of Pareto, Hicks and Kaldor to rationalize the collateral damage of technological change. In short, it is not up to the market to meet all demands—some may simply not be economical.

Second, there are real and documented cases where the actions of one producer could have a material negative effect on other producers. In effect, there is a technical negative externality. For example, the costs and prices observed by one group of producers (e.g. the GM producers) may not fully reflect the full costs of their actions if genetic material adventitiously presents itself in other producer’s product, possibly lowering their profits. Akerlof (1970) offered the theory of lemons to suggest that when a potentially unwelcome trait is introduced into a market without effective product differentiation, it causes the entire product line to suffer lower demand and prices (his example was the effect of the poor quality cars in the resale market and its effect on the price of all used cars, because consumers could not distinguish between the lemons and the higher quality cars). There is significant literature that attempts to explain when and where markets will be able to optimally provide the right quantities and qualities of goods and services, including institutional economics (Coase 1932, Williamson 1979, and Mahoney 1992), supply chain management and the economics and law of liability. This literature examines the respective roles of individuals, firms and governments in constructing the appropriate rules and institutions that protect against new technologies or products prematurely or unnecessarily destroying value of other products.

Third, some assert that GM and non-GM crops are essentially the same (homogenous) but some consumers and citizens beg to differ. Even if there may be no substantive physical difference between their nutritional value, composition or potential allergenicity, the simple reality that a transgene has been used in the production of the GM food changes its provenance

and implicit value for some consumers. Who defines the differences, how it is defined, how it is verified and what it signifies are not easily sorted out. Firms and markets at times are unable to discern and resolve this issue. Decision making is a complex process. Economic theory now posits that consumers typically purchase the attributes that are embodied in a product, rather than purchase a product for itself. The product, per se, does not give utility to the consumer; the characteristics of the product do (Lancaster, 1966). While consumers cannot directly purchase units of goods of quality, they can choose to avoid the goods that they perceive to have lower quality. They can also choose to pay a higher price for the goods that they perceive to have a higher quality (Kuperis et. al., 1999). Exposure, attention, and perception are important because they affect what consumers comprehend, the attitude they have and what they remember, which in turn affects the decisions they make. Thus consumer information and knowledge play a major role in the attitude formation process. There is extensive literature in the emerging field of behavioural economics that suggests citizen and consumer cognition and opinion formation are not as clear cut as assumed in the neoclassical economic model. Hence, markets may at times be unable to provide the right quantities of the right qualities at market clearing prices.

Fourth, the very nature of those product attribute differences presents problems for producers and consumers. Given that upstream production methods often cannot be distinguished in downstream consumer products by unaided consumers, some assistance is needed (i.e. we have less than full information). Consumer economics has spent a great deal of time examining the most appropriate role of the state and markets in assuring full and accurate information is available to assist production and consumption decisions.

In essence, there are four theoretically justifiable rationales for intervening in markets to secure an appropriate level of co-existence.

4. Market-making actors

Markets are fundamentally challenged by innovation—the advent of biotechnology in the agrifood system is not the first and will not be the last example of technology advancing faster than the institutions needed to govern it. Douglass North (1990) concludes that ‘neo-classical theory is simply an inappropriate tool to analyze and prescribe policies that induce development. It is concerned with the operation of markets, not with how markets develop.’ Joel Mokyr (1997: 1) explains why: ‘there usually is, at some level, an (sic) non-market institution that has to

approve, license, or provide some other imprimatur without which firms cannot change their production method. The market test by itself is not always enough. In the past, it almost never was.’ He notes that increasingly:

The adoption of a wholly new technology is often the target of long debates and public discourse, unlike many other technical and economic choices. The role of persuasion and rhetoric in these decisions is something economists have paid scant attention to, and hence they have not had much success in understanding why, for example, some economies have adopted nuclear power or why some have allowed experimental drugs to be sold and others did not. Furthermore, not all resistance is purely social. There are instances in which the technological ‘system’ resists a novel and improved component because it does not fit the operation of the whole (Mokyr 1997:2).

Phillips (2007) asserts that our society is fundamentally faced with a complex systems problem when considering how to govern these types of transformative technologies and their products. Kenneth Boulding (1970) suggested three distinct domains—the compulsory, the contractual and the familistic—yield three different methods of integration: coercive states that distribute rights and obligations; quid pro quo exchanges in the market governed by supply and demand; and voluntary dealings, where cooperation, reciprocity and solidarity engage community and society (Paquet 2001). Boulding (1970) argues that society can be viewed as encompassed by a ‘social triangle’, where all organizations—including the state, the market and civil authorities—are built on one or a balance of the three relationship systems.

The triad of institutions—governments/states, the market and social/familial organizations—each have specific institutional attributes that make them more effective at producing particular types of goods (Picciotti 1995). The government sector is best at producing public goods—low excludability makes privatization infeasible while the low voice component makes it difficult for the collective sector to organize. The private sector tends to dominate whenever clear and enforceable property rights make rival goods excludable—the property of exclusion allows private firms to sell at the marginal cost of production. The participatory sector is best at governing common pool goods (e.g., standards)—the collective group will usually have information that enables them to more effectively manage the resource and capture the benefits.

While in theory there are candidate institutions that could and probably should take the lead to address the four market challenges identified above, in practice they all are self-limited. Governments, while motivated to resolve moral issues, are often incapable of meeting the technical norms of democracy and public good. Markets are obviously imperfect: amorality, externalities and asymmetric information are endemic in the system. Finally, the ‘third sector’ faces real challenges in appropriately mobilizing the public (Olson 1965).

5. Critical assessment of the challenges of co-existence

With four fundamental market problems and three core actors (and possibilities of hybrids), there should be ways of effectively and efficiently resolving those issues.

5.1 The morality of sustaining choice

The root issue facing GM foods is the fear (some assert reality) that the new, advancing technologies that are more efficient tend to drive out less economic methods of production. We have seen that many times over the eons. Tractors and combine harvesters, for example, have largely replaced horses, oxen and large threshing crews, displacing many of those who earned their incomes and livelihoods from those activities. Joseph Schumpeter has called that the process of ‘creative destruction’, where the new relegates the old to the margins or the history books. The economic assumption is that those resources released from the production of less competitive goods and services, and the labour saved through technological innovation, will be reallocated to more productive and compensatory activities. Economists rationalize this outcome through the Paretian optimality criteria, where the economic change unambiguously generates a net gain in economic welfare (the core Paretian criteria), which is large enough to fully compensate all those who would be disadvantaged and still leave some ahead (the Hicksian compensated demand criteria) but, because the event is occurring in a democracy, it is not actually organized (the Kaldor criteria). In short, it is left for the sociologists, anthropologists, psychologists and ethicists to consider further. While I cannot attest to their combined view, at least some philosophers assert that there is no moral imperative for the state to intervene to ensure that everyone’s preferences are respected (e.g. Thompson 2006).

One difficulty is that we seldom have costless transitions. There can be significant costs of changing crops, changing jobs, and changing consumption. In those cases, the state at times

will step in and compensate those who face the largest cost of change. We provide unemployment and retirement bonuses, we provide retraining programs, we provide incentives and subsidies to farmers and firms to change their production system or to retool their operations and we provide tax and price support for many sectors facing restructuring. While in many cases the cost for these interventions comes from the common purse, in some instances firms are obligated to bear much of the cost (e.g. workers covered by collective agreements often have clauses that mandate their employer to provide assistance to deal with technological change). For the most part, however, we do not directly force those gaining from a specific technological change to compensate those who lose from that change. The biggest challenge of doing so is to identify those specific people to compensate and to apportion that cost appropriately among the winners. The transactional costs of such an effort usually force governments to do this at one remove from the technological change itself.

5.2 The lemons problem

Full containment of GM traits may not be easily attained—even small traces of GM produce can act as ‘lemons’ in the non-GM food markets, driving away consumers and lowering the market clearing prices for all producers. Following Coase’s advice, one option is simply to assign the ownership rights and then let GM and non-GM producers negotiate a balance among themselves. In one way, this is exactly what some countries have done. In the Canada and US, GM producers have the de facto and de jure right to commercialize their technology and are not required by law to enact any proactive containment policies or programs. In those circumstances, non-GM producers either have to invest in isolation or negotiate some form of buffer between their production and that of GM producers. In one sense, this is analogous to the circumstances of most organic producers around the world, who self identify as using specific production methods and are responsible for ensuring their compliance with the norms. Generally, where there are price premiums, non-GM farmers have an incentive to make the effort to preserve the unique identity of their product. In this way, the costs and benefits are internalized and balanced in decision making. The EU, in contrast, assigns the rights to non-GM producers (REG 003/556/EC), thereby compelling seed merchants, GM producers, wholesalers and food processors to undertake policies and practices that isolate GM produce from the non-GM and organic production and supply chain. In this case, however, the commercial benefits of sustained

identity for non-GM crops (if any) are captured by the non-GM producers but the costs of identity preservation are largely borne by GM producers. This disconnect between costs and benefits creates the possibility that too much will be expended to maintain co-existence.

One product that has prompted significant study was the proposed introduction of Roundup Ready wheat in Canada and the US. Kuntz (2001) examined the potential cost of GM wheat acting as a lemon in the Canadian international wheat trade, concluding that uncontrolled comingling could jeopardise up to 85% of the price premium estimated to be extracted from international markets by the operation of the Canadian Wheat Board. Huso and Wilson (2005) and Wilson et al (2005) were more sanguine about the prospective effect on US producers, concluding that with a lower estimated premium for bread wheat in the US the economic effect would be relatively smaller. Furtan, Gray and Holzman (2003) undertook a complementary analysis, incorporating the changes in farmer benefits along with industry and consumer impacts, concluding that in the presence of the lemons effect there would be no clear first-mover benefits for Canadian farmers adopting GM wheat. Furtan, Guzel, and Weseen (2007) went on to examine whether there were adequate private incentives for market actors to find some intermediate outcome. They concluded that even if GM producers had the right to operate without restrictions, organic producers in Western Canada had large enough premiums to provide them with the incentive to negotiate 'landscape clubs' that would isolate and preserve their organic status and related market premiums.

In a way, the choices made in Canada, the US and the EU apply aspects of three key product differentiation strategies that are often variably applied to the lemons problem: segregation, identity preservation and traceability (Phillips and Smyth 2003).

Lin (2002, 263) defines segregation as the requirement "that crops be kept separate to avoid co-mingling during planting, harvesting, loading and unloading, storage and transport". Segregation systems are mostly used when food safety could be jeopardized by co-mingling of the segregated product and all other like products. Participation is not optional—any producer or firm involved with segregated products has to comply with rules that have been set or approved by a regulatory agency. A private firm often will have responsibility for developing the actual system but a regulator will be the final arbiter on approving the system for field use. The focus of product delivery within a segregated supply chain is mostly downstream. Segregated commodities commonly have industrial value, so these products are supplied to meet the criteria

of the processor. Product failure would most definitely see a complete recall of any products suspected of being affected and could result in criminal prosecution in the most severe instances. Testing and auditing are vital features of segregation systems and are usually conducted by agents of the regulator. While this system is the most formal and visible of the three systems, it is not commonly used. There are very few open-field crop segregation systems presently operating in the global agri-food system. The most commonly cited segregation systems in Canada relate to canola. Canada now has systems in place for high erucic acid rapeseed (HEAR), which has industrial value due to the specific oil profile—there have been a series of HEAR varieties under segregation rules in Canada (called contract registration by the regulator). In the past, two varieties of transgenic, novel oil canola (Calgene Laurical™ varieties) were also contract registered and produced between 1996 and 1999. All plant-made pharmaceutical would also require full segregation; there is no tolerance for co-mingling. As one might expect, the costs have tended to be relatively high, and by implication, the product premiums must be higher. HEAR earns on average a \$60/tonne premium in Canada and unsubstantiated reports peg premiums well over \$100/tonne for other specialty industrial and pharmaceutical crops in the past few years.

Identity preserved production and marketing (IPPM), in contrast, is initiated by private firms in the food industry to extract premiums from a marketplace that has expressed a willingness to pay for an identifiable and marketable product trait or feature. An IPPM system is a ‘closed loop’ channel that facilitates the production and delivery of an assured quality by allowing identification of a commodity from the disposition of germplasm to the processed product on a retail shelf (Buckwell, *et al.*, 1999; Lin, 2002). The objective of any IPPM system is revenue management. Premiums need to be available to attract participants and the efforts of voluntary participants will be directed towards capturing a share of the premium. The lead stakeholders in IPPM systems are private firms seeking to capture increased value of special traits. The role of any regulator is to ensure that industry standards are handled in such a way as to prevent consumer fraud. As with many products, information may be asymmetric, as only the product seller can know with certainty what level, if any, of cheating has occurred in the delivery of the product. Moral hazard may be present due to the presence of premiums. Effective IPPM systems that span entire supply chains often have extensive two-way information flows. Information about purity and quality of the product flows downstream and information coming

from consumers' preferences flows upstream. While the information flow in IPPM systems is two-way, the focus of the system is downstream. Each participant in the system wants to ensure they extract a portion of the value of the special trait, whether from production, processing or retailing the product. This means that each participant will focus on the needs of the next participant in the supply chain. Market failure can result in fraud charges for improper labelling and also create awareness with consumers that certain brand names can not be trusted. Second parties acting on behalf of the brand owner or developer of the special trait will usually do testing and auditing.

Table 1: Product differentiation strategies			
	Segregation	IPPM	Traceability
Objective	Product safety	Revenue capture	Liability management
Status	Mandatory	Voluntary	Voluntary or mandatory
Leader	Regulator	Private company	Commodity group, standards organization or regulator
Information flow	One-way	One or two way	Two-way
Supply chain focus	Downstream	Downstream	Upstream
Testing/auditing	1 st party/regulator	2 nd party/brand owner	3 rd party/standards orgn
Production arrangements	Regulation & contracts	Contracts	Membership in standard
Production controls	Buffers/land use/containment	Product quality	Process standards and record keeping
Enforcement	Public	Private	Collective
Quality criteria based on	Regulations or HACCP	Brands or product standards	Process standards (e.g. ISO)
Tolerance levels	Set in law	Defined by market	Performance based
Information provided to	Regulator	Consumer	Regulator, retailer or processor
Penalties for failure in product market	Criminal prosecution; mandated product recalls	Consumer fraud charges; lost brand value	Consumer fraud charges; exclusion from product category
Price premium	None	Yes	None
Labelling	None required	Private brands	Quality marquee
Source: Adapted from Smyth and Phillips (2003).			

Numerous IPPM systems operate around the world. Some involve only the breeders and the wholesale market or processor, while others extend to the retailer. Their structure depends on the attribute they are trying to preserve. Some novel oils, such as low linolenic oils that are more stable in fryers, only have value at the processing level while others, such as high oleic oils, have health attributes that can be marketed to consumers. Identity preserved production and marketing systems are especially important for providing information to consumers about the provenance of a product, as those attributes are not visible or detectable in the product itself. A number of IPPM systems operate in North America. While organic products are perhaps the most noticeable IPPM

products, Cargill has an IPPM system in place to export canola to Japan (the variety gives off virtually no odour when used to fry food), General Mills operates an IPPM system for a select variety of white wheat that possesses a special trait for 'flake curling' when processed into breakfast cereal and Dow AgroSciences uses an IPPM for Nexera canola sold into the Japanese specialty oil market. In each of these systems, there are a range of costs and benefits. Essentially, the systems must generate adequate premiums in the intermediate or final markets to justify the added costs. The market actually determines the value of the systems, by revealing what tolerance for off-types it will allow (which sets the benchmark for costs) and then revealing the incremental premium for the differentiated trait. A number of studies show the complexity and sensitivity of system costs to the tolerances for adventitious admixtures (Gosnell 2001 and Matlzber and Kalaitzandonakes 2000). A number of case studies have calculated the incremental costs (over the commodity system) to be in the range of US\$20/tonne to US\$35/tonne; by assumption their continued operation implies that the premiums must exceed those levels.

The third product differentiation system is traceability. The International Organization for Standardization (ISO) defines traceability as the "ability to trace the history, application or location of an entity by means of recorded identifications" and the *Codex Alimentarius* Commission has adopted this as their working definition for all Codex standards (Codex, 2001). Traceability systems are designed to ensure that products that encounter problems can be identified, isolated and removed from the supply chain, both mitigating harm and reducing potential liability (Smyth, Phillips, Kerr and Khachatourians 2004). Participation in a traceability system can be voluntary, depending on where in the supply chain the participant is located. The closer the participant is to the start of the supply chain, the more likely it will be that participation is voluntary. The lead stakeholder may be a commodity group demanding greater clarity in or selection of food products, a standards council that is comprised of representatives from all sectors of the supply chain or the regulator seeking to ensure consumer protection. Traceability systems have information flowing two-ways as these systems are designed to react quickly to food safety concerns. If a product is discovered to exceed any defined tolerance level at any point in the supply chain, traceability will be used to identify the source of the problem and to locate any retail products that may be affected. Information on food safety flows upstream while information on specific product lots flows downstream. This results in the focus of traceability systems being upstream. Market failures can result in consumer fraud charges in

addition to permanent exclusion from selling into that supply chain. Testing and auditing will be conducted according to the standards developed by third-party organizations.

There are an increasing number of traceability systems operating. Perhaps the oldest and most developed system is the manufacturers' lot number system that traces processed foods from plants to consumers. Those were implemented largely to handle liability of contaminated foods. More recently, the UK retail chains have adopted extensive traceability systems (from retailer to farmer), initially for beef but now for a growing list of products, in order to manage their liabilities flowing from the UK Food Safety Act, 1990. The livestock industry in 25 countries has either introduced or announced plans to introduce partial traceback systems (from slaughter house to birth), while there has been significant discussion about if and how a traceback system can be developed for commodity grains and oilseeds. While these systems often add between 1-5% to the cost of a product, they do not add any directly identifiable premium to the product—instead they act as a form of insurance against a food contamination that could cause the recall of an entire product category. The EU requires in its latest set of labelling rules a traceback system both within the EU and in the exporting countries in order to validate claims of GM or GM-free status in products without detectable rDNA (EU 2001). This is a novel use of traceback, as no other systems operating in the global food system are imposed by the state—all of the others are economic choices adopted by liable firms seeking to limit their exposure to losses.

5.3 Standards

There are no clear, unambiguous, transparent or acknowledged norms or standards about what constitutes GM or non-GM foods. The common definition asserts genetically modified organisms have genetic characteristics which are altered by the insertion of a modified gene or a gene from another organism using the techniques of genetic engineering. Individuals have mixed and at times confused understanding about what genes, transgenes and genetic engineering are and how they are used. This is complicated because regulators use a wide range of terminology and definitions. The EU in Article 2(2) of Directive 2001/18/EC defines genetically modified organism (GMO) as an “organism, with the exception of human beings, in which the genetic material has been altered in a way that does not occur naturally by mating and/or natural recombination” which includes recombinant nucleic acid techniques, mechanical techniques (including micro-injection, macro-injection and micro-encapsulation) and cell fusion (including protoplast fusion)

or hybridisation techniques, where live cells with new combinations of heritable genetic material are formed by means of methods that do not occur naturally. The US uses the term genetic engineering, which involves recombinant DNA techniques to transfer genetic material among donor and recipient organisms. Just to complicate matters, Canada uses for the purposes of regulatory action the concept of plants with novel traits (PNTs), which are plants that contain “a trait which is both new to the Canadian environment and has the potential to affect the specific use and safety of the plant with respect to the environment and human health. These traits can be introduced using biotechnology, mutagenesis or conventional breeding techniques.” In response, the Codex Alimentarius Commission committee on food labelling has been working for more than a decade on trying to reconcile these two perspectives, but the closest they have come is to refer to GM/GE foods. The effort is currently stalemated, with some rules capturing only transgenic modifications while others also capture mutagenic and conventionally mediated crops, as long as the traits are novel.

Meanwhile, there is a small but significant non-governmental effort to develop standards to handle the concerns related to GM/GE foods. The organic industry, for example, has acted in most developed countries to modify their standards to exclude genetically modified/engineered plants or animals. As befits a process based standard, their standard only deals with planned, intentional use of GM seeds and does not explicitly address adventitious presence of genetically modified traits.

Mancur Olson highlights the fundamental challenge. Given the underlying non-rival, non-excludable but voice intensive nature of standards, there are few inherent incentives for those who might benefit from clear and uniform standards to invest their time and energy in the expensive and time-consuming process of developing standards. Given the anonymity of the process and the large number of actors, boundedly-rational opportunistic individuals and institutions will simply wait for others to do the heavy lifting—in short, free-riding is the rational process.

The Canadian process to create a standard for GM foods, funded by the government of Canada, offers one strategy for overcoming the common pool problem of standards. In 1999 the Canadian Council of Grocery Distributors (CCGD) asked the Canadian General Standards Board (CGSB) to assist in developing a National Standard for the Voluntary Labelling of Foods that Are, or Are Not, Genetically Engineered. The CCGD, representing 80 percent of Canada's

grocery and supermarket operations, sought to give food processors consistent guidance to assist them in developing label claims that are informative, understandable, verifiable, and not false or misleading. The CGSB, an organization in Public Works and Government Services Canada, oversees the process to develop standards for Canadian products and services. The committee that developed the food labelling standard consisted of 53 voting members and 74 information (or non-voting) members who represented consumers, the food industry, and general interest groups such as governments and universities. As required under the CGSB process, the three categories were balanced so that no one group was able to dominate the voting. The committee first met in November 1999 and over the next four years it met formally 11 times and held three votes to reach consensus. The final vote released on November 6, 2003, showed that of the 53 total votes expected, 40 voted yes, 6 vote no, 5 abstained and 2 did not vote. The Standard for Voluntary Labelling and Advertising of Foods That Are and Are Not Products of Genetic Engineering as a National Standard of Canada of the Standards Council of Canada was announced on April 15, 2004. This standard offered a two-tailed measure, with non-GM being defined as less than 5% of the product while a proactive assertion of GM content (e.g. a particular nutritional feature) would require 95% of the product to be of that type (CGSB 2004). As a standard, this measure then is adjudicated by national consumer laws related to truthful claims.

5.4 Labelling

Ultimately, labels are the most direct form of communication between the actors in the supply chain and the consumer. Effective and efficient labelling systems forestall market failures, but the policy area is fraught with challenges. Labels can and probably should be the front line of defence in the response to the ‘lemons market.’ To do that, however, labels must address the needs of individuals. Giannakas and Fulton (2002) examine the consumption effects of genetic modification (GM) under alternative labelling regimes and segregation enforcement scenarios. They show that if consumers perceive GM products as being different than their traditional counterparts, then the existence of market imperfections in one or more stages of the supply chain can prevent cost savings associated with the new technology from being transmitted to consumers, leading to welfare losses for consumers. They assess the respective welfare ranking of ‘no labelling’ and ‘mandatory labelling’, concluding that the impacts vary depending on: (i)

the level of consumer aversion to GM products; (ii) the size of marketing and segregation costs under mandatory labelling; (iii) the share of the GM product in total production; and (iv) the extent to which GM products are incorrectly labelled as non-GM products.

Most governments are aware of the important role of labels in market-making. Most countries currently have laws that require product labels to disclose weights and ingredients and increasingly governments have extended this to include nutritional information. In addition, most countries have truth-in-labelling laws that require labelling claims to be accurate and not misleading. In addition to these formal provisions, firms frequently brand and market their products as differentiated goods in order to optimize their value in the marketplace. In some cases these are supplemented by standards that specify what production methods have been used (or not used), such as Kosher, Halal or organic products. Enforcing these systems then involves governments, firms and various civil authorities or their agents.

Virtually all countries agree on one aspect of GM food labelling—namely that GM foods that have substantive changes in nutrition, composition or allergenicity must be proactively labelled. Beyond that, it is not clear which set of actors should do what. The European Union (Art. 12.2 of REG 1829/2003) requires that all foods containing 0.9% or more GM material by content (either present or if the inputs used involved GM traits) must be proactively labelled as GM. This model of legally mandated positive labelling of GM content is used by at least 22 other countries, including Australia, New Zealand, Japan, China, Korea, Thailand and Brazil, only the threshold varies from 1% to 5%. Alternatively, the US, Canada and Argentina do not have explicit rules mandating labelling; they rely instead on pre-existing consumer laws related to truthfulness in labelling to control for unsubstantiated claims (Phillips and McNeil 2001).

Government labelling rules alone are not enough—in absence of any clear definitions, norms or standards, labels simply mask the fundamental information gaps.

6. Conclusions

The global agri-food markets, and especially markets for genetically modified foods, are at a crossroads. It is probably fair to assume that consumers will not get less demanding over coming years or that technology will stop advancing. The real uncertainties relate to how regulators and industry will manage the two trends. There would appear to be three possible futures.

The pessimistic future might be that technologies swamp the capacities of consumers and regulators to assess, test and adopt new products and of producers to confidently and appropriately quality assure their products. In that case, everyone will be playing catch up, which would create the conditions for individual national governments or perhaps corporate supply chains to attempt to handle their own problems by erecting even higher or more impermeable barriers around their specific markets. This would be disastrous, as the global agri-food system depends critically on trade—many consumers and nations around the world require trade to assure the appropriate quantities and qualities of food to meet their needs.

The alternate, optimistic outcome might be for regulators, industry and interest groups to come together through negotiation or litigation and adopt common standards, testing protocols and regulatory processes that can effectively and efficiently deliver the right quantities and qualities to meet the demand. This would not be impossible to achieve, but is unlikely given the trajectories of governments and industry.

Finally, the most likely outcome would involve us muddling through, with firms, sectors, standards organizations and governments just about keeping ahead of the pressures for product differentiation coming from consumers, the technology and regulators. To some extent, this would be like moving along the hogs-back of a steep hill—one small deviation either side would tip the sector into a new direction.

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