Busy Bees, Zero Tolerance, Foregone Trade and Inhibited Investment: Can the Global Divide Over GM Foods Be Bridged?

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Introduction

On September 6, 2011 the Court of Justice of the European Union (ECJ) ruled that pollen found in honey and food supplements constituted a foodstuff (Court of Justice of the European Union, 2011). This judgement that, on first glance, would appear to represent rather arcane hair splitting regarding a minor agricultural crop may, in fact, have major implications for agriculture on a global basis. This is because it may well be a tipping point in the decade long battle over how international trade in genetically modified (GM) organisms and food is to be governed. As a result, it is time for a major stocktaking of the state of play in the on-going controversy over agricultural biotechnology. This paper tracks the different regulatory paths that have emerged for agricultural biotechnology and examines the long-run implications for trade and investment.

In the late 1990s it became increasingly clear that a major rift was developing in the global agricultural market (Isaac and Kerr, 2007). The rift had developed over the approval processes to be used to licence genetically modified organisms for commercial production. Two major agricultural producers, the European Union (EU) and the United States (US), were on differing sides of the rift. Until the late 1990s the EU and the US had similar approval processes and criteria for licencing GM-crops. Thus, while approvals were not synchronized between the EU and the US, neither the outcomes of licencing applications nor their timing were likely to diverge sufficiently to negatively impact international trade in agricultural products to a significant degree, nor to act as a major disincentive to investing in the development of GM products. As with any new transformative technology, there were differences of opinion regarding its acceptability across all societies. In the United States,

dissenting voices were not particularly widespread, nor effective, and approvals of GM products continued apace under the generally accepted science-based procedures of the Risk Assessment Framework (Isaac, 2007).

In contrast, in the late 1990s opposition to the licencing of GM products in the EU appeared to be widespread (Perdikis, 2000) and they were more effective in garnering the attention of policy-makers (Kerr, 2001). In the face of fierce opposition toward the licencing of additional GM-crops, the European Commission declared a temporary moratorium on approvals of new GM-crops until a new system for GM approvals could be put in place (Viju et al., 2011a). At that point, asynchronous approvals – whereby products are licenced in one political jurisdiction but not at the same time in another – of GM products in the US and the EU became the norm. Asynchronous approvals lead to major international trade restrictions and, ultimately, to increases in the riskiness of making investments in GM products, thereby slowing the pace of technological improvement (Gaisford and Kerr, 2004). As global population continues to increase and is expected to rise from 7 billion to 9 billion by 2050, major increases in agricultural productivity will be required to maintain even current levels of food security (Pardy and Alston, 2010; Thompson, 2011). The global rift over GM products may well inhibit the rate of productivity growth.

The Importance of Asynchronous Approval of GM Products

The decision of the European Commission to impose a moratorium on the approval of GM products set in motion a chain of events that would ripple around the globe. The reason for the moratorium on the licencing of GM products in the EU was because those opposed to GM products were expressing their concerns about potential long term effects on human health of consuming GM foods and/or the potential risks to the environment posed by the release of GM organisms. As a result, non-licenced GM products could also not be imported into the EU, and along with the licencing moratorium came an import ban. The EU's import

ban had two major international effects. It reduced the potential market for GM-crops that achieved approval in exporting countries; an outcome which eventually fed back into the investment decisions of those developing GM crops. In effect, the major GM crops from approving countries – corn (maize), canola (rapeseed), soya – were effectively shut out of EU markets. It also meant that for each GM crop, countries had to weigh up the cost of foregone EU markets against the domestic benefits from increased productivity and increased sales to adopting countries. In some cases, where dependence on EU markets was large, GM crops were withdrawn; e.g. GM flax in Canada (Viju et al., 2011b) or delayed; e.g. GM wheat (Fulton et al. 2001). In particular, some developing countries had to make difficult choices: accepting GM products and their benefits in terms of increased agricultural productivity and/or lower priced imports for consumers, but risking a loss of access to the EU market. If their regulatory and oversight systems could not guarantee sufficiently low levels of cross-contamination to satisfy the EU, developing countries could face lost market access, not only for the particular GM crop but for other crops with the unexpected presence of GM material (Hobbs et al., 2004). Of course, there were other countries outside the EU such as Japan where acceptance of GM crops also became a contentious political issue (Holtby et al, 2007). Over time, the globe became divided between GM accepting countries and those that do not accept GM products.

Due to asynchronous approvals and less than full adoption of GM crops in countries that did licence them, considerable efforts and investments were made in the private sector to segregate GM products from non-GM products so that market access for non-GM products could be retained (Phillips et al., 2006, Perdikis et al., 2003). Further, major economic actors all along agri-food supply chains from producers of inputs such as seeds, to transportation firms, to food processors, to supermarkets had to develop strategies and alter their procedures to accommodate the regulatory divergence arising from asynchronous approvals in the

markets they serviced (Gaisford et al., 2001; Isaac et al., 2005). For food companies it has meant a major paradigm shift from striving for cost-reducing homogeneity to accommodating efficiency reducing heterogeneity (Isaac et al., 2004). The costs to the international trading system of asynchronous approvals appear to have exceeded the direct costs of foregone markets.

The parallel existence of GM and non-GM products, however, raises questions about how trade in non-GM products is to be operationalized – the issue is contamination. Contamination of non-GM products can take two forms: (1) contamination of export shipments of non-GM product with GM products of the same species; e.g. the contamination of non-GM soya with GM soya; (2) the contamination of a non-GM product with a GM product from another species; e.g. non-GM wheat with GM rapeseed. Contamination is a common problem in transboundary shipments of bulk agricultural commodities, not solely an issue relating to GM products. It is simply not commercially possible to eliminate all foreign material from bulk shipments. The problem of contamination is dealt with through testing and the setting of tolerances. Thus, there are tolerances specified, for example, for faecal material or insect parts, and then testing levels are established. If a shipment is contaminated at levels lower than the specified tolerance then it can be imported. The lower the tolerance level specified the higher the cost for those involved in the export supply chain to monitor and clean the shipment. If a shipment is rejected due to excessive contamination, there are considerable costs associated with finding alternative markets or destroying the shipment. If the tolerances are set too low the benefits of trade are forgone. As tolerances rise the risks of disease, hazards; e.g. allergic reactions, and other negative impacts on consumers, or negative environmental effects increase. In most cases, the tolerances established are a compromise between the costs associated with reducing contamination and the costs to society of allowing greater levels of contamination (Hobbs and Kerr, 1999).

In the case of unlicensed GM products, the EU policy is zero tolerance. There are two categories of unapproved GM-product events under EU regulations. The first is described as a *low-level presence* (LLP) whereby the GM product has been approved in the export market but not in the importing market, the asynchronous approval case. The second form of GM contamination is known as *adventitious presence* (AP), which occurs when the GM product is not approved in any market (i.e. is an experimental product or is cultivated under confined field trials). Due to asynchronous approvals, unapproved GM events are becoming more common as the commercial production of GM crops has spread around the globe.

The stated EU policy is a 0.9 percent contamination threshold of tolerance for LLP of GM products that have been licenced in the EU found in non-GM food and feed products. Any conventional product found with 0.9 percent GM co-mingling must consequently be labelled as GM. The EU maintains zero tolerance for the LLP of GM products that have not been licenced that are found in conventional food products. This means there can be no imports when any co-mingling is found. Zero tolerance, however, must be operationalized. As it is not commercially viable to test every individual grain of an imported shipment, sampling and testing methods as well their thresholds must be specified for exporters. In other words, potential exporters need to be informed as to what they must do to satisfy the EU that their shipments of non-GM products are free of contamination.

There have been a number of examples of non-GM shipments to the EU being contaminated with GM material. A search of the GM Contamination Register indicates 223 cases of non-GM contamination by unauthorized GM material worldwide during the period 1997 - 2010, with 141 cases occurring in Europe. Some cases of contamination with GM material refer to Canadian rapeseed/canola (1997), US corn (EU moratorium/de facto import ban, 1998), Starlink corn (processed corn for food, 2000), Bt10 corn (corn gluten for feed, 2005), Liberty Link rice 601 and 604 (2006), Herculex maize (2006/2007), Roundup Ready

II and Liberty Link (soya, 2008), BT 63 rice (2008), MON88017, MON89034 and MIR 604 (corn in soya, 2009) and FP 967 (Triffid flax, 2009/2010) (COCERAL, 2010; Viju et al., 2011b). The 2009 incident where shipments of EU approved soya varieties from the US were refused entry due to contamination with trace amounts of a GM corn variety that was not approved in the EU represented a major trade disruption. Also in 2009 there was a major LLP event where the exporter had a clear desire to continue to have access to the EU market. On September 8 2009, Germany issued an EU-wide Rapid Alert notification confirming the presence of GM-flax in some samples of flax imports from Canada. Imports of Canadian flax were embargoed until Canadian exporters could satisfy the EU regulators that shipments conformed to EU standards. The process of satisfying EU regulators entailed the development of a detailed sampling and testing regime. The GM-flax product that co-mingled with non GM-flax is the variety known as Triffid.

Oil seed flax (also known as linseed) is largely grown for industrial use, with the oil used in the manufacture of linoleum and paint. The flax seed is crushed to extract the oil, with the residual meal used as an animal feed. Small quantities of oil seed flax are also consumed by humans. There is no segregation of seed to be used for industrial use from seed destined for human consumption in export shipments. In the case of oil seed flax shipments from Canada to the EU, flax for human consumption is sourced from common cargo (Viju et al., 2011b).

In most years, Canada is the world's largest flax producer – approximately 750,000 metric tonnes annually. Less than 20 percent of Canadian flax production is consumed domestically. Until the incident when the LLP of Triffid flax was detected in the EU, approximately 70 percent of Canada's flax exports were destined for the EU. With the detection of Triffid flax, imports of all Canadian flax were first embargoed and then, with Canada's development of a testing and monitoring protocol, which was subsequently accepted by the EU, the embargo was lifted. As yet, Canadian exports of flax to the EU have not fully recovered. In the short run, as the protocol was being put into operation – and risks were high for Canadian

exporters – much of the Canadian flax surplus to domestic requirements apparently moved to China at prices much lower than were typically received in Europe (Viju et al., 2011b). Thus, the closing of the EU market to Canadian flax imposed considerable costs on the Canadian industry and the direct costs associated with the protocol appear to be significant. Further, EU importers of flax for industrial uses had no alternative sources of supply and also suffered considerable losses. As the operation of the protocol has become transparent and refined, Canadian exports to the EU have begun to recover.

While Triffid flax had been licenced in Canada, it was never grown commercially. It was withdrawn from the market and efforts were made to destroy all existing stocks of seeds – to the best of anyone's knowledge Triffid flax no longer existed. Canada exported flax to the EU for a decade after the Triffid variety was withdrawn and there were no tests available to detect its presence. Genetic science is not, however, static and new tests are being developed on an on-going basis. In 2009 a new test detected elements of Triffid flax in baked goods in the EU. This test was then used in Canada and elements of Triffid flax were found throughout the supply chain. The detection of Triffid flax, a GM product not approved in the EU, led to the immediate import ban (Viju et al., 2011b).

In the case of Triffid, flax shipments from Canada could have been co-mingling for up to a decade but there were no Triffid-specific tests which could detect it. While unauthorized but known GMs are often detected with the same methods used for authorized GMs, it is unlikely that the appropriate detection methods are always readily available. As a result, the regulatory processes have not been transparent.

The Triffid flax case raises some vexing questions related to zero tolerance. Triffid flax 'contamination' is widespread in both Canada and the EU despite efforts in Canada to destroy it. This means that consumers in the EU could have been eating flax containing GM material for up to a decade. Thus, it calls into question what the import ban and testing protocol are meant to accomplish – in some views *closing the barn door after the horse has*

escaped. The only way Canadian flax exports could escape zero tolerance would be for the crop to be licenced in the EU. This is a lengthy and costly process which has little transparency (Viju et al., 2011a). Triffid flax is now agronomically obsolete so that authorization will never be sought. The EU has never assessed the safety of Triffid flax or done a risk assessment – as is required by its international obligations. Trade in flax is lumbered with considerable additional costs without any tangible benefits. Estimates of the trade loss associated with Triffid flax contaminations were in excess of $110 million for 2009, the largest loss being for European industrial use importers that, in effect, had no alternative sources of supply (Dayananda, 2011).

The other interesting question arising from the Triffid case is the role of testing. With zero tolerance, the level of tolerance for contamination is effectively defined by the efficacy of the available test. Triffid flax escaped detection because there was no test. With an improved test, Triffid was detected. The test was developed in the private sector. Subsequent to the detection of Triffid flax, the test was widely used in both Canada and the EU – benefiting the firm that developed the test. There is a clear incentive to invest in improved testing. As asynchronous approval continues apace, and thus the number GM products that are not authorized in the EU but enter the marketplace somewhere in the world grows, the likelihood of contamination increases. This creates a growing incentive to devise better tests. The result will be increased detection of contamination, more frequent disruptions to trade, and rising monitoring and cleaning costs for those wishing to engage in exporting.

The problem of asynchronous approval was, however, supposed to be temporary. The 1999 EU moratorium on the approval of new GM products and the ban on imports of unlicensed GM products was only to be in place only until a new EU licencing regime for GM products was operationalized One of the most sensitive areas of international trade relates to the rules pertaining to human, animal and plant health and threats to the natural

environment – sanitary and phytosanitary issues. In the Uruguay Round of multilateral trade negotiations, an Agreement on the Application of Sanitary and Phytosanitary Measures (SPS) was reached. It was agreed by all WTO member states, including the EU, that scientific legitimacy would be the sole criterion upon which trade measures imposed for sanitary or phytosanitary reasons could be justified (Isaac, 2007).

The central elements of the SPS are that to impose a trade barrier there must be a scientific reason for its imposition, and that failing to impose the barrier would lead to an inacceptable level of risk. Thus, a country wishing to impose a barrier must provide a legitimate scientific justification and undertake a risk assessment. Either of these can be challenged by an exporting country and, ultimately, it is up to a WTO disputes panel to determine if the barrier is justified. The SPS recognizes that there may be situations when there is insufficient evidence to arrive at a scientific conclusion and in those cases a country is allowed to impose a temporary barrier until sufficient scientific information is available – a precautionary barrier. If a country imposes a precautionary barrier it is obligated to pro-actively seek the needed scientific information. Thus, firms that wish to engage in international trade in products where problems related to human, animal or plant health or risks to the natural environment could arise can expect certain processes to be followed if trade barriers are imposed. A scientific reason should be provided, a risk assessment should be undertaken, if there is no scientific consensus then, while a temporary barrier is imposed, the imposing country should be actively seeking the required information.

Genetically modified organisms and products fall under SPS. Due to the vociferous opposition from some members of civil society, the EU Commission has chafed under its SPS obligations as the opponents of biotechnology have steadfastly insisted that the scientific evidence on the safety of GM organisms and products is insufficient, the risks are too great and/or that the technology is simply unacceptable under any circumstances. Domestically,

policy makers in the European Union needed to devise an approval mechanism that allowed social considerations as well as scientific considerations to be part of the approval process for GM products. The clear intent was to devise an approval process, not a mechanism to perpetually banish GM products from the EU market – although some of their constituents clearly wished for the latter.

In 2003, the United States and Canada, among others, challenged the import ban on GM products at the WTO. In a 2006 judgement, the WTO Panel agreed with the complainants and asked the EU to bring its import regime into compliance with its SPS obligations – attempting largely to eliminate the trade problems arising from asynchronous approval by having all countries live by the agreed rules. The EU said it would comply but asked for time to put a new regime in place – thus extending the period of asynchronous approval. While the outlines of the new EU policy were announced in 2003, it has been a very difficult political process to finalize the policy and it remains a work in progress. The first new GM products under the revised policy were, however, licenced in 2010.

The first product to successfully work its way through the revised EU-level approval process – BASF's Amylopectin ('Amflora') potato – received its approval on March 15 2010 based on an application made in February 2005. Thus, it has not been possible to fully assess the new EU approval regime until recently. The EU's 2003 domestic regulatory regime is extremely complex, comprising at least 3 Directives and 9 Regulations as well as Recommendations. The procedures set out have not been fully clarified because only a limited number of the potential approval/rejection paths have been called upon (Viju et al., 2011a).

Cutting through the complexity of EU decision making, the approval procedures at the EU level do not make science the final arbitrator in decisions. There is a scientific body that reviews GM applications. The European Food Safety Authority (EFSA) has jurisdiction

over the scientific assessment of GM product authorization applications. Its GM Panel reviews each GM product authorization application on a case by case basis. The GM Panel consists of 21 independent experts supported by a number of specialized Working Groups drawing on a pool of more than 40 external experts in fields such as allergenicity, ecology, microbiology, toxicology, plant physiology and molecular genetics. The EFSA can refuse to approve an application to allow a new GM product on a scientific basis. All of this is broadly compliant with the SPS.

The problem arises, however, in the instance where the EFSA recommends approval on the basis of its scientific assessment. At this point, the approval moves into the political arena and a scientifically acceptable GM product can be denied approval for non-scientific reasons. This runs directly counter to the interpretation by the US and other countries that have accepted biotechnology of the SPS rules, and suggests that the EU may not be in compliance with the Panel ruling in 2006 (Viju et al., 2011a). Of course, the EU will have a different interpretation, and it will require a new WTO challenge and Panel ruling to decide on where the EU regime complies with SPS obligations. This process would take considerable time and asynchronous approvals will continue.

A new challenge to the EU import regime for GM products may not be mounted due to the damage to the multilateral trading institutions that would arise if the EU failed to comply (Isaac and Kerr, 2003). There is a precedent for the EU choosing not to comply with a WTO Panel ruling when faced with vociferous opposition from some members of civil society: the case of its import ban on beef produced using growth hormones (Kerr and Hobbs, 2005). The EU could also argue that the rules of trade pertaining to GM products should be those of the Biosafety Protocol (BSP) rather than those of the WTO; the EU regime would comply with the BSP rules which explicitly allow criteria other than science to form the basis of trade barriers restricting market access to GM products (Hobbs et al., 2005). The

international law regarding whether the WTO or the BSP should apply is sufficiently muddled that resolution is likely to prove elusive (Kerr and Hall, 2004).

The bottom line is that the problem of asynchronous approvals is unlikely to be resolved through the mechanism of multilaterally agreed international trade law. Alternative mechanisms will have to be found if the global rift is to be resolved.

Why the Ruling on Bees Matters

While the new approval mechanism for GM products in the EU may be contentious from the perspective of international trade law, the mechanism has been successful in granting approval to licence recent products for planting and import into the EU. Thus, while approvals are not synchronized, at least the possibility of the same GM product being approved in both jurisdictions now exists. The scientific process used is similar, which should lead to broadly similar results unless political factors come into play in the EUs decision making. It is still early days, but thus far political factors have not proved a major impediment to approvals.

At the start of 2011, the EU Register of GM Food and Feed lists 38 GM authorized products for food and/or feed use: 6 cotton varietals, 22 maize, 1 bacterial biomass, 1 yeast biomass, 3 varieties of rapeseed, 1 potato, 3 soybean types and 1 sugar beet (EC, n.d.b). The Amflora starch potato, with an altered starch composition, was approved for food and feed use, as well as for cultivation, in the EU. This 2010 authorization is the first new GM organism approved for food/feed use as well as cultivation in the EU since the embargo on new GM products (McLeod, 2010). All other authorizations approved since the end of the embargo in 2003 have been renewals of existing GM products already present in the EU market. Those which have any economic importance have been approved for use only as animal feed.

While the approval of GM products for production in the EU under the 2003 reforms led to some initial optimism regarding the resolution of the problems associated with asynchronous approval, the battleground over GM products within the EU has shifted. There are two new battlegrounds: (1) individual member states of the EU refusing to allow the cultivation of GM products that have received approval at the EU level and; (2) co-existence regulations. Co-existence means that those who wish to grow non GM crops can do so without fear of contamination from licenced GM crops.

Once the European Commission approves the GM product, that particular GM product is authorized. Individual GM product authorizations are valid throughout the EU for 10 years and are renewable (Plan and Van den Eede, 2010). The renewal process is similar to that of the original authorization and will include any new information pertaining to the GM product in question.

The European Commission has run into stiff opposition from some member states of the EU that do not wish to be bound by its approval of GM varieties for cultivation. It does not have the political mandate to impose its will on recalcitrant member states (Viju et al., 2011a). As a result, in July 2010, the European Commission released Recommendation 2010/C200/01. Within it, the Commission has proposed an article, (26b), applicable to all GM product that will be authorized for cultivation in the EU, either under Directive 2001/18/EC or 1829/2003/EC, allowing member states to restrict or prohibit cultivation of approved GM crops in part or all of their territory (EC, 2010a). In other words, individual member states will be free to restrict or prohibit the cultivation of specific GM strains or GM crops as a whole, in parts of or in their entire territory, on socio-economic grounds (MEEP, 2010). A member state can only adopt such measures against the cultivation of GM crops; they cannot adopt measures prohibiting the import and/or the marketing in the EU of

authorized GM seeds (EC, 2010b).This amendment will also be applicable to all GM products that have already been authorized for cultivation in the EU.

Given that some member states now support and permit cultivation of GM crops once they receive approval at the EU level, while others will restrict or ban it, and the EU's open internal borders will allow within EU movements of authorized GM seeds or plants, complicated issues arise for all the member states, regardless of their treatment of GM crops.

Member states that permit cultivation of GM crops will incur high monitoring, testing and transactions costs to ensure segregation of GM and non GM products, which is necessary for traceability, labelling and the provision of consumer information as mandated by the European Commission. In member states that permit cultivation, producers' productivity and efficiency gains due to the adoption of GM crops will be offset by increased monitoring, labelling and traceability requirements for their product on-farm and in transit.

Member states that restrict or ban the cultivation of GM crops will also incur high monitoring and testing costs, as well as significant enforcement costs to ensure that GM products do not enter their territory. The practical aspect of enforcement in a customs union without borders is likely to lead to prolonged legal challenges.

Firms, either domestic or international, with GM products wanting access to the EU market will face high transactions and fulfilment costs. It is entirely possible that should the EU follow a trajectory of devolving greater power to the member states regarding GM products, firms may actually be confronted with the task of familiarizing themselves with the requirements of 28 different regulatory regimes for GM products (27 sets of individual member state regulations and the EU-level authorization process) (Viju et al., 2011a). Under the 2010 recommendations, firms must still undergo the EU authorization process, and then will need to navigate the regulatory regimes of each member state. As a result, information asymmetry and transactions costs will increase for firms. Even if firms are highly efficient

and effective at meeting regulatory requirements, they will still be subject to greater risks due to the unpredictability and uncertainty in each member state market given the member state's ability to restrict or ban the cultivation of an individual GM crop. Firms will incur greater monitoring, marketing and legal costs as they adapt to each member state's market and monitor their respective legal and regulatory regimes. Hence, firms are likely to face significantly higher costs and risks than if they only had to seek approval of a GM product at the EU level. As a result, they are less likely to seek approval of a GM product already licenced in an exporting country. With no approval in the EU, the problems associated with asynchronous approval will persist.

The other major battleground within the EU over GM products is over co-existence. The issue of co-existence has been driven by the organic industry which has, in part, defined and differentiated itself as producing GM-free products (Sawyer et al., 2009). Thus, contamination of organic crops by non-organic crops threatens the premiums available from selling organic products. Further, given the stigma that some consumers in the EU attach to GM products, producers of non-GM conventional crops would also likely suffer financially if their products are contaminated with GM material. The EU has come down strongly on the side of organic and conventional producers' rights to maintain their GM-free status. As a result, the process of regulatory development to ensure co-existence has also been seized upon by others in the EU opposed to GM products as a potential means to impose significant costs on the GM industry.

The heart of the matter is defining the size of buffer zones that those that wish to produce GM crops must establish to ensure contamination does not take place. This process is technical, requiring considerable scientific information. It varies from crop to crop. The larger the buffer zone, the lower the profitability of producing a GM crop. Although the size of buffer zones for GM crops, where they have been established, vary from member state to

member state and crop to crop, they have generally been defined in terms of metres. For example, in Germany, buffers for maize are 150 metres between GM maize and conventional maize fields, and 300 metres between GM and organic fields (Anon, 2011).

The September, 2011 ruling of the European Court of Justice (ECJ) that pollen found in honey and food supplements constituted a foodstuff will likely alter co-existence regulation considerably. Given that trace amounts of pollen are found in honey and pollen is also used as a food supplement, if the *pollen* collected from a GM crop(not the crop per se) has not been approved as a food in the EU, it faces zero tolerance. Pollen from each GM strain would be considered a different food. Contaminated honey and pollen supplements could not be sold within the EU. Honey and pollen supplements from countries that approve GM-products are likely contaminated and, under zero tolerance, could not be imported even if the GM crop itself had secured approval in the EU. While honey and pollen supplements are minor crops, under the concept of co-existence, bee keepers in the EU will have the right to protection from contamination from any GM crop in their vicinity.

Bees are free ranging livestock. They fly considerable distances to collect pollen. As a result, the size of the buffer zones required to support co-existence will have to change considerably:

> No sooner was the ECJ's judgment published than the German Agriculture Minister, Ilse Aigner, announced that the current separation distances would have to be reassessed. Bavarian Environment Minister Markus Söder went into more detail and called for a 3 km safety distance between beehives and fields with GM crops. Friends of the Earth Germany (BUND) and the German Society for Nature Conservation (NABU) are calling for a separation distance of at least five kilometres, and the President of the German beekeeping association (DIB), Peter Maske, is calling for ten kilometres. "That should make this type of crop farming unattractive and impractical for farmers," says Maske (Anon, 2011).

To be clear, even the conservative estimates as to the size of buffers would require anyone who wishes to grow a GM crop in the EU acquire or control sufficient land to create a three kilometre band of separation between the GM crop and the nearest bee keeper. Given the

typical size of fields and farms in most of the EU, this is likely to be very difficult. Bee keeping has very low barriers to entry so that the opponents of GM crops could find it relatively easy to encourage widespread small-scale bee keeping – as a deterrent to farming GM crops. Given lengths that anti-GM NGOs have been willing to go to in the past, encouraging the spread of bee keeping is likely to seem an attractive strategy. Further, the exact size of the mandated buffers may not be determined for a considerable period as it will require scientific evidence and consensus on the ranges that bees can travel.

Given the fixed costs associated with gaining approvals for GM foods in the EU, no one is likely to seek approval of GM pollen from a specific GM crop variety as a food. Hence, given the cost associated with satisfying the co-existence requirement, firms developing new GM crops are likely to be deterred from seeking approval for the crop. As a result, asynchronous approval will persist and any progress that could be expected from the post-moratorium EU approval regime effectively nullified. The global food market will remain effectively segregated with international trade inhibited. The incentive to invest in new GM products will be commensurately reduced (Smyth et al., 2011). In short, bees matter a great deal.

Conclusion

The gains available from trade and from increased technological efficiency are two generally agreed sources of increased prosperity. While the forces of protectionism and technological skepticism are well understood and accepted as detractors from the potential prosperity gains available, they are also either expected to be temporary or to impose costs on a few markets. The divergent paths in the governance of biotechnology that have emerged since the EU declared a moratorium on the licensing of new GM products at the end of the 1990s have had considerable effects on international trade and the rate of innovation. Prior to the commercialization of biotechnology, scientific approval was the generally accepted

international method for dealing with new technology. This is evidenced by the widespread international use of the risk assessment framework (RAF) and multilateral acceptance of science as the decision criteria regarding the establishment of trade barriers justified on sanitary and phytosanitary grounds. For example, both the US and the EU use the RAF domestically, and both accepted the SPS Agreement. The divergent path that subsequently arose, however, was generally expected to be temporary while the EU put in place a process for approving GM innovations that included both scientific approval and social acceptability.

The addition of social acceptability to the solely science-based approach that continued to be used in countries that license new GM products was never expected by EU policy makers to lead to a significant divergence in the rate at which biotechnology innovations were to progress. More rigorous scientific assessments and the flexibility to deal with social concerns was what had been envisioned. Of course, there were those in civil society that hoped that the biotechnology would be banished from the EU but that was never the intent of most policy-makers. A new approval process was eventually put in place at the EU level and new GM products are working their way through the process. In the interim, however, regulatory hurdles have been put in place on a piecemeal basis that will perpetuate asynchronous rates of approval globally. In particular, the regulations relating to zero tolerance and co-existence will be particularly difficult to alter.

When the divergent paths for the acceptance of technological advances based on biotechnology emerged, the initial focus was on the direct benefits of trade forgone associated with the denial of market access. These forgone benefits continue to exist, but as asynchronous approval continues, and its effects cumulate, the focus is shifting to the trade problems associated with contamination. As more and more GM products receive approval in exporting countries, the probability of contamination of non-GM products increases. This, in turn, leads to widespread disruptions in trade, but on a shipment-by-shipment basis. As a

result the risks associated with trade in agricultural products have risen considerably. If asynchronous approvals continue, the risk will continue to rise.

The decision to invest in technological improvements is based, in part, on the size of the market that can be expected for the new product. If the market for biotechnology innovation is expected to remain truncated for the foreseeable future, investment will be inhibited and the rate of technological progress slowed.

Trade and investment policies tend to be assessed using a partial equilibrium, comparative statics approach. The problems associated with asynchronous approvals are interlinked multimarket phenomenon that are constrained by multiple and stacked regulations. Undertaking a full assessment of the economic benefits foregone by the inability to re-synchronize the process of technological approvals in biotechnologyrepresents a significant challenge for economists.

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