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Why Are US and EU Policies Toward GMOs So Different?

Kym Anderson and Lee Ann Jackson
Centre for International Economic Studies, University of Adelaide, South Australia

A global computable general equilibrium model is used to examine how adoption of genetically modified (GM) biotechnology affects the welfare of interest groups within the United States and the European Union in the absence of policy responses to this technology and in their presence. Results indicate that changes in real income of producers can help explain differing GM policies in these two regions.

Key words: biotechnology, general equilibrium, political economy, standards, trade policy.

> "Until we understand *why* our society adopts its policies, we will be poorly equipped to give useful advice on how to change those policies" (Stigler, 1975, p. xi).

Introduction

Over the past decade, the United States (US) and the European Union (EU) have implemented widely divergent regulatory systems to govern the production and consumption of genetically modified (GM) agricultural crops. In the United States, many products have been tested and commercially produced and marketed, while in the EU, few products have been approved and a *de facto* moratorium has limited the production, import, and domestic sale of most GM crops. These divergent approaches have led to conflict over the implications for international trade in genetically modified products, to the point where in September 2003 the United States, Canada, and Argentina succeeded in establishing a World Trade Organization dispute panel to begin to test the legality of European policy towards imports of GM foods.

Data show that GM policies of the EU are substantially altering trade flows. Canadian varieties of GM canola have not been approved, so its exports to the EU ceased after 1998, to the benefit of Australian and Central European canola growers. The EU has not approved most US varieties of GM maize, hence EU maize imports from the United States have almost ceased as well. In contrast, Argentina has been able to substitute for the United States as a maize supplier, because it grows EU-approved GM varieties. Soybean imports from the United States and Argentina have been affected less seriously; nonetheless, Brazil has become the EU's preferred supplier since 1998—despite the fact that 10–20% of the Brazilian soybean crop (70% in the south) is estimated to consist of illegal GM varieties (United States Department of Agriculture, 2003). Because of these sharp changes, the current shares of various exporters of these products in EU imports are now much further away from those suppliers' shares of global exports.

The divergence in regulatory approaches between the United States and the EU is puzzling, given the many economic similarities of these economies. Some analysts have argued that these differences stem from fundamental differences in consumer attitudes and expectations (e.g., Bernauer & Miens, 2001). Yet, evidence shows that in high-income countries, even with the support of environmental groups, consumers are traditionally weak policy lobbyists relative to producer groups (Hillman, 1989). This paper explores the hypothesis that differences in US and EU farm interest groups provide an additional or alternative explanation. In this paper, the policy environment and political economy forces at work are first described, before the well-received Global Trade Analysis Project (GTAP) model is used to provide intranational distributional implications of GM policies. Results from simulations described below are consistent with a private-interest explanation for the GM policy choices of these two economies.

Complex Policy Environments

The policy environment for GM crops involves a complex system of production and consumption policies. Production policies include acceptance of commercialization of new products and regulations to manage potential environmental risks associated with GM production. In the United States, three different agencies are responsible for various aspects of GM crops. The Food and Drug Administration makes market approval decisions, the Environmental Protection Agency monitors the use of crops that produce their own pesticides or herbicides, and the US Department of Agriculture regulates the introduction of new crops into the environment during field testing. All three agencies depend on industry provision of safety evidence, but the fundamental assumption concerning GM food crops is that unless evidence shows that modification has substantially altered their composition, they pose no more health risks than conventional food products. In the EU, prior to the initiation of the production moratorium, the approval process entailed a long iterative process among EU and state-level regulatory agencies, with the final step being evaluation by the EU Council of Ministers. If the product was not deemed safe at this stage, it could be neither produced in nor imported into the EU.

Production policies have obvious implications for producer outcomes in the way they either encourage adoption or generate additional production costs. However, producers are also affected by GM consumption policies—particularly labeling regulations that, in the case of the EU, have become increasingly stringent over time. After the EU moratorium on GM production was lifted in late 2003, all food and animal feed consisting of, containing, or produced from a GMO—irrespective of whether DNA or protein of GM origin is detectable in the final product—will need to be labeled. The tolerances for the unintentional presence of GMOs is the lowest in the world: 0.9% for approved GM foods (of which there are very few) and 0.5% for yet-to-be-approved GM food, and only then if there is evidence that appropriate steps are in place to avoid accidental contamination (European Commission, 2003). In the United States, Canada, and Argentina, by contrast, labeling is required only where there has been a significant alteration of product attributes (e.g., nutritional quality) or there is a health risk such as allergenicity, but voluntary labeling may be used. The leniency or strictness of labeling regulations will influence the costs to producers of complying with regulations, especially those associated with segregation and identity preservation.

Interest Group Diversity

Although consumer, environmental, and producer groups in western countries have many similarities, the consumer and farm interest groups engaged in the GM policy debate in the United States and the EU have region-specific reasons to diverge in their response to this issue.[1] On the consumer side, it has been suggested that differing experiences with previous food safety scares have shaped consumers' trust in food safety authorities. A 2001 survey in the United States, conducted by the International Food Information Council (IFIC; http://ific.org), found a low degree of consumer dissatisfaction overall. The IFIC attributes positive attitudes in the United States towards GM products partly to public trust in regulatory bodies such as the US Food and Drug Administration (76% of consumers have a "great deal" or a "fair amount" of confidence in the US food safety authorities), and partly to consumers having acquired more information about GM food. In the European Union, consumer attitudes towards GM foods are more hostile and have not softened much over the past seven years.

On the producer side, the benefits that agricultural producers can obtain from GM products will depend in part on the scale of their farm operations and the costs of regulatory compliance for segregation and identity preservation. Tough labeling laws and low unintentional GM tolerance levels require producers to put an expensive segregation and identity preservation system in place if and when GM varieties are approved. In the densely settled European landscape, more buffer zoning per hectare of GM crop would be needed than in broadacre landscapes such as in the United States. For many small EU farmers, the potential productivity gains would be more than offset by the management costs of buffer zoning. Hence, other things being equal, one would expect a greater proportion of EU than US farmers preferring to produce non-GM crops.

The importance of GM crops in the national agricultural economy and the extent to which nationally produced crops are traded internationally are also critical factors in determining producer payoffs to GM adoption. Over the past decade, feedgrains and oilseeds (mostly maize and soybean) accounted for 18% of the gross value of agricultural output in the United States, and the livestock sector that uses those products as inputs accounted for another 44%. In recent years, the US shares in global production of maize and soybeans have been 40% and 43%, respectively. With more than one fifth of production exported, US shares in global exports (including intra-EU trade) are 66% and 51%, respectively (Foster, Berry, & Hogan, 2003). Therefore, US maize and soybean producers have a strong interest in a low degree of GMO regulation both at home and in their export markets.

1. Other interest groups (including biotechnology corporations) also have an influence in the GM policy debate, but multinationals and the research communities working with them are equally prevalent in the United States and the EU, so this cannot be a major explanation for the differences in GM policies across the North Atlantic.

The interests of EU farmers, on the other hand, are less clear-cut. Although they could benefit directly from more-productive technologies, depending on the regulatory costs mentioned above, the first-available GM food crops (maize and soybean) play minor roles in the agricultural economy of the EU. In the past five seasons, they produced only 6% of the world's maize and only 1% of the soybean. Given that North America and Argentina have already adopted GM technology, EU food producers have had to weigh the potential benefits of remaining GM-free against the foregone cost savings of not adopting GM varieties, based on existing and future consumer aversion at home and in third-country markets. If consumer aversion subsides in the years ahead, increased acceptance of GM crops will erode the potential market access and price benefits of remaining GM-free. What about the EU livestock sector? Although it is almost as big as that of the United States, if tough standards also applied to feed ingredients, then EU livestock producers would support anti-GM policies, because they too are unlikely to benefit as much from the GM technology as the more maize-and-soybean-intensive North American livestock producers.

Under what circumstances over the medium term might it be conceivable that EU farmers are better off denying themselves access to GM technology, and how would current GM-adopting farmers in America fare in those circumstances? This question can only be addressed using an empirical model of the world's food markets, to which we now turn.

Simulating GM Agricultural Technology Shocks and Policy Responses

The global economy-wide GTAP model can capture the effects of productivity increases of GM crops, of consumer aversion to consuming GM products, and of the substitutability of GM and non-GM products as intermediate inputs into final consumable food. The version of the GTAP model used here is aggregated to 10 regions, 12 sectors, and five types of factors: (a) agricultural land (specific to farming), (b) other natural resources (specific to other primary sectors), (c) basic (unskilled) labor, (d) skilled labor, and (e) other capital. All nonspecific factors are assumed to be perfectly mobile within the economy, and perfect competition, full employment, and constant returns to scale are assumed throughout the economy. (See Hertel, 1998, for comprehensive model documentation. The model is solved with GEMPACK software described in Harrison & Pearson, 1996.)

Factor Ownership by Farmers and Other Households

In this analysis, economies are assumed to be composed of three groups of households: (a) farmers, (b) basic (unskilled) wage earners, and (c) owners of human and other capital. Income of each group comes from a combination of factors. Farm households earn income from farm and nonfarm activities. The existing GTAP database provides specific information about the availability and use of land, unskilled labor, skilled labor, and other capital in the agricultural sector and in other sectors. Nonfarm activities of farm households are assumed to use factors in the same proportion as activities conducted by the typical capital-owning household. Thus, factor shares for farm households are a weighted sum of factor income shares used in agricultural production and the factor income shares of capital owners. The shares of farm household income from nonfarm activities is assumed to be 90% in Japan and Korea, 50% in China and the EU, 35% in North America (NA), 25% in Australasia, and 20% in other developing countries. Basic wage earners receive all their income from unskilled nonfarm labor. Capital-owning households gain income from ownership of land, skilled labor, and capital used in nonagricultural sectors. Percentage changes in real income are calculated as the change in nominal income net of the change in the consumer price index.

Scenarios

The initial impact of GM adoption is a crop productivity shock. To distinguish the more-productive GM varieties, the adopting crops are each subdivided into GM and non-GM product, and an output-augmenting, Hicks-neutral productivity shock is implemented on the GM varieties of these commodities to capture their higher productivity. Following Stone, Matysek, and Dolling (2002), these model simulations assume that total factor productivity is higher for GM than for non-GM varieties by 6% for oilseeds and 7.5% for coarse grains. North America and Argentina are currently adopting GM varieties. Therefore, we assume 40% of coarse grain production and 65% of oilseed production is GM in North America, and 11% of coarse grain and 75% of oilseed production is GM in Argentina. For prospective adopting countries, we assume only three quarters of the US adoption rates.

Results from three basic simulations highlight the variation in interest group payoffs under different policy scenarios. The first scenario examines the impacts of GM adoption by the major adopting countries without

Table 1. Percentage change in real incomes in the United States and the EU under various GM crop adoption and policy response scenarios: GM coarse grains and oilseeds.

	North America (US + Canada) and Argentina adopt			NA, Arg., and EU adopt	All countries adopt
	Without policy response	With EU moratorium	With EU and other OECD moratorium	Without policy response	Without policy response
Farmers					
US + Canada	-0.07	-0.27	-0.52	-0.08	-0.11
EU-15	0.00	0.07	0.11	0.00	-0.01
Unskilled nonfarm laborers					
US + Canada	0.02	0.02	0.03	0.02	0.02
EU-15	0.00	-0.01	-0.01	0.01	0.00

Table 2. Percentage change in real incomes in the United States and the EU under various GM crop adoption and policy response scenarios: GM coarse grains, oilseeds, rice, and wheat.

	North America (US + Canada) and Argentina adopt			NA, Arg., and EU adopt	All countries adopt
	Without policy response	With EU moratorium	With EU and other OECD moratorium	Without policy response	Without policy response
Farmers					
US + Canada	-0.08	-0.31	-0.61	-0.09	-0.18
EU-15	0.00	0.08	0.12	0.00	-0.02
Unskilled nonfarm laborers					
US + Canada	0.02	0.03	0.02	0.02	0.02
EU-15	0.00	-0.01	0.00	0.01	0.01

Note. Data from authors' GTAP model simulation results.

an EU moratorium. The second scenario evaluates the impact of the EU moratorium on welfare outcomes, given GM adoption by the United States, Canada, and Argentina. The third scenario examines the impact of the EU moratorium spreading to other OECD countries (Japan, Korea, Australia, and New Zealand). These three scenarios are then compared with scenarios in which the EU and then the rest of the world also adopt GM coarse grain and oilseed varieties.

Distributional Effects

Estimates of the distributional consequences of these adoption and policy scenarios provide an additional perspective on the underlying political economy of GM regulations in North America and the EU. Tables 1 and 2 report the percentage changes in real incomes of both farm households and the other group most vulnerable to consumer food price changes: other unskilled laborers.

Even without a policy response by the EU or others, the first column of Table 1 shows that farmers in North America (NA) would lose slightly from GM adoption by themselves and Argentina because of the technology's impact on their terms of trade. (Of course, the early adopters would gain before the international prices for these crop products fell, and the biotech firms providing the GM varieties also would gain.) That column also shows that EU farmers would not be worse off through not adopting, because they grow much less of these crops, and their livestock producers can gain from the lowered price of imported feedgrain and oilseeds.

The second column of Table 1 shows the impact of the EU moratorium, which is modeled as a ban on imports of coarse grain and oilseeds from GM-adopting countries. That policy response increases considerably the loss to North American farmers, while benefiting EU farmers, because it is equivalent to increasing EU agricultural protectionism (where crop farmers evidently gain more than livestock producers lose). If that moratorium spreads to other (non-NA, non-EU) OECD countries, column 3 shows the divergence in impact between NA and EU farmers is even more pronounced, with EU farmers gaining more and NA farmers losing more due to the greater change in the international terms of trade. On the other hand, if the EU allowed the adoption, import, and sale of GM products domestically, column 4 shows that EU farmers as a group would be no better off, because these are minor crops in EU agriculture, whereas NA farmers would be only slightly worse off due to the greater competition from EU farmers. Moreover, if all countries adopted these GM varieties, greater competition would reduce EU farmer incomes slightly but would also lower NA farmer incomes.

Also, notice from the lower half of Table 1 that NA unskilled workers benefit only slightly from GM technology, and that benefit would rise very little if the EU moratorium spreads to other OECD countries; EU unskilled workers are only very slightly worse off with the EU moratorium than if the EU were to adopt the same liberal approach towards GM products as North America.

Together these results suggest that EU farmers have an interest in banning the domestic production and sale of GM coarse grain and oilseed varieties and encouraging other countries to do the same. North American farmers, by contrast, lose considerably from the EU moratorium and would lose more as more countries emulated the EU policy; hence, they have an interest in ensuring that other countries treat GM and non-GM varieties as like products. Moreover, in both sets of countries, there is unlikely to be any opposition to those farmers' preferred policy positions from consumers, because even the most vulnerable households (those dependent just on unskilled wage earnings) are affected hardly at all in terms of real incomes. That leaves farm lobby groups free to influence the climate of public opinion in their favor. In the EU, that can be done via support of environmental and food safety groups' dissemination of (possibly biased) information suggesting the need for precaution, whereas in North America it can be done through stressing the positive benefits of GM technology.

Coarse Grains, Oilseeds, Rice, and Wheat Adoption

An additional set of simulations examines the implications for farmers' real income of also adopting GM rice and wheat—two crops that could be available for commercial release very soon. To generate the results reported in Table 2, we assumed these crops would raise rice and wheat productivity by 5% in adopting countries. A comparison of results in Tables 1 and 2 indicates that as more GM crops are adopted, the real income benefits and costs to US and EU farmers are magnified, but real incomes of unskilled laborers remain nearly constant. In particular, EU farmers have slightly more incentive to support the moratorium when these crops are included, despite the fact that they thereby deny themselves access to this cost-saving technology, including the much more important wheat crop.

Implications for North American and EU Farm Lobbyists

These results are not inconsistent with the hypothesis that producer interest groups are playing a role in determining policy in the two regions: North American farmers would have the smallest decrease in real income with no anti-GM reaction abroad, whereas EU farmers would be harmed by moving away from the import ban towards the more liberal NA policy. These results also suggest that farmer interest groups may care about how policy and adoption choices in their country affect the policy and adoption incentives in other countries. For example, as GM crops are shunned by more countries, EU farmers are increasingly better off. Hence, an additional incentive for EU farmers to support a continued EU GM moratorium is the extent to which this moratorium creates a disincentive for other countries to adopt and thus give up access to GM-free EU markets. For US farmers, although real farm incomes decrease more when many countries adopt a larger variety of GM crops and no moratorium is in place, these decreases in income are still less than the decreases that occur under the EU and the broader moratorium. Hence, US farmers would prefer to have increased worldwide adoption of GM varieties—particularly if they continue to be among the first countries to adopt.

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Authors' Note

Anderson and Jackson were both at Centre for International Economic Studies at the University of Adelaide, Australia when preparing this paper. Anderson is on leave with the Development Research Group of the World Bank in Washington DC and Jackson is now with the WTO Secretariat in Geneva. The views expressed are the authors' alone and not necessarily those of their current employers.