How will the GMO debate affect the WTO and farm trade reform?

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Foreword

Professor Kym Anderson visited Massey University as a 2000 Venture Trust International Fellow. He has a distinguished career as an agricultural and international economist, and is a leading expert on international agricultural trade. Since completing his PhD at Standford University (USA) he has held positions at the Centre for Economic Policy Research (London), the GATT Secretariat, the Australian National University and the Australian Department of Trade. He has also consulted for many national and international agencies including the GATT, WTO, OECD, and various UN agencies. He is currently Director of the Centre for International Economic Studies at the University of Adelaide.

This Discussion Paper is based on a public seminar he presented at Massey University. Genetically modified organisms are likely to become a very big issue for the World Trade Organisation, as GMOs represent a major technological change that has the potential to affect billions of people world wide.

Bans and counter bans on GMO foods by trading partners could have serious consequences on global economic development, and possible disputes could clog up the effective working of the World Trade Organisation and it's policy of farm trade reform, "Trade policy measures such as bans and restrictions are not first-best ways of achieving domestic objectives such as food safety and biosecurity. Environmental, food safety and ethical concerns may be better served by allowing market forces to set standards as we are seeing with current labelling proposals.

Allan N Rae
Director

1 Introduction

This paper addresses the question: how might a new quarantine issue, namely genetically modified organisms (GMOs), impact on the World Trade Organization's rules and their interpretation by the its Dispute Settlement Body? It suggests that the GMO issue is almost certain to affect the way the WTO's Sanitary and Phytosanitary (SPS) Agreement is interpreted and, should it come under sufficient pressure, re-negotiated. Since national quarantine policy officials are involved in both dispute settlement and rules-negotiating at the WTO, this paper provides a glimpse of what might be in store for them in those capacities as well as in their work as quarantine decision-makers in the future. The paper also includes an empirical analysis of the trade and welfare effects that could be involved in GMO cases. This has two purposes. First, it provides some idea of the potential trade and welfare effects of SPS policy reactions to the GMO issue. Second, it illustrates a methodological approach that, to the authors' knowledge, is more comprehensive than any used by previous analysts for estimating the market effects of quarantine policies. The methodology would be inappropriate for cases involving just one small product in a small country. However, for across-the-board reviews of quarantine measures, and for cases involving major products and major traders – as with GMOs -- the economy-wide, general equilibrium approach used here is very relevant. And it will become even more so as and when economic assessment becomes more of a mainstream activity in quarantine analysis in the future (if not by quarantine officers, then certainly by agricultural policy advisors and trade negotiators concerned with the domestic and trade effects of SPS measures both at home and abroad).

While the use of modern biotechnology to create GMOs through agricultural research has generated exuberance by those looking forward to a new 'green revolution', GMOs have also attracted strong criticism. The opposition is coming from groups concerned, among other things, about the safety of consuming genetically modified foods, the environmental impact of growing genetically engineered crops, and the ethics related to using that technology *per se*. Scepticism toward genetic engineering has been particularly rife in Western Europe, which has stunted that region's contribution to the development and use of genetically engineered crop seeds and foods. In contrast, farmers in North American and several large developing countries (notably Argentina and China) have actively developed and adopted GM crops, and citizens there generally (perhaps unwittingly) have accepted that development and consume the foods generated by it. Meanwhile many other countries, including Australia and New Zealand, are in the process of introducing strict labelling requirements on GM foods and feed.

Environmental, food safety and ethical concerns with the production and use of GM crops have been voiced so effectively as to lead to the recent negotiation of a Biosafety Protocol (UNEP 2000) with its endorsement of the use of the precautionary principle. However, if that Protocol were to encourage discriminatory trade barriers or import bans, or even just long delays in approving the use of imported GM seeds, it may be at odds with countries' obligations under the World Trade Organization. Section 2 of this paper provides a brief overview of the trade policy issues at stake here. It suggests that these issues have the potential to lead to complex and wasteful trade disputes. The extent to which that potential is realized depends in large part on the economic stakes involved. They can only be determined by quantitative economic modelling, using – pending more reliable knowledge -- assumptions about the sizes of any shifts in farm product supply (or demand) curves. Section 3 of the paper illustrates one approach to such modeling. A well-received empirical model of the global economy (GTAP) is used to quantify the effects on production, prices, trade patterns and national economic welfare of certain countries' farmers adopting GM maize and soybean crops without and then with trade policy or consumer responses in Western Europe (where opposition to GMOs is most vocal). The results suggest such policy or consumer responses can alter significantly the potential size of the global GMO dividend and its distribution. The paper concludes in Section 4 by drawing lessons from the analysis for the future of quarantine policy making, for the SPS Agreement, for the WTO's attempts more broadly to reduce excessively protectionist technical barriers to trade and provide an effective mechanism for resolving trade disputes, and for food exporters such as Australia and New Zealand as their farmers puzzle over whether their 'clean, green' image and market access abroad would be compromised by adopting GMO technology.

2 GMOs, agricultural trade policies, and the WTO

2.1 National policy reactions to GMOs

Genetic modification or engineering is a new biotechnology that enables direct manipulation of genetic material (inserting, removing or altering genes) and thereby accelerates the development process, shaving years off R&D programs. Protagonists argue that genetic engineering entails a more-controlled transfer of genes because the transfer is limited to a single, or just a few selected genes, whereas traditional breeding risks transferring unwanted genes together with the desired ones. Antagonists, however, argue that the side effects in terms of potentially adverse impacts on the environment and human health are unknown – and probably unknowable without decades of further research and use.

GM techniques and their applications have developed very rapidly since the introduction of the first genetically modified plants in the 1980s. Transgenic crops currently occupy about 4% of the world's total agricultural area (compared with less than 0.5% as recently as 1996). Cultivation so far has been most widespread in the production of GM soybeans and maize, accounting for 54% and 28% of total transgenic crop production in 1999, respectively, with the United States accounting for almost three-quarters of the total GM crop area. Other major GM crop producers are Argentina, Canada, China, Mexico and South Africa, but India and several Eastern European countries also have a number of transgenic crops in the pipeline for commercialisation (James 1999; European Commission 2000).

The resistance to GMO production and use also has developed rapidly in numerous countries, especially by well-organised activists in Western Europe. That triggered the imposition in October 1998 of a *de facto* moratorium on the authorization of new releases of GMOs in the European Union (EU), and even stricter standards are mooted in the EU's revised Directive 90/220 of August 2000. These moves could be a prelude to a future EU ban on both the production and importation of food containing GMOs (following the EU ban on imports of beef produced with the help of growth hormones). Before the imposition of the moratorium, releases of GMOs were reviewed on a case-by-case basis and had to be approved at every step from laboratory testing through field testing to final marketing. By contrast, the permit procedure in the United States is far simpler and faster.

There are also marked differences in national labelling requirements. The US Food and Drug Administration does not require labelling of GM foods *per se*, but only if the transgenic food is substantially different from its conventional counterpart. The EU, by contrast, requires labelling of all foodstuffs, additives and flavours containing 1% or more genetically modified material (Regulations 1139/98 and 49/2000). Individual countries within the EU have added further requirements (OECD 2000). Numerous non-European countries, including some developing countries, also have enacted GMO consumer legislation. Australia and New Zealand are to introduce mandatory labelling for all foods containing GMOs (ie, a zero threshold), following a poll showing more than 90% approved such a move. Some developing countries also are reacting: Brazil has introduced restrictive conditions on imports of GM products, and Sri Lanka has taken the extreme step of banning the imports of GMOs, pending further clarification as to their environmental and food safety impacts.

Identity preservation systems to enable reliable labelling of food can be costly, however, and more so the more stages of processing or intermediate input use a crop product goes through before final consumption. A recent European survey suggests full traceability could add 6-17% to the farmgate cost of different crops (European Commission 2000). Who bears those costs, and are the benefits sufficient to warrant them? Products containing GMOs that are not verifiably different from their GM-free counterparts are not going to attract a price premium, so their producers would not volunteer to label them as containing GMOs, given (a) the cost of identity preservation throughout the food chain and (b) the negative publicity about GMOs which is likely to lower the price of goods so labelled. Coercion would therefore be required -- but for benefits that are difficult to perceive, since the label has virtually no information content (in contrast to, for example, the positive health warning on cigarette packets) because there are no known risks of consuming GMOs.

A non-regulatory alternative to positive labelling regulations is to encourage the voluntary use of negative labels such as ‘this product contains no GMOs’ (Runge and Jackson 2000). With perhaps the majority of processed foods now containing some GMOs, this market alternative would require labels on a much smaller and presumably declining proportion of products. And that subset, like organic food, could attract a price premium, perhaps sufficient to cover the cost of identity preservation and labelling. That still requires the separation of GM-free products from GM-inclusive ones, however. Furthermore, it begs the question as to what is the threshold below which ‘this product contains no GMOs’ should apply. For the label to be meaningful abroad for exported GM-free products, multilateral agreement on that threshold would be needed.

2.2 The Cartagena Protocol on Biosafety

Given the different attitudes and national approaches to regulation of genetically modified products, future trade disputes are a distinct possibility. The Cartagena Protocol on Biosafety (finalized in Montreal on 29 January 2000) may have added to that likelihood. The Biosafety Protocol has the objective of ensuring safe transboundary movement of living modified organisms resulting from modern biotechnology, If ratified by the parliaments of 50 signatories, the Protocol will not only reconfirm the rights of ratifying countries to set their own domestic regulations but also allow each country to decide whether and under what conditions it will accept imports of GM products for release into the environment (for example, as planted seeds). This condoning of import restrictions appears also to apply to GMOs intended as food, feed or for processing.[1] Importantly, the Protocol stipulates that lack of scientific evidence regarding potential adverse effects of GMOs on biodiversity, taking into account also the risks to human health, need not prevent a ratifying country from taking action to restrict the import of such organisms in order to reduce perceived risks (UNEP 2000). In essence, this reflects an acceptance of the guiding influence of

[1] Details concerning the latter products are still to be decided, however, pending the findings of the FAO/WHO Codex Alimentarius Commission’s Ad Hoc Intergovernmental Task Force on Foods Derived from Biotechnology. There is uncertainty because while the Protocol relates to biosafety rather than human safety, the phrase “… taking into account effects on human health …” survived the drafting process. The Codex Task Force is due to report within four years of its creation in June 1999.

the precautionary principle, that is, “better safe than sorry”.[2] The Protocol requires that GMOs intended for intentional introduction into the environment or for contained use must be clearly identified as living modified organisms; but modified organisms intended for direct use as food or feed, or for further processing, just require a label stating that the product “may contain” such organisms. No labelling requirements for processed foods such as cooking oil or meal were established by the Protocol.

2.3 WTO agreements and GMOs

An important aspect of the Biosafety Protocol that is unclear and hence open to various interpretations concerns its relationship with the WTO agreements. The text states that the “Protocol shall not be interpreted as implying a change in the rights and obligations of a Party under any existing international agreements”, but at the same time the Protocol claims that this statement is “not intended to subordinate [the] Protocol to other international agreements” (UNEP 2000 p.1). Certainly the Protocol’s objective of protecting and ensuring sustainable use of biological diversity whilst also taking into account risks to human health is not inconsistent with WTO agreements. The WTO acknowledges the need of member states to apply and enforce trade-restricting measures in order to protect human, animal or plant health and life as well as public morals. That right for a country to set its own environmental and food safety regulations at the national level is provided for in Article XX of the GATT. But the key goal of the WTO is to achieve effective use of the world’s resources by reducing barriers to international trade. For that reason WTO members also have agreed to not use unduly trade-restrictive measures to achieve environmental or food safety goals. More than that, such measures must be consistent with the key principles of the WTO: non-discrimination among member states, ‘national treatment’ of imports once having entered the domestic market, and transparent customs procedures. Whether the current WTO agreements prove to be in conflict with the rights to restrict trade in living modified organisms apparently provided for in the Biosafety Protocol only time – and possibly legal proceedings via the WTO’s Dispute Settlement Body -- can tell.

Members of the WTO also have trade obligations under other WTO agreements that restrict the extent to which trade measures can be used against GMOs. More specifically related to food safety and animal and plant health are the Agreement on Sanitary an Phytosanitary Measures (SPS) and the Agreement on Technical Barriers to Trade (TBT). These agreements allow member states to impose certain restrictions on trade if the purpose of the measure is to protect human, animal or plant life and health. The TBT agreement also covers technical measures aimed at protecting the environment and other objectives. At the same

[2] The precautionary principle implies that considerations of human health and the environment rank higher than possible economic benefits in circumstances where there is uncertainty about the outcome.

time the agreements aim at ensuring that applied measures and technical regulations are no more trade-restrictive than necessary to fulfil the stated objectives.

Both the SPS and TBT agreements encourage the use of international standards, guidelines and recommendations where they exist, such as in the realms of the Codex Alimentarius (the FAO's international food standards body). Currently there are no international standards for genetically modified products,[3] although the Biosafety Protocol explicitly notes that signatories "shall consider the need for and modalities of developing standards with regard to the identification, handling, packaging and transport practices, in consultation with other relevant international bodies." (UNEP 2000 p. 10, Article 18.3.) International harmonization of regulatory approval procedures for genetically modified products is currently under discussion in several forums including the FAO and OECD. The establishment of international standards for the production, regulation and labelling of these products may be helpful as a way of reducing future trade disputes among developed countries – but could impose onerous compliance costs on poorer GM-exporting countries.

Under the SPS agreement a country may apply higher than international standards *only* if these can be justified by appropriate scientific risk assessments. In other words, while the SPS agreement explicitly allows member states to set their own standards for food safety and animal and plant health, it requires that measures be based on scientific risk assessments in a consistent way across commodities. The TBT agreement is more flexible because member states can decide that international standards are inappropriate for a number of other reasons, such as national security interests (GATT Article XXI). Hence determining which WTO agreement a given trade measure is covered by is of key importance. The SPS agreement covers food safety measures and animal and plant health standards regardless of whether or not these are technical requirements. The TBT agreement, on the other hand, covers all technical regulations, voluntary standards and compliance procedures, except when these are sanitary and phytosanitary measures as defined in the SPS agreement (WTO 1998a).

The SPS agreement's scientific requirement is important because it is more objective than the TBT agreement's criteria for determining what is a justifiable trade restriction and what is hidden protectionism. On the other hand, the SPS agreement may be inadequate for legally justifying restrictions introduced on the basis of some vocal groups' opposition to GM foods. Official disputes about

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[3] However, the Codex Committee on Food Labelling is currently considering the adoption of an international standard on GMO labelling.

trade in genetically modified products have not yet materialized[4], but experience from earlier WTO dispute settlement cases that are comparable to the GMO debate give an indication as to how the existing rules may be applied. The SPS agreement was used in the beef hormone dispute between the US and the EU, for example (WTO 1998c). In short, the EU import ban on meat and meat products from hormone-fed livestock was found to be in conflict with the EU's WTO obligations, the main argument being that the EU could not present documented scientific risk assessment of the alleged health risk to justify the ban.

Scientific evidence is not always sufficient for governments to make policy decisions, or it may simply be unavailable. In such cases, Article 5.7 of the SPS agreement allows WTO member states to take precautionary measures based on available pertinent information. At the same time, members are obliged to seek additional information so that a more objective evaluation of the risks related to the relevant product or process can be made within a reasonable period of time. The precautionary principle is an understandable approach to uncertainties about genetically modified products, but there is a risk that when used in connection with internationally traded products, it can be captured by import-competing groups seeking protection against any new technology-driven competition from abroad. It may thus be extremely difficult to assess whether a measure is there for precautionary reasons or simply as a form of hidden protectionism. For this reason, attention will focus acutely on how the provisions of the Biosafety Protocol – the most explicit acceptance of the use of the precautionary principle in an international trade agreement relating to food products to date – are interpreted given current WTO commitments.

The existing trade agreements deal with regulations and standards concerning not just products but also production processes and methods *if but only if they affect the characteristics or safety of the product itself*: standards for production processes that do *not* affect the final product are not covered by the existing agreements. In relation to genetically engineered products, if the process itself were to alter the final product in such a way that there are adverse environmental or health effects associated with consumption, use or disposal of the product, restricting trade in this product need not violate existing WTO rules, ceteris paribus. However, if genetic engineering only concerns the production process and not the final characteristics of a transgenic product, domestic regulations that restrict the use of this method of production cannot be used to restrict imports of

[4] Thailand did formally object to Egypt's ban on GM imports in the latter half of 2000, but the matter was settled without going to the trouble of setting up a Dispute Settlement panel at the WTO. It objected not to Egypt's right to impose a ban, but rather to the fact that Thai exports were singled out for exclusion.

products produced by this method simply because the importing country finds it unacceptable by its own environmental, ethical or other norms.[5]

This discussion leads back to the role of scientific evidence. Some would argue that genetically modified products are different from conventional products *regardless* of whether this can be verified scientifically in the final product. One of the priorities of the European Commission in the next WTO round of multilateral trade negotiations is to obtain a clarification of the role of non-product-related processes and production methods within the WTO (European Commission 1999). If trade restrictions based on production methods are allowed, this could lead to the inclusion of a long list of non-tariff barriers, and not only in relation to biotechnology products.

Labelling of foods in relation to international trade is normally covered by the TBT agreement unless the label relates directly to food safety, in which case it is covered by the SPS agreement. Only labelling programs that concern production processes affecting the final product would be covered by the existing TBT agreement. Determining whether or not a genetic modification affects the final product will probably have to be done on a case-by-case basis. Where labelling programs are not encompassed by the TBT agreement, which potentially may be the case for many transgenic products, the other agreements of the WTO will be applicable without exceptions (Tietje 1997). GATT Article III concerning non-discrimination, for example, stipulates that member states may not discriminate between otherwise like goods on the basis of their country of origin. A key issue using this Article will be the interpretation of the concept of 'like goods' and whether the presence of genetically modified material is 'sufficient' to differentiate products. Article III seeks to avoid measures that are based on a false differentiation of products.

In short, the emergence of GMOs in agricultural and food production introduces several new and contentious issues to be dealt with by the WTO membership and ultimately its Dispute Settlement Body (DSB). The DSB has not yet been able to resolve the dispute over the EU's ban on imports of beef produced with growth hormones (WTO 1998c), so it is difficult to see how it will be able to do any better with the far more complex issue of GM products should the EU choose to ban their importation too – particularly now that there is a Biosafety Protocol on the table condoning the use of the precautionary principle and suggesting scientific evidence need not prevent importing countries from restricting GM trade. The systemic consequences are that future rounds of agricultural (and other product) trade negotiations are at risk of being ineffective (in so far as re-

[5] This product/process distinction became (and has remained) prominent at the WTO as a result of the famous tuna-dolphin case in the early 1990s. The general issue continues to be hotly debated. See, for example, the recent paper by Howse and Regan (2000).

instrumentation from traditional support measures to technical standards becomes common), and so too is the integrity of the DSB.

To get a sense of how likely it is that trade disputes erupting over GMOs, it is necessary to assess the economic stakes involved. That is, how large are the potential gains from GMO crop technologies, to what extent will various countries benefit (or lose) from their adoption, and how would trade policy responses or adverse consumer reactions affect those projected outcomes? It is to these questions that we now turn.

3 An empirical illustration

Theory alone is incapable of determining even the likely direction, let alone the magnitude, of some of the effects of subsets of farmers adopting GM-inclusive seeds, without or with trade policy and consumer reactions in other countries. Hence an empirical modelling approach is needed. To illustrate the usefulness of that approach in informing GMO debates, this section summarizes one recent quantitative effort. It makes use of a well-received empirical model of the global economy (the GTAP model) to examine what the effects of some (non-European) countries adopting the new GMO technology might be (Nielsen and Anderson 2000b). For such purposes the single-market partial-equilibrium approach has to give way to a global economy-wide, computable general equilibrium (CGE) approach.[6]

The Global Trade Analysis Project (GTAP), based at Purdue University, offers such a general equilibrium model.[7] It captures the vertical and horizontal linkages between all product markets both within the model's individual countries and regions as well as between countries and regions via their bilateral trade flows. The database used for these applications reflects the global economic structures and trade flows of 1995. It has been aggregated to a small number of regions to highlight the main participants in the GMO debate, and it focuses on the primary agricultural sectors affected by the GMO debate.

Specifically, the effects of an assumed degree of GM-induced productivity growth in selected countries are explored for maize and soybean.[8] Those results

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[6] Such an approach for comprehensive quarantine analysis has been called for by James and Anderson (1998) and Roberts (2000). See also Anderson, McRae and Wilson (2001).

[7] The GTAP model is a multi-regional, static, applied general equilibrium model based on neo-classical microeconomic theory with international trade described by an Armington (1969) specification, which means that traded products are differentiated by country of origin. See Hertel (1997) for comprehensive model documentation and McDougall et al. (1998) for the latest GTAP database.

[8] These two crops are perhaps the most controversial because they are grown extensively in rich countries and are consumed by people there both directly and via animal products. Much less controversial are cotton (because it is not a food) and rice (because it is mostly consumed in

are compared with what they would be if (a) Western Europe chose to ban consumption and hence imports of those products from countries adopting GM technology or (b) some Western European consumers responded by boycotting imported GM foods. The following scenarios are based on a simplifying assumption that the effect of adopting GM crops can be captured by a Hicks-neutral technology shift, i.e. a uniform reduction in all primary factors and intermediate inputs to obtain the same level of production.[9] For present purposes the GM-adopting sectors are assumed to experience a one-off increase in total factor productivity of 5%, thus lowering the supply price of the GM crop to that extent.[10] Assuming sufficiently elastic demand conditions, the cost-reducing technology will lead to increased production and higher returns to the factors of production employed in the GM-adopting sector. Labour, capital and land consequently will be drawn into the affected sector. As suppliers of inputs and buyers of agricultural products, other sectors will also be affected by the use of genetic engineering in GM-potential sectors through vertical linkages. Input suppliers will initially experience lower demand because the production process in the GM sector has become more efficient. To the extent that the production of GM crops increases, however, the demand for inputs by producers of those crops may actually rise despite the input-reducing technology. Demanders of primary agricultural products such as grains and soybean meal for livestock feed will benefit from lower input prices, which in turn will affect the market competitiveness of livestock products.

The widespread adoption of GM varieties in certain regions will affect international trade flows depending on how traded the crop in question is and whether or not this trade is restricted specifically because of the GMOs involved. To the extent that trade is not further restricted and not currently subject to binding quantitative restrictions, world market prices for these products will have a tendency to decline and thus benefit regions that are net importers of these products. For exporters, the lower price may or may not boost their trade volume, depending on price elasticities in foreign markets. Welfare in the exporting

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developing countries). For a parallel quantitative assessment of the latter two products, see Nielsen and Anderson (2000c).

[9] Available empirical evidence (see the surveys in USDA (1999) and James (1997, 1998, 1999)) suggests that cultivating GM crops has non-trivial cost-reducing effects. Nelson et al. (1999) suggest that glyphosate-resistant soybeans may generate a total production cost reduction of 5%, and their scenarios have *Bt* corn increasing yields by between 1.8% and 8.1%.

[10] Due to the absence of sufficiently detailed empirical data on the agronomic and hence economic impact of cultivating GM crops, the 5% productivity shock applied here represents an average shock (over all specified commodities and regions). Changing this shock (e.g. doubling it to 10%) generates near-linear changes (i.e. roughly a doubling) in the effects on prices and quantities. This lowering of the supply price of GM crops is net of the technology fee paid to the seed supplier (which is assumed to be a payment for past sunk costs of research) and of any mandatory 'may contain GMOs' labeling and identity preservation costs. The latter are ignored in the CGE analysis to follow, but further research might explicitly include them and, to fine-tune the welfare calculations, even keep track of which country is the home of the (typically multinational) firm receiving the technology fee.

countries would go down for non- adopters but could also go down for some adopters if the adverse terms of trade change were to be sufficiently strong. Hence the need for empirical analysis.

Three maize/soybean scenarios are considered below. The first of them (scenario 1) is a base case with no policy or consumer reactions to GMOs. GM-driven productivity growth of 5% is applied to North America, Mexico, the Southern Cone region of Latin America, India, China, Rest of East Asia (excluding Japan and the East Asian NICs), and South Africa. The countries of Western Europe, Japan, Other Sub-Saharan Africa and elsewhere are assumed to refrain from using or be unable at this stage to adopt GM crops in their production systems. The second scenario imposes on this base case a policy response by Western Europe: Western Europe not only refrains from using GM crops in its own domestic production systems, but the region is also assumed to reject imports of maize and soybean products from GM-adopting regions. Scenario 3 considers the case in which consumers express their preferences through market mechanisms rather than through government regulation.

Scenario 1: Selected regions adopt GM maize and soybean

Table 1 reports the results for scenario 1. A 5% reduction in overall production costs in the maize and soybean sectors leads to increases in coarse grain production of between 0.4% and 2.1%, and increases in oilseed production of between 1.1% and 4.6%, in the GM-adopting regions. The production responses are generally larger for oilseeds as compared with coarse grain. This is because a larger share of oilseed production as compared with coarse grain production is destined for export markets in all the reported regions, and hence oilseed production is not limited to the same extent by domestic demand, which is less price-elastic. Increased oilseed production leads to lower market prices and hence cheaper costs of production in the vegetable oils and fats sectors, expanding output there. This expansion is particularly marked in the Southern Cone region of South America where no less than one-fourth of this production is sold on foreign markets. In North America maize and soybean meal are used as livestock feed, and hence the lower feed prices lead to an expansion of the livestock and meat processing sectors there.

Due to the very large world market shares of oilseeds from North and South America and coarse grain from North America, the increased supply from these regions causes world prices for coarse grain and oilseeds to decline by 4.0% and 4.5%, respectively. As a consequence of the more intense competition from abroad, production of coarse grain and oilseeds declines in the non-adopting regions. This is particularly so in Western Europe, a major net importer of oilseeds, of which about half comes from North America. Coarse grain imports into Western Europe increase only slightly (0.1%), but the increased competition and lower price are enough to entail a 4.5% decline in Western European production. In the developing countries too, production of coarse grain and oilseeds is reduced slightly. The changes in India, however, are relatively small compared with e.g. China and the Southern Cone region. This is explained by the domestic market orientation of these sales. That means India's relatively small production increase causes rather substantial declines in domestic prices for these products, which in turn benefits the other agricultural sectors. For example, 67% of intermediate demand for coarse grain and 37% of intermediate demand for oilseeds in India stems from the livestock sector, according to the GTAP database.

For non-adopting Australia and New Zealand, the fall in the international price of coarse grain and soybean lowers the price of their imports of those products, but that benefit is small and is more than outweighed by the fact that the fall in the price of these livestock inputs in other countries lowers the competitiveness of grass-fed livestock in this region. This is reflected in the fall in their domestic prices and exports of livestock products.

Global economic welfare (as traditionally measured in terms of equivalent variations of income, ignoring any positive or negative externalities) is boosted in this first scenario by US$9.9 billion per year, two-thirds of which is enjoyed by the adopting regions (Table 1b). It is noteworthy that all regions (both adopting and non-adopting) gain in terms of economic welfare, except Sub-Saharan Africa which loses slightly because a small change in the terms of trade. Most of this gain stems directly from the technology boost. The net-exporting GM-adopters experience worsened terms of trade due to increased competition on world markets, but this adverse welfare effect is outweighed by the positive effect of the technological boost. Western Europe gains from the productivity increase in the other regions only in part because of cheaper imports; mostly it gains because increased competition from abroad shifts domestic resources out of relatively highly assisted segments of EU agriculture. The group of high-income East Asian countries, as relatively large net importers of the GM-potential crops, benefits equally from lower import prices and a more efficient use of resources in domestic farm production. Australia and New Zealand, by contrast, lose because the terms of trade go against their export-oriented livestock producers.

Scenario 2: Selected regions adopt GM maize and soybean plus Western Europe bans imports of those products from GM-adopting regions

In this second scenario, Western Europe not only refrains from using GM crops in its own domestic production systems, but the region is also assumed to reject imports of oilseeds and coarse grain for SPS reasons from GM-adopting regions. This assumes that the labelling enables Western European importers to identify such shipments and that all oilseed and coarse grain exports from GM-adopting regions will be labelled “may contain GMOs”. Under those conditions the distinction between GM-inclusive and GM-free products is simplified to one that relates directly to the country of origin, and labelling costs are ignored. This import ban scenario reflects the most extreme application of the precautionary principle within the framework of the Biosafety Protocol.

A Western European ban on the imports of genetically modified coarse grain and oilseeds changes the situation in scenario 1 rather dramatically, especially for the oilseed sector in North America which has been highly dependent on the EU market. The result of the European ban is not only a decline in total North American oilseed exports by almost 30%, but also a production decline of 10%, pulling resources such as land out of this sector (Table 2). For coarse grain, by contrast, only 18% of North American production is exported and just 8% of those exports are destined for Western Europe. Therefore the ban does not affect North American production and exports of maize to the same extent as for soybean, although the downward pressure on the international price of maize nonetheless dampens significantly the production-enhancing effect of the technological boost. Similar effects are evident in the other GM adopting regions, except again for India.

For Sub-Saharan Africa, which by assumption is unable to adopt the new GM technology, access to the Western European markets when other competitors are excluded expands. Oilseed exports from this region rise dramatically, by enough to increase domestic production by 4%. Western Europe increases its own production of oilseeds, however, so the aggregate increase in oilseed imports amounts to less than 1%. Its production of coarse grain also increases, but not by as much because of an initial high degree of self-sufficiency. Europe’s shift from imported oilseeds and coarse grain to domestically produced products has implications further downstream. Given an imperfect degree of substitution in production between domestic and imported intermediate inputs, the higher prices of domestically produced maize and soybean mean that livestock feed is slightly more expensive. (Half of intermediate demand for coarse grain in Western Europe stems from the livestock sector.) Inputs to other food processing industries, particularly the vegetable oils and fats sector, also are more expensive. As a consequence, production in these downstream sectors declines and competing imports increase. For equal and opposite reasons, Australia and New Zealand are not quite as badly off in this scenario as in scenario 1.

Aggregate economic welfare implications of this scenario are substantially different from those of scenario 1 (again, leaving aside any externalities). Western Europe now experiences a decline in aggregate economic welfare of US$4.3 billion per year instead of a boost of $2 billion (compare Tables 4b and 3b). Taking a closer look at the decomposition of the welfare changes reveals that adverse allocative efficiency effects explain the decline. Most significantly, EU resources are forced into producing oilseeds, of which a substantial amount was previously imported. Consumer welfare in Western Europe is reduced in this scenario because, given that those consumers are assumed to be indifferent between GM-inclusive and GM-free products, the import ban restricts them from benefiting from lower international prices. Bear in mind, though, that in this as in the previous scenarios it is assumed citizens are indifferent to GMOs. To the extent that some Western Europeans in fact value a ban on GM products in their domestic markets, that would more or less than offset the above loss in economic welfare.

The key exporters of the GM products, North America, Southern Cone and China, all show a smaller gain in welfare in this as compared with the scenario in which there is no European policy response. Net importers of maize and soybean (e.g. 'Other high-income' which is mostly East Asia), by contrast, are slightly better off in this than in scenario 1. Meanwhile, the countries in Sub-Saharan Africa are affected in a slight positive instead of slight negative way, gaining from better terms of trade. In particular, a higher price is obtained for their oilseed exports to European markets in this as compared with scenario 1.

Two-thirds of the global gain from the new GM technology as measured in scenario 1 would be eroded by an import ban imposed by Western Europe: it falls from $9.9 billion per year to just $3.4 billion, with almost the entire erosion in economic welfare borne in Western Europe (assuming as before that consumers are indifferent between GM-free and GM-inclusive foods). The rest is borne by the net-exporting adopters (mainly North America and the Southern Cone region). Since the non-adopting regions generally purchase most of their imported coarse grain and oilseeds from the North American region, they benefit even more than in scenario 1 from lower import prices: their welfare is estimated to be greater by almost one-fifth in the case of a Western European import ban as compared with no European reaction. In the case of Australia and New Zealand they too are slightly better off in the sense that they lose less in this than in scenario 1.

Scenario 3: Selected regions adopt GM maize and soybean plus some Western Europeans' preferences shift against GM maize and soybean

As an alternative to a policy response, this scenario analyses the impact of a partial shift in Western European preferences away from imported coarse grain and oilseeds and in favour of domestically produced crops.[11] The scenario is implemented as an exogenous 25% reduction in final consumer and intermediate demand for *all* imported oilseeds and coarse grain (that is, not only those which can be identified as coming from GM-adopting regions).[12] This can be interpreted as an illustration of incomplete information being provided about imported

[11] See the technical appendix of Nielsen and Anderson (2000a), which describes how the exogenous preference shift is introduced into the GTAP model.
[12] The size of this preference shift is arbitrary, and is simply used to illustrate the possible direction of effects of this type of preference shift as compared with the import ban scenario.

products (still assuming that GM crops are not cultivated in Western Europe), if a label only states that the product “may contain GMOs”. Such a label does not resolve the information problem facing the most critical Western European consumers who want to be able to distinguish between GMO-inclusive and GMO-free products. Thus some European consumers and firms are assumed to choose to completely avoid products that are produced outside Western Europe. That import demand is shifted in favour of domestically produced goods. Western European producers and suppliers are assumed to be able to signal -- at no additional cost – that their products are GM-free by e.g. labelling their products by country of origin. This is possible because it is assumed that no producers in Western Europe adopt GM crops (perhaps due to government regulation), and hence such a label would be perceived as a sufficient guarantee of the absence of GMOs.

As the results in Table 3 reveal, having consumers express their preferences through market mechanisms rather than through a government-implemented import ban has a much less damaging effect on production in the GM-adopting countries. In particular, instead of declines in oilseed production as in scenario 2 there are slight increases in this scenario, and production responses in coarse grain are slightly larger. Once again the changes are less marked for India and in part also for China, which are less affected by international market changes for these products. As expected, domestic oilseed production in Western Europe must increase somewhat to accommodate the shift in preferences, but not nearly to the same extent as in the previous scenario. Furthermore, there are in fact minor price reductions for agri-food products in Western Europe in part because (by assumption) the shift in preferences is only partial, and so some consumers and firms do benefit from lower import prices. In other words, in contrast to the previous scenario, a certain link between EU prices and world prices is retained here because we are dealing with only a partial reduction in import demand. The output growth in Sub-Saharan Africa in scenario 2, by taking the opportunity of serving European consumers and firms while other suppliers were excluded, is replaced in this scenario by declines: Sub-Saharan Africa loses export share to the GM-adopting regions.

The numerical welfare results in this scenario are comparable with those of scenario 1 (the scenario without the import ban or the partial preference shift) for all regions except, of course, Western Europe. Furthermore, the estimated decline in economic welfare that Western Europe would experience if it banned maize and soybean imports is changed to a slight gain in this scenario (although recall that these welfare measures assume consumers are indifferent to whether a food contains GMOs). The dramatic worsening of resource allocative efficiency in the previous scenario is changed to a slight improvement in this one. This is because production in the lightly assisted oilseeds sector increases at the expense of production in all other (more heavily distorted) agri-food sectors in Western Europe.

The welfare gains for North America are more similar in this scenario than in the previous one to those of scenario 1. But even in scenario 2 its gains are large, suggesting considerable flexibility in both domestic and foreign markets to respond to policy and consumer preference changes, plus the dominance of the benefits of the new technology for adopting countries. Given that the preference shift in scenario 3 is based on the assumption that non-adopters outside Western Europe cannot guarantee that their exports to this region are GMO-free, Sub-Saharan Africa cannot benefit from the same kind of 'preferential' access the region obtained in the previous scenario, where coarse grain and oilseeds from just identifiable GMO-adopting regions were banned completely. Hence Sub-Saharan Africa slips back to a slight loss in this scenario due to a net worsening of its terms of trade and the absence of productivity gains from genetic engineering techniques. Australia and New Zealand also slip back to almost the same situation as in scenario 1. Globally, welfare in this case is only a little below that when there is no preference shift: a gain of $8.5 billion per year compared with $9.9 billion in scenario 1, with Western Europe clearly bearing the bulk of this difference (ignoring the benefit to those European consumers who can now choose to but GM-free products).

4 Conclusions

The results demonstrate that the potential economic welfare gains from adopting GMO technology in even just a subset of producing countries for these crops is non-trivial. In the case considered in the first scenario it amounts to around $10 billion per year for coarse grain and oilseeds (gross of the cost of the R&D that generated GM technology). Moreover, developing countries would receive a sizeable share of those gains, and more so the more of them that are capable of introducing the new GM technology. The second scenario shows that the most extreme use of trade provisions, such as an import ban on GM crops by Western Europe, would be very costly in terms of economic welfare for the region itself (assuming opposition to GMOs is not very deep) – a cost which advisors to governments in the region should weigh against the perceived benefits to voters of adopting the precautionary principle in that way. More than that, exporters of GM products would not be able to reap as much benefit from the new technology in the presence of such a trade restriction. These gains foregone are sufficiently large that if policy makers ignore them when considering policy responses to appease opponents of GMOs, they risk getting into trade disputes.

The above facts may well not prevent some countries from imposing import restrictions on GM products however, for at least four reasons. First, the Biosafety Protocol might be interpreted by them as absolving them of their WTO obligations not to raise import barriers. Second, if domestic production of GM crops is banned, farmers there would join with GMO protesters in calling for a raising of import barriers so as to keep out lower-cost ‘unfair’ competition. Third, the on-going lowering of import barriers, following the Uruguay Round Agreement on Agriculture and the information revolution’s impact in reducing costs of trading internationally, pressure import-competing farmers to look for other ways of cutting imports.[13] And fourth, the cost of banning GMO imports in Western Europe amounts to barely US$15 per capita per year – hardly a major impediment to imposing an import ban.

Given these political economy forces, is there a way for WTO to accommodate them without having to alter WTO rules? Bagwell and Staiger (1999) address this question in a more-general setting and offer a suggestion. It is that when a country is confronted from greater import competition because of the adoption of a new domestic standard that is tougher than applies abroad, it should be allowed to raise its bound tariff by as much as is necessary to curtail that import surge. One can immediately think of problems with this suggestion, such as how to determine what imports would have been without that new standard. Rather than increase tariffs, however, direct payments that have a minimal distorting effect on trade may be a preferable alternative, especially if they are consistent with current WTO support commitments. Options of this sort may have to be contemplated if the alternative is to add to the EU beef hormone case a series of GMO dispute settlement cases at the WTO that are even more difficult to resolve.

The empirical results presented above show the importance of using a general equilibrium model when assessing the economic implications of quarantine measures (or indeed any other technical barriers to trade) adopted by large countries and/or affecting large product groups. While the indirect economic effects on related groups may not be of direct concern to quarantine officers, they certainly should concern policy makers and advisors responsible for sound management of the economy, in addition to agricultural trade negotiators.

Finally, what are the implications of these developments for export-oriented farmers in countries such as Australia and New Zealand? They are currently puzzling over whether their ‘clean, green’ image and market access abroad would be compromised by adopting GMO technology. On the one hand, if consumers in such regions as Western Europe and Northeast Asia are willing to pay a sizeable premium for GM-free foods, Australian and New Zealand farmers might be better off labeling their produce as such and enjoying the price premium rather than adopting GMO technology – at least for a time. That is probably even more true for New Zealand farmers if their Australian counterparts choose to adopt the

[13] The emergence of the concept of agriculture’s so-called ‘multifunctionality’, and the call for trade policy and the WTO to deal with environmental and labour standards issues, can be viewed in a similar light (Anderson 1998, 2000).

new technology, since that provides them an extra degree of product differentiation. Over time, though, there is the possibility that, as with milk pasteurization and many other past food innovations, consumer resistance to GMOs will diminish, especially as quality enhanced GM products are developed. Being ready to swiftly adopt when that point in time is reached would then be wise. By the same logic, it remains sensible for Australia and New Zealand to lend their weight in opposing trade barriers to GM imports by other WTO members, even though in the short term their farmers would appear to lose a little less from GM adoption abroad if they stay GM-free and Europe imposes a ban on GM imports.

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Table 1. Scenario 1: Effects of selected regions[a] adopting GM maize and soybean

(a) Effects on production, domestic prices and trade (percentage changes)

	North America	Southern Cone	China	India	Western Europe	Sub-Saharan Africa	Australia and New Zealand
Production							
Coarse grain	2.1	1.6	1.0	0.4	-4.5	-2.3	-5.0
Oilseeds	3.6	4.6	1.8	1.1	-11.2	-1.3	-3.4
Livestock	0.8	-0.0	0.1	0.4	-0.2	-0.1	-0.8
Meat & dairy	0.5	0.0	0.1	1.3	-0.1	-0.1	-0.6
Veg. oils, fats	1.1	4.5	1.4	0.0	-0.9	-1.2	-2.1
Other foods	0.2	0.1	0.4	1.5	-0.1	0.0	-0.3
Market prices							
Coarse grain	-5.5	-5.5	-5.6	-6.7	-0.5	-0.4	-0.8
Oilseeds	-5.5	-5.3	-5.6	-6.5	-1.2	-0.3	-0.7
Livestock	-1.8	-0.3	-0.4	-1.4	-0.3	-0.3	-0.4
Meat & dairy	-1.0	-0.2	-0.3	-1.0	-0.2	-0.2	-0.2
Veg. oils, fats	-2.4	-3.1	-2.6	-1.0	-0.5	-0.2	-0.3
Other foods	-0.3	-0.2	-0.5	-1.0	-0.1	-0.2	-0.1
Exports[b]							
Coarse grain	8.5	13.3	16.8	37.3	-11.5	-20	-26.8
Oilseeds	8.5	10.5	8.2	21.5	-20.5	-26.5	-28.4
Livestock	8.9	-2.0	-3.3	9.4	-1.1	-1.5	-1.5
Meat & dairy	4.8	-0.9	-0.9	5.8	-0.5	-0.2	-1.3
Veg. oils, fats	5.8	14.3	5.6	-3.8	-4.9	-5.3	-10.9
Other foods	0.2	0.1	1.6	7.6	-0.6	0.1	-1.3
Imports[b]							
Coarse grain	-1.6	-4.6	-4.2	-20.5	0.1	11.3	11.3
Oilseeds	-2.6	-9.2	-1.6	-8.6	2.5	16.5	13.7
Livestock	-2.1	1.3	0.9	-5.2	0.2	0.5	0.5
Meat & dairy	-1.9	0.2	0.8	-1.7	-0.0	0.1	0.0
Veg. oils, fats	-3.7	-3.6	-1.7	3.1	1.3	3.4	3.7
Other foods	0	-0.1	-0.6	-3.1	0.1	-0.1	0.4

(b) Effects on regional economic welfare

	Equivalent Variation (EV)	Decomposition of welfare results, contribution of (US$ million):		
	US$ million pa	Allocative Efficiency Effects	Terms of Trade effects	Technical Change
North America	2,624	-137	-1,008	3,746
Southern Cone	826	120	-223	923
China	839	113	66	672
India	1,265	182	-9	1,094
Western Europe	2,010	1,755	253	0
Sub-Saharan Africa	-9	-2	-9	0
Aust/New Zealand	-70	3	-71	0
Japan &Asian NIEs	1,256	551	712	0
Other dev/transition	1,120	171	289	673
WORLD	9,859	2,756	0	7,108

[a] North America, Mexico, Southern Cone, China, Rest of East Asia, India, and South Africa.

[b] Includes intra-regional trade.
Source: Nielsen and Anderson's (2000b) GTAP model results.

Table 2. Scenario 2: Effects of selected regions[a] adopting GM maize and soybean *plus* WE bans GM imports (a) Effects on production, domestic prices and trade (percentage changes)

	North America	Southern Cone	China	India	Western Europe	Sub-Saharan Africa	Australia and New Zealand
Production							
Cereal grain	0.9	0.0	0.8	0.4	5.3	-2.2	-5.2
Oilseeds	-10.2	-3.6	-0.8	0.8	66.4	4.4	-1.3
Livestock	1.2	0.3	0.2	0.4	-0.8	0.0	-0.4
Meat & dairy	0.8	0.3	0.2	1.4	-0.5	-0.0	-0.5
Veg.oils,fats	2.4	8.1	1.6	0.1	-3.4	0.0	-2.1
Other foods	0.3	0.4	0.5	1.6	-0.5	-0.1	-0.4
Market prices							
Cereal grain	-6.2	-6.0	-5.6	-6.7	0.8	-0.0	-0.7
Oilseeds	-7.4	-6.8	-6.0	-6.5	5.8	0.4	-0.4
Livestock	-2.2	-0.7	-0.4	-1.4	0.5	0.1	-0.3
Meat & dairy	-1.3	-0.4	-0.3	-1.0	0.3	0.1	-0.2
Veg.oils,fats	-3.3	-4.0	-2.7	-1.0	2.0	0.0	-0.2
Other foods	-0.4	-0.3	-0.5	-1.0	0.1	0.0	-0.1
Exports[b]							
Cereal grain	0.3	-2.9	5.0	23.4	15.9	-13.1	-27.1
Oilseeds	-28.8	-69.2	-18.4	-8.7	167.2	105.0	3.8
Livestock	13.7	4.0	-1.4	12.6	-3.8	-1.8	-0.4
Meat & dairy	7.5	2.1	0.1	7.1	-1.4	0.3	-1.2
Veg.oils,fats	14.4	26.2	7.0	1.3	-15.0	5.8	-12.1
Other foods	1.5	1.9	2.0	8.0	-1.4	-0.6	-1.4
Imports[b]							
Cereal grain	-1.9	-5.3	-2.8	-20	3.3	13.4	13.4
Oilseeds	-5.6	-21.9	3.0	-3.7	0.6	22.5	18.6
Livestock	-3.2	0.1	0.1	-5.9	0.9	0.5	0.7
Meat & dairy	-2.8	-0.5	0.8	-1.8	-0.2	-0.0	-0.2
Veg.oils,fats	-7.7	-5.5	-1.7	4.0	5.5	2.4	2.6
Other foods	-0.6	-0.6	-0.8	-2.8	0.1	0.2	0.3

(b) Effects on regional economic welfare

	Equivalent Variation (EV)	Decomposition of welfare results (US$ million pa):		
	US$ million pa	Allocative Efficiency Effects	Terms of Trade effects	Technical Change
North America	2,299	27	-1,372	3,641
Southern Cone	663	71	-303	893
China	804	74	70	669
India	1,277	190	-3	1,092
Western Europe	-4,334	-4,601	257	0
Sub-Saharan Africa	42	5	38	0
Aust/New Zealand	-52	-1	-49	0
Japan &Asian NIEs	1,423	593	831	0
Other dev/transition	1,296	101	531	672
WORLD	3,419	-3,541	0	6,966

[a] North America, Mexico, Southern Cone, China, Rest of East Asia, India, and South Africa.
[b] Includes intra-regional trade. Source: As for Table 1.

Table 3. Scenario 3: Effects of selected regions[a] adopting GM maize and soybean *plus* WE preference shift

(a) Effects on production, domestic prices and trade (percentage changes)

	North America	Southern Cone	China	India	Western Europe	Sub-Saharan Africa	Australia and New Zealand
Production							
Coarse grain	1.8	1.3	1.0	0.4	-2.0	-2.6	-5.2
Oilseeds	1.0	2.8	1.1	1	8.7	-1.6	-3.7
Livestock	0.9	0.0	0.2	0.4	-0.4	-0.1	-0.7
Meat & dairy	0.6	0.1	0.1	1.3	-0.2	-0.0	-0.6
Veg. oils, fats	1.2	5.0	1.4	-0.0	-1.1	-1.2	-2.1
Other foods	0.2	0.2	0.4	1.5	-0.2	0.1	-0.4
Market prices							
Coarse grain	-5.7	-5.6	-5.6	-6.7	-0.2	-0.4	-0.8
Oilseeds	-5.9	-5.6	-5.7	-6.5	0.1	-0.3	-0.8
Livestock	-1.9	-0.4	-0.4	-1.4	-0.1	-0.3	-0.4
Meat & dairy	-1.1	-0.2	-0.3	-1.0	-0.1	-0.2	-0.2
Veg. oils, fats	-2.6	-3.3	-2.6	-1.0	-0.4	-0.2	-0.3
Other foods	-0.3	-0.2	-0.5	-1.0	-0.1	-0.2	-0.1
Exports[b]							
Coarse grain	6.6	9.7	13.9	34.1	-29.7	-24.1	-28.0
Oilseeds	1.4	-4.5	2.1	14.1	-41.5	-32.4	-31.4
Livestock	9.8	-0.9	-3.0	10.0	-1.8	-1.2	-1.3
Meat & dairy	5.3	-0.4	-0.8	6.0	-0.7	0.1	-1.3
Veg. oils, fats	6.7	15.8	5.5	-4.0	-5.8	-4.9	-11.4
Other foods	0.4	0.4	1.7	7.6	-0.7	0.1	-1.4
Imports[b]							
Coarse grain	-1.7	-4.8	-3.9	-20.4	-23.6	11.5	11.6
Oilseeds	-2.9	-9.6	-0.7	-7.4	-17.7	17.3	14.5
Livestock	-2.3	1.1	0.8	-5.3	0.4	0.2	0.6
Meat & dairy	-2.1	0.1	0.8	-1.7	-0.1	-0.0	-0.1
Veg. oils, fats	-4.2	-3.8	-1.5	3.4	1.5	3.4	3.7
Other foods	-0.1	-0.2	-0.6	-3	0.1	-0.1	0.4

(b) Effects on regional economic welfare

	Equivalent Variation (EV)	Decomposition of welfare results, contribution of (US$ million):		
	US$ million pa	Allocative Efficiency Effects	Terms of Trade effects	Technical Change
North America	2,554	-100	-1,092	3,726
Southern Cone	785	109	-246	917
China	834	106	69	672
India	1,267	184	-9	1,093
Western Europe	715	393	319	0
Sub-Saharan Africa	-5	0	-7	0
Aust/New Zealand	-70	2	-70	0
Japan &Asian NIEs	1,303	565	744	0
Other dev/transition	1,120	168	293	673
WORLD	8,503	1,428	0	7,081

[a] North America, Mexico, Southern Cone, China, Rest of East Asia, India, and South Africa

[b] Includes intra-regional trade. Source: As for Table 1.

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