Developing countries are now the dominant voting bloc in the World Trade Organization (WTO). Many developing countries, especially the least developed, maintain that the Uruguay Round Agreement on Agriculture did little or nothing to benefit them. While many of these countries have presented proposals in the WTO for revisions to the agreement, most of these countries have limited analytical capability for developing and assessing such revisions. To assist developing countries in these efforts the International Agricultural Trade Research Consortium undertook an independent impact analysis to provide information on agricultural trade liberalization.

This chapter reviews and assesses the results of the six empirical studies appearing later in this volume (chapters 3–8). These six studies examine the impact of several basic scenarios for WTO agricultural reform. The studies did not all address the same questions, and so strict comparisons of all of the results are not possible. This review highlights the results for which there is a strong consensus and those that appear to differ across studies. This chapter examines the impact on commodity prices and production, level of international trade, and welfare gains and losses for both developing and developed
countries. It also draws out some of the policy implications and identifies areas for further work.

**DESCRIPTION OF THE MODELS AND SCENARIOS**

This brief overview of the structure of the models used in the studies is intended to provide only a general understanding of the strengths and differences among the various analytical approaches. The models differ substantially in country and regional and commodity coverage, methodology, policy specification, and time periods covered. While these differences make comparisons more difficult, they do add to the robustness of the results.

The models differ in their measurement of some of the basic data concepts, including support and protection of agricultural production. These concepts have also been introduced into the models in different ways. Because such basic data assumptions are critical for interpretation of the model results, these differences make straightforward comparisons of the results more difficult.

Two of the models have a general equilibrium structure while four are partial equilibrium specifications. Both types of model have been used extensively in trade liberalization studies. The study by the OECD Joint Working Party on Agriculture and Trade (chapter 8) provides a helpful comparison of the strengths and contributions to trade policy evaluations of these two types of model frameworks.

**Dimaranan, Hertel, and Martin**

The study “Potential Gains from Post-Uruguay Round Trade Reforms: Impacts on Developing Countries” (chapter 6) uses the Global Trade Analysis Project (GTAP) model, a fairly standard multiregion applied general equilibrium structure that has been widely applied in trade analysis. For this study the GTAP model was aggregated to 23 regions (4 developed, 19 developing) and 28 sectors (15 agricultural, 9 manufacturing, and 5 services). The model includes estimates of bilateral trade protection measures, and for this study information was added on several nonreciprocal measures such as the Generalized System of Preferences (GSP) and the European Union’s Everything but Arms initiative. Baseline projections were made to 2008 and include all tariff reductions introduced under the Uruguay Round.

Data on support and protection include ad valorem tariff equivalents (applied rates, where data exist), agricultural export subsidies (as reported to the WTO), and the use of the Organisation for Economic Co-operation and Development (OECD) producer subsidy equivalent, excluding market price support, for domestic agricultural support.

Four scenarios were examined:

- Developed countries only liberalize.
- Developing countries only liberalize.
■ Full multilateral liberalization.
■ Partial (50 percent) multilateral liberalization.

Liberalization included reductions in agricultural tariffs, manufactures and services tariffs, agricultural export subsidies, and agricultural domestic support.

**Hoekman, Ng, and Olarreaga**

The study “Reducing Agricultural Tariffs or Domestic Support: Which Is More Important for Developing Countries?” (chapter 3) uses a simple partial equilibrium framework highly disaggregated by country and commodity.\(^2\) The model comprises a series of country and region import demand and export supply functions for agriculture and food commodities, with a market clearing international price. A novel feature of this study is its estimate of import demand and export supply elasticities. The model covers 119 countries.

Data on import and export revenue and tariffs are from the World Bank and United Nations Conference on Trade and Development (UNCTAD) World Integrated Trade Solutions (WITS) database. These support and protection data include tariffs for the 158 agricultural and food commodities, specified at the Harmonized System (HS) six-digit level, that receive domestic support in at least one WTO member country. The model uses WTO aggregate measurement of data for the level of support in the domestic sector.

Two scenarios were examined:
■ A 50 percent reduction in agricultural tariffs.
■ A 50 percent reduction in domestic support.

**Rosegrant and Meijer**

The study “Projecting the Effects of Agricultural Trade Liberalization on Trade, Prices, and Economic Benefits” (chapter 4) of a partial equilibrium model.\(^3\) It includes 16 agricultural commodities and 36 countries and regions.

As a measure of protection International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) uses producer and consumer subsidy equivalents as price wedges between international and domestic markets. Reductions in these subsidies are assumed to be phased in over 2005/06. The liberalization scenarios involve the removal of these subsidies.

Four scenarios were examined:
■ Full multilateral liberalization.
■ Developed countries only liberalize.
■ Developing countries only liberalize.
■ Partial (50 percent) multilateral liberalization.

**Vanzetti and Sharma**

The study “Projecting the Effects of Agricultural Trade Liberalization on Developing Countries Using the ATPSM Partial Equilibrium Model” (chapter 5) uses
the Food and Agriculture Organization (FAO) Agriculture Trade Policy Simulation Model (ATPSM). It is a static, multicommodity, multiregion, partial equilibrium trade model. The model is highly disaggregated by commodity (36) and country (161). Countries were divided into developed and developing and then further divided into those for which domestic agricultural policy data are available and all others. The unique feature of ATPSM is its ability to analyze changes in tariff rate quotas. It allows the calculation of changes in within-quota tariffs and outside-quota tariffs and of import, export, and production quotas. It also allows assessment of export subsidies and domestic support. The base period for the quantity and price data is 1996–98. The data are from the FAO accounts.

The support and protection data include applied tariffs, tariff rate quotas, quotas, export subsidies, and set-aside quantities as reported to the WTO. For domestic agricultural support the model uses the WTO aggregate measurement of support data, which exclude green and blue box support (implying low initial levels of support for the European Union and the United States). All import protection is expressed as tariff rate equivalents. Liberalization involves reductions in trade protection and domestic support.

Four scenarios were examined:

- Developed countries only liberalize.
- Developing countries only liberalize.
- Full multilateral liberalization.
- Partial (50 percent) multilateral liberalization.

Policy changes are limited to countries for which policy information exists on tariff rate quotas, export subsidies, and domestic support.

**OECD Joint Working Party on Agriculture and Trade**

The study “The Medium-Term Impacts of Trade Liberalization in OECD Countries on the Food Security of Nonmember Economies” (chapter 8) uses the Aglink model, supplemented by the FAO World Food Model, and the Global Trade Analysis Policy (GTAP) model. Aglink is a partial equilibrium model, with detailed OECD member country policy specification. For this study the rest of world bloc of Aglink was replaced by detailed specification of 115 nonmember countries from the FAO World Food Model. The study also used the applied general equilibrium GTAP model. The main objective of the study was to examine the food security implications of agricultural trade liberalization. The scenarios were conducted using the OECD 2005 baseline.

Three scenarios were examined:

- Continuation of Uruguay Round–type increases in market access.
- Continuation of Uruguay Round–type reductions in export subsidies.
- Continuation of a Uruguay Round–type agreement (GTAP model only).
In most cases the tariff reductions were relative to applied tariffs. In the full reform scenarios this is irrelevant since all rates are taken down to zero. But in cases of partial reform it matters whether the reductions are taken from applied rates or bound rates. If a country has a bound rate of 100 percent and an applied rate of 50 percent, a 50 percent cut in the bound tariff has no (immediate) impact on the import price level.5

**Roberts, Bueter, and Jotzo**

The study “Agricultural Trade Reform in the WTO: Special Treatment for Developing Countries” (chapter 7) uses the Australian Bureau of Agricultural and Resource Economics’ (ABARE) Global Trade and Environment Model (GTEM), a global general equilibrium model derived from the GTAP model.6 GTEM’s strength lies in its extensive detail: the database represents 66 regions and 62 sectors across the world economy.

Six scenarios were examined, all partial liberalizations:

- A 30 percent reduction in tariffs in developed countries and a 20 percent reduction in tariffs in developing countries.
- A 30 percent reduction in tariffs in developed countries and no reduction in developing countries.
- A 30 percent reduction in tariffs in developed countries and a 20 percent increase in tariffs in developing countries.
- No change in tariffs in developed countries and a 20 percent increase in tariffs in developing countries.
- A 20 percent increase in tariffs in both developed and developing countries.
- No change in tariffs in developed countries and a 20 percent reduction in tariffs developing countries.

**SUMMARY OF PRINCIPAL RESULTS**

Some of the pitfalls and possible approaches to comparing model results are previewed in box 2.1.

**Dimaranan, Hertel, and Martin**

Full liberalization by both developed and developing countries is projected to increase global exports of agricultural commodities by 10.5 percent, or $72 billion, and manufactures and services by 5 percent, or $377 billion. Liberalization by developing countries only increases agricultural exports by an additional 70 percent more than if only developed countries liberalize (6.6 percent increase compared with a 3.9 percent increase). The differences between these two scenarios are even greater for manufactures and services—3.6 percent and 1.4 percent.

Variations in the projected change in level of exports of agricultural commodities are considerable. If only developed countries liberalize, or if all coun-
While there are some obvious differences in the models used for the studies reported in this volume, such as whether they are partial or general equilibrium, some more subtle differences also affect the evaluation and comparison of results:

**Regional and commodity coverage—aggregation matters.** The more disaggregated the underlying base data, the more likely that the model will detect significant structural and welfare changes—particularly in agriculture where tariff peaks are important. Partial equilibrium models typically have an advantage because databases are easier to construct on a detailed basis. The World Bank model in the study by Hoekman, Ng, and Olarreaga is particularly disaggregated, working at the Harmonized System six-digit level.

A more subtle issue is the analysis of aggregate results—particularly the distinction between developed and developing countries. The World Bank, for example, has explicit criteria for defining aggregations classified by income. Thus, the newly industrialized economies of Asia are typically included in the developed country aggregate. But the WTO has a different classification, as do many independent analysts. In agriculture this can make a significant difference since some of the highest agricultural distortions are in the Republic of Korea and Taiwan, China, and thus could affect the split between developed and developing economies.

**Time dimension—comparative static or dynamic.** Three of the reported studies derive from dynamic scenarios, two from comparative static, and one from both. The dynamic models require more effort, in particular the development of a baseline, and assumptions on output growth, productivity, factor supply, and (crucially) the policy environment—for example, final implementation of Uruguay Round commitments and China’s WTO accession. (Comparative static simulations may also include a presimulation that incorporates policy changes, albeit in a static environment.) If these policy changes are excluded from the baseline, the results will be biased upward. For example, final implementation of the Uruguay Round and China’s accession to the WTO may raise global income by $50 billion. If global reform is undertaken with a no-change-in-policy baseline, the global gains could amount to $300 billion. With the two policy changes included in the baseline, however, reforms might generate only $250 billion in additional gains.

It is also important to realize that dynamic results are to some extent driven by structural changes—thus the share of agriculture in the global economy is more than likely to decline through 2015–20 and the share of developing economies is bound to increase—particularly if the Asian economies continue to grow at 5–6 percent a year. Relative to comparative static results the declining share of agriculture will dampen the importance of agriculture, while the rising share of developing countries will increase the importance of developing countries.

(continued)
In evaluating dynamic results it is also important to scale the results to a common base for comparison. For example, in comparing income gains of $300 billion in 2015 from a dynamic model with gains of $125 billion in 1997 from a comparative static model, a first approximation is to assess the change in real income in percentage terms in 2015, say 1 percent, and to scale that to 1997’s income. If the global economy is growing at 3 percent a year on average, the scale factor to apply would be (about) 0.6, and thus $300 billion would be equivalent to $176 billion scaled to 1997’s economy. If the scaling is done on a country-by-country basis, the resulting country-specific gains may not sum to the global scaled gain because of changes in the structure of the global economy.

Model elasticities—especially for trade. While most of the models use a variety of elasticities, the most important for trade policy analysis may be the trade elasticities. Low trade elasticities are associated with relatively larger price changes and lower quantity changes from reform. Thus, low trade elasticities will tend to exacerbate negative terms of trade consequences, particularly for net food importers.

While not all of the studies in this volume report their trade elasticities, it is clear that the studies apply a wide range of elasticities. The two GTAP-based studies use relatively low Armington elasticities—elasticities that determine the degree of substitution between domestic goods and imported goods. In the standard GTAP version 5, these elasticities are around 2–3 (the new version of GTAP uses substantially higher Armington elasticities based on recent econometric work). The econometrically estimated elasticities of the study by Hoekman, Ng, and Olarreaga are even lower. OECD’s Aglink model is at the other extreme, with the assumption that traded agricultural commodities are homogeneous (implicitly assuming an infinite Armington elasticity). Model results are not linear with respect to the Armington elasticities over all ranges of the elasticities, but typically in the range of 2–3 linearity can be assumed. In other words, if global reform yields $100 billion using Armington elasticities of 2–3, doubling of these elasticities could yield gains of up to $200 billion at the global level, though perhaps with regional variation. The higher trade elasticities will also be associated with higher changes in trade volumes.

Model specification—many options. Beyond the general equilibrium and partial equilibrium differences, there are also differences in model specification and closure. For example, how land is combined with capital and labor in agriculture, the degree of land mobility and expansion or contraction, the modeling of tariff rate quotas and ad valorem equivalent tariffs, and assumptions of perfect or imperfect competition. It is hard to evaluate the impacts of model specification differences unless various approaches are explicitly included in the results from the same model—for example, comparing the results with and without imperfect competition.
tries liberalize, exports of wheat, feed grains, and livestock and meats fall. Sugar exports also fall if developed countries only liberalize. If developing countries only liberalize, exports of all 15 agricultural commodity categories rise. For manufactures, the textiles and wearing apparel categories increase substantially under all liberalization scenarios. Japan is expected to benefit most from export growth in percentage terms and Western Europe in absolute terms under all liberalization scenarios. Under the developed countries only liberalize scenario, gains to all developing countries and regions are small or negative. Under developing countries only liberalize and all countries liberalize scenarios, exports increase substantially more for all 19 developing countries and regions, in particular, China, India, Brazil, Taiwan (China), Middle East and North Africa, other newly industrialized countries, and other Latin America countries.

The welfare effects of full liberalization are estimated at $58 billion, with $42.3 billion (73 percent) accruing to developed countries and $15.8 billion (27 percent) to developing countries. The largest welfare gainers are Japan, Western Europe, Brazil, Oceania, other newly industrialized countries, and North America. Welfare losses are substantial for the Middle East and North Africa region and the rest of world. Most of the developing countries and regions (except China; Taiwan, China; other newly industrialized countries; and Brazil) experience negative terms of trade effects. Overall, developing countries are projected to experience welfare losses from the removal of agricultural export subsidies and domestic agricultural supports.

Several factors are behind the low overall welfare gains and some of the regional impacts. First, the version 5 GTAP model used in the study has particularly low Armington elasticities. This exacerbates the negative terms of trade effects, which amount to $10 billion for developing countries, with a major portion borne by the Middle East and North Africa region ($8.5 billion). Most developing countries suffer terms of trade loss, save for the agricultural exporters in Latin America and the manufactures exporters in East Asia. Also lowering the welfare gains are the built-in policy changes in the baseline scenario—final implementation of the Uruguay Round including elimination of the textile and clothing quotas, and China’s and Taiwan, China’s WTO accession commitments.

**Hoekman, Ng, and Olarreaga**

The two basic scenarios examined in the study were a 50 percent reduction in the level of tariffs and a 50 percent reduction in the level of domestic support. The analysis focused on the 158 (of more than 900) agriculture and food products at the HS six-digit level that received domestic support in at least one WTO member country. The average tariff on these products was 18 percent, but there were tariff peaks of 200–300 percent for some commodities (tariffs were highest for dairy, sugar, meat, and cereals). Domestic support was found...
to be concentrated in developed countries (88 percent of total support), with virtually none in the least developed countries.

The study found that the least developed countries are most affected by domestic support and protection. The study also found a larger negative impact from restricted market access than from domestic support to agriculture. For all country groups (developed, developing, and least developed) export revenues increase much more from the 50 percent reduction in tariffs than from the 50 percent reduction in domestic support—some six to seven times more for each group. The differences in welfare increases are even more pronounced—3–50 times for larger tariff cuts than for reductions in domestic support. The food import bill, however, declines with reductions in domestic support, but rises with reductions in tariffs. There is also considerable diversity among individual countries.

The GTAP model results also show that border barriers matter more than domestic support measures. The results show that elimination of border barriers accounts for 84 percent of the global gains from full reform and elimination of domestic support for 15 percent. It should be noted, however, that the GTAP results include elimination of manufactured tariffs on manufactured goods as well as agricultural goods.

**Rosegrant and Meijer**

On a global basis liberalization of agricultural trade has stronger effects on the volume and the regional distribution of trade for milk and meats than of cereals because protection is generally higher for dairy and meat commodities. Global commodity price increases are largest for milk, at 33 percent, with smaller increases of 10–19 percent for meat and 8–13 percent for cereals.

Full multilateral liberalization of the 16 commodities generates global benefits of $24.4 billion, with developed countries gaining $10 billion and developing countries $14.4 billion. When only developed countries liberalize, the benefits are smaller ($16.7 billion), but the developing countries’ share (72 percent) is higher than under the full liberalization scenario (59 percent). Also, West Asia and North Africa are projected to experience negative welfare benefits, while South Asia gains more than under full liberalization. When only developing countries liberalize, the biggest gainers are developed countries (73 percent). Regionally, Sub-Saharan Africa is one of the biggest winners from agricultural trade liberalization.

The results indicate that if only developed countries liberalize, developing countries realize most of the gains. The converse is true when only developing countries liberalize.

**Vanzetti and Sharma**

Under full multilateral agricultural liberalization commodity prices increase significantly, especially for the most protected commodities (butter, 30 percent;
cheese, 21 percent; concentrated milk, 23 percent; wheat, 16 percent; sheep meat, 15 percent; and tobacco, 20 percent). For most fruits and vegetables, price increases are less than 5 percent.

Under full agricultural trade liberalization total welfare gains are estimated at $24 billion, $6 billion to developing countries, including $0.7 billion for least developed countries, and $18 billion to developed countries. Under the scenarios where either developed countries or developing countries do not liberalize their agricultural sector, nonliberalizers also experience significant welfare losses. When both groups liberalize the welfare gains are smaller for each group than when only one group liberalizes.

By sector the biggest welfare gains for developed countries are for cereals and sugar, followed by meat and dairy. For developing countries the biggest welfare gains are for oils and oilseeds, followed by cereals, sugar, and meat. Developed countries have small welfare losses for tobacco and cotton, oils and oilseeds, and tropical beverages. For developing countries the only sector to experience a welfare loss is dairy.

Most welfare gains go to countries that make the greatest changes in support and protection—the European Union, Japan, and the United States. Welfare declines for the majority of countries—92 of the 161 countries. These welfare losses occur largely because of the rise in world prices for commodities (for net importers), the loss of quota rents, and the failure to liberalize. Most of the countries experiencing welfare losses are developing countries or economies in transition.

Quota rents are an important influence on negotiation on changes to the tariff rate quota system. To the extent quota rents are captured by the exporting country, an expansion of the quota and/or a reduction in the out-of-quota tariff can generate welfare losses for the exporter.

Agricultural trade liberalization increases net trade revenue for all country groups. The biggest gainers under the full liberalization scenario are developing countries, with a gain of $43 billion. Developed countries net trade revenue increases by $20 billion. Improved market access increases net trade revenue, whereas reduced domestic support decreases net trade revenue. Regardless of the scenario developing countries gain more than developed countries in net trade revenue. Partial multilateral liberalization has less than a 50 percent impact on net trade revenue.

**OECD Joint Working Party on Agriculture and Trade**

Countries were classified in several ways to allow comparisons among 11–14 types of countries. These include classifications by net trade position (both primary and processed), by competition with OECD countries, by food self-sufficiency, and by food security (based on five criteria).

The Aglink partial equilibrium exercise showed only minor changes in world cereal prices (up 1 percent) from the further reduction in export subsi-
dies since these play only a small role during the forecast period. Beef and dairy product prices, however, increase 2–7 percent. Improved access to markets results in very little change in cereal prices, but significant increases in beef prices (3.6 percent) and whole milk powder prices (9.5 percent).

The results for GTAP also show a modest increase in commodity prices. In contrast to the Aglink results, however, cereal prices rise more than meat and dairy prices. With liberalization of OECD agriculture, GDP increases in most developing countries and regions by 0.09 percent. India and the food neutral agricultural importers are exceptions, as their GDP declines. Under the scenario of full multilateral liberalization, OECD countries see little increase in GDP, while developing countries’ gains are substantial. Similar to the results with the GTAP model in the study by Dimaranan, Hertel, and Martin, these results—higher changes in world prices and negative terms of trade impacts—are driven by the relatively low Armington elasticities.

**Roberts, Bueter, and Jotzo**

Under the scenario of a 30 percent developed country and 20 percent developing country reduction in barriers to trade, developed countries gain about $7 billion in GDP and developing countries (mostly middle income) about $5 billion. The gains are smaller for the three groups of countries (developed countries, middle-income developing countries, and low-income developing countries) when developed countries only liberalize. If developing countries increase protection while developed countries liberalize, developing countries’ GDP declines. If only developed countries liberalize, there are small GNP gains for the three groups of countries, but mainly for the middle-income developing countries.

Under the scenario of a 30 percent developed country and 20 percent developing country reduction in barriers to trade, developing country exports increase by about 8 percent to developed countries and about 4 percent to other developing countries. When developed countries only liberalize, the gains in exports by developing countries to developed countries are slightly lower, while exports to other developing countries decline.

**CONSISTENCY IN RESULTS**

The six studies reach similar conclusions on trade liberalization in a number of areas. All the studies emphasize the significant gains in global trade expansion, welfare, and higher commodity prices.

**Global Welfare**

All studies find a significant increase in global economic welfare. Even when only developed countries or developing countries liberalize, the gains are still
substantial (albeit smaller) for both groups. Magnitudes of global welfare gains for agriculture are similar among the studies.

**Regional Welfare**

The largest trade and welfare gains occur in countries and regions that liberalize as part of a multilateral process. A significant number of countries that do not participate in liberalization experience only limited welfare gains or even losses.

The welfare impacts of full and partial agricultural liberalization from five of the studies are summarized in table 2.1, along with some basic adjustments made for this analysis. Two of the studies did not examine full liberalization. The Dimaranan, Hertel, and Martin results are scaled to 1997, assuming a 3 percent annual growth rate (results are reduced by 28 percent).10 The Roberts, Buetre, and Jotzo results are also reduced, by a factor of 32 percent and then doubled because the study’s partial liberalization represents a 30 percent cut by developed countries and a 20 percent cut by developing countries rather than the 50 percent cut used in the other studies.11 Finally, the Rosegrant and

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a. The partial liberalization scenario is only a 30 percent reduction by developed countries and a 20 percent reduction by developing countries. The adjusted results are “scale” adjusted for time and then doubled.
— Not available.
Meijer partial reform results are reduced by nearly 50 percent because of the reported gains in 2020.12 The results for developed countries are remarkably similar, ranging from a low of $10 billion from the Roberts, Buetre, and Jotzo study to $15–$16 billion for the other studies. The Rosegrant and Meijer study is an outlier, with a negligible gain of $2 billion for developed countries. Given the widely disseminated total of $300–$350 billion in annual OECD agricultural support, the small gain from the IMPACT model of Rosegrant and Meijer is somewhat surprising.13

The results for developing countries are also by and large consistent across these studies, mainly small and even slightly negative. With the exception of the Rosegrant and Meijer study, the gains are substantially less than for developed countries. Additional information about the models would be needed to better assess the reasons for these results, but clearly the low Armington elasticities used in the GTAP model of Dimaranan, Hertel, and Martin are in part responsible.

Commodity Prices

Commodity prices would be expected to rise as a result of trade liberalization. Nevertheless, there is considerable diversity among commodities, with some commodities experiencing little gain or even losses. The most protected commodities (milk, meats) experience the greatest gains.

Policy Differences

A larger impact would be expected from increased market access than from reduced domestic support. There is agreement among the studies that developing countries would benefit relatively more than developed countries from improved market access.

Sectors

The studies indicate that liberalization of manufacturing is more important than liberalization of agriculture, on an absolute basis, especially for developing countries.

APPARENT INCONSISTENCIES IN RESULTS

Divergences in results of the six studies relate mostly to the distribution of the gains. These apparent differences do not lessen the strength of the conclusions noted above.

Export Gainers

The GTAP model results of the Dimaranan, Hertel, and Martin study suggest that certain commodity groups could experience a reduction in exports (cere-
als, meats) if all countries liberalize. If only developing countries liberalize this result is reversed, and the value of all 15 commodity groups increases. The partial equilibrium model runs indicate that there would be gains in all commodity group exports.

**Welfare Gainers**

The benefits to developing countries from agricultural liberalization appear to differ in the studies. The GTAP model results of Dimaranan, Hertel, and Martin suggest that if all countries liberalize, there would be a global gain of $30 billion but a loss of $4.8 billion to developing countries. That loss is the result of the negative effects of export subsidies and domestic support—and the resulting negative terms of trade impacts—offsetting the gains from improved market access. The results of the Rosegrant and Meijer study show a global gain of $24 billion, of which $14 billion accrues to developing countries. The Roberts, Buetre, and Jotzo study finds a similar increase in GDP, but suggests that developed countries would benefit more (because they undertake larger reductions). The OECD Joint Working Party on Agriculture and Trade also finds that developing countries gain the most when all countries liberalize their agriculture.

**Price Impacts**

The Vanzetti and Sharma study finds significant price increases for some commodities (30 percent for butter, 16 percent for wheat). Rosegrant and Meijer also find substantial price increases (33 percent for milk, 18 percent for beef). Some of the other studies find much smaller price gains from agricultural trade liberalization. The GTAP model used by the OECD Joint Working Party on Agriculture and Trade finds only small commodity price changes and a greater rise in cereal prices than in meat prices.

**RESULTS FROM OTHER STUDIES**

The studies in this volume cover a variety of models and approaches, but the literature includes many more analyses of the impacts of global agricultural trade reform. Box 2.2 briefly summarizes some of the other studies—all based on general equilibrium models—including work based on the World Bank’s LINKAGE model (Beghin and van der Mensbrughe 2005); the Mirage model of the French economic research institute Centre d’Etudes Prospectives et d’Informations Internationales (CEPII; Bouët and others 2003); an International Monetary Fund-based application of the standard GTAP model (Tokarick 2003); and a Dutch-based application using a variant of the GTAP model (Francois, van Meijl, and van Tongeren 2003). While far from an exhaustive survey, these studies when combined with those reported here are representative of the broad spectrum of applied agricultural trade policy analysis.14
While none of the more recent work undertaken with the prerelease version 6 of the GTAP database with a 2001 base year is included here, two key features of the new database should be mentioned. First, it includes changes in protection measures since 1997, the base year of the previous release, and therefore includes further implementation of the Uruguay Round accords. Second, the new protection measures are based on the MACMaps protection data—a joint product of CEPII and the International Trade Centre in Geneva. The new database incorporates bilateral preferences—notably the Generalized System of Preferences and initiatives such as the European Union’s Everything But Arms agreement. Because of these changes the new base year and database are likely to dampen the gains from trade relative to models using version 5. Still, agricultural protection—particularly among OECD countries—has not changed substantially since 1997, and early results suggest that agriculture will continue to hold a disproportionate role in any Doha Round agreement (or failure) and its aftermath.

The four studies summarized in box 2.2 generally show much greater gains from agricultural trade reform than the studies included in this volume (and summarized in table 2.1)—bearing in mind that the results presented in box 2.2 come from full removal of trade and domestic distortions in agriculture. The $155 billion adjusted results for the LINKAGE model under full reform are well above the $20 billion adjusted results for the GTAP model of Dimaranan, Hertel, and Martin (which is just a bit lower than the reported $24 billion gain from the Vanzetti and Sharma study). The regional breakdown also shows a stark contrast—with developing countries gaining almost as much as developed countries in the LINKAGE model results of Beghin and van der Mensbrugghe.

It is not easy to bear down on all of the differences between the two models, but some are clearly relevant. The GTAP model of Dimaranan, Hertel, and Martin incorporates many trade preferences in its base data that are not included in the LINKAGE model base data, which uses the standard GTAP data set. The two models also have a different starting point for Chinese tariffs. The standard GTAP data set, used in LINKAGE, is based on statutory tariffs, which are well above applied tariffs in China. These base data differences will clearly bias the LINKAGE results upward. The GTAP model, of Dimaranan, Hertel, and Martin, implements policy changes in its baseline—for example, final Uruguay Round implementation, including removal of textile and apparel quotas, and China’s WTO commitments—leading to a downward bias in the GTAP results since LINKAGE picks up gains from trade reforms that are included in the GTAP baseline.

Several other features also bias the GTAP results downward. The Armington elasticities are low—much lower than the elasticities used in the LINKAGE model. Bringing them up to LINKAGE levels would require more than a doubling of these key elasticities and would likely result in more than a doubling of the welfare gains, with the negative welfare gains for developing countries being reversed. GTAP assumes a low level of land mobility across sectors and no land expansion. This severely dampens the agricultural supply response,
particularly for the large agricultural exporters such as Argentina and Brazil. GTAP does not allow for a dynamic response to trade reform.

While the GTAP model has some dynamic features, they are built into the baseline: shocks are based on a view of what the world would look like in 2008, but GTAP is otherwise a comparative static simulation—with fixed factor stocks. In LINKAGE shocks are phased in over a six-year period (2005–10), and the results of trade reforms are measured in 2015 relative to the baseline. It thus picks up any pro-growth effects generated by the trade reform—such as a higher capital stock and greater land availability.\(^{18}\)

These differences highlight the difficulties of model comparison, as described in box 2.1. One practical solution for comprehending these differences is to undertake these comparisons more methodically, with modeling groups testing each other’s alternatives systematically. But even if these various models provide a plausible range of results, there are many reasons to believe that the results are still on the low end of the possible gains from trade. Most simulations ignore potential scale economy effects, pro-growth effects (through trade-led productivity increases), and the impacts of excluded policy changes, such as trade facilitation and services.

**IMPLICATIONS FOR POLICY AND FUTURE WORK**

The studies indicate that widespread exemptions from agricultural trade liberalization requirements for developing countries, including Special and Differential Treatment, may not be in their best interests. Results from all the studies emphasize the need for countries to be active participants in trade liberalization in order to achieve positive and substantial welfare gains. While improving market access in developed countries is part of the story, developing countries have much to gain from increasing market access in their own countries—particularly in agriculture, where income elasticities are still relatively high and growth prospects are promising.

Improved market access is clearly the area of greatest benefit for both developed and developing countries. The Hoekman, Ng, and Olarreaga and the GTAP studies compare the impact from different types of trade policy support and protection—the so-called three pillars. The results show a much more substantial impact from enhancements of market access than from reduced domestic support or export subsidies. This is an important observation for guiding trade negotiating strategies. Further work on the trade impact of different types of domestic policies could provide some refinement to this area of concern.

The results emphasize the great variability in the gains from trade liberalization. While the global results are clear, they mask some of the differences at a more disaggregated level. Not all countries can expect welfare gains from liberalization of agricultural trade. For example, Vanzetti and Sharma found that only 52 of 161 countries had positive welfare gains. Thus even some countries that liberalize agriculture do not achieve welfare gains. Further analysis of
Several other selected studies also provide welfare estimates from agricultural trade reform. These studies (Beghin and van der Mensbrugghe 2005; Bouët and others 2003; Francois, van Meijl, and van Tongeren 2003; and Tokarick 2003) are all general equilibrium models largely based on GTAP version 5.

Of all the studies the Beghin and van der Mensbrugghe study using LINKAGE shows some of the highest welfare gains from agricultural liberalization, at $265 billion (see table). Applying a scale factor of 40 percent to the results brings the gains from global agricultural reform to about $155 billion—but

### Summary of Welfare Effects of Selected General Equilibrium-Based Studies

(Change relative to baseline)

<table>
<thead>
<tr>
<th>Study</th>
<th>Model</th>
<th>Time framework</th>
<th>Scenario</th>
<th>Welfare effects (US$ billions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beghin and van der Mensbrugghe (2005)</td>
<td>LINKAGE</td>
<td>2015 All sectors</td>
<td>Agriculture 100%</td>
<td>385 188 196</td>
</tr>
<tr>
<td>Bouët and others (2003)</td>
<td>Mirage</td>
<td>Comparative static/ increasing returns to scale</td>
<td>Harbinson proposal\textsuperscript{a}</td>
<td>0.42–0.74\textsuperscript{b}</td>
</tr>
<tr>
<td>Francois, van Meijl, and van Tongeren (2003)</td>
<td>GTAP variant</td>
<td>Steady-state/ comparative static</td>
<td>Agriculture 50%; constant returns to scale</td>
<td>28 17 11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Steady-state/ comparative static</td>
<td>Agriculture 100%; increasing returns to scale</td>
<td>97 39 58</td>
</tr>
<tr>
<td>Tokarick (2003)</td>
<td>GTAP</td>
<td>Comparative static</td>
<td>100%</td>
<td>128 98 30</td>
</tr>
</tbody>
</table>

\textsuperscript{a} The Harbinson proposal has two features. First, it is tiered so that higher tariffs face a proportionately higher cut. Second, it allows for special and differential treatment so that cuts by developing countries are less than cuts for developed countries. For developed countries Harbinson proposed a 40 percent reduction for tariffs under 15 percent, a 50 percent reduction for tariffs of 15–90 percent, and a 60 percent reduction for tariffs above 90 percent. Developing countries have four bands with a 25 percent reduction for tariffs below 20 percent, 30 percent reduction for tariffs of 20–60 percent, a 35 percent reduction for tariffs of 60–120 percent, and a 40 percent reduction for tariffs above 120 percent. The reductions are relative to the bound tariffs, not the applied—this is particularly important for developing countries, where the difference between applied and bound rates are large.

\textsuperscript{b} Percentage of baseline income.
still higher than Tokarick, at $128 billion, and Francois, van Meijl, and van Tongeren, at nearly $100 billion. Bouët and others do not report the dollar figures, but Beghin and van der Mensbrugge’s gain of $265 billion from global agricultural reform represents 0.6 percent of world income in 2015 and is thus in the mid-range of the percentage gains reported by Bouët and others.

Some of the discrepancies can be readily accounted for. Francois, van Meijl, and van Tongeren do a presimulation that includes China’s WTO accession commitments, so the baseline already incorporates a number of reforms that are not included in the baselines of some of the other studies. Both Bouët and others and Francois, van Meijl, and van Tongeren assume increasing returns to scale, except in agriculture. The increasing returns to scale are likely to have only modest impacts on the results since they are for agricultural liberalization only. The higher Armington elasticities used in the LINKAGE model also bias the results upward. It is unclear in the other models what elasticities are being used, though most are probably using some version of the relatively low GTAP version 5 elasticities. The Mirage model of Bouët and others uses two sets of elasticities. The standard elasticities—which they deem too low—yield the lower figure of a 0.42 percent increase in global income. Doubling the standard elasticity yields again of 0.74 percent.

A critical issue is the gains to developing countries. The results from Francois, van Meijl, and van Tongeren and Beghin and van der Mensbrughe are consistent, with relatively even sharing of the gains between developed and developing regions. This is somewhat surprising since the LINKAGE model is also picking up the gains from China’s accession commitments, which are significant, whereas these are included in the baseline of the other study. At the same time, both models are in some sense dynamic and are picking up trade-induced growth in investment. This impact would be assumed to be higher in developing countries, skewing the gains toward them. Tokarick’s results, on the other hand, are consistent with many GTAP applications. The low Armington elasticities will reinforce the negative terms of trade effects, particularly for food importers, dampening the positive efficiency gains for developing countries.

Finally, most of the reported results obscure the wide variations across regions—a point emphasized by Bouët and others. They go further, since their initial protection measures include existing trade preferences for developing countries—largely left out of the GTAP version 5 database. Thus, their results pick up significant losses for some developing regions in terms of trade and erosion of preferential access—for example, 0.85 percent for the Africa, Caribbean, and Pacific region and 0.56 percent for the rest of world. These losses are significantly dampened, however, by the doubling of the Armington elasticities, to 0.27 percent and 0.1 percent.

NOTE

1. It is important be bear in mind the distinction between the GTAP model and the GTAP database. Some researchers make adjustments to the database. For example, Bouët and others use a different source for protection measures. Most global general equilibrium models today are based on the GTAP data set. However, while there are significant similarities across models, many researchers use their own models for analysis and not necessarily that available through GTAP.

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**Box 2.2 Continued**
commodities traded, export and import position, and income level is required to identify the characteristics of countries that do not experience welfare gains. More effort is needed to identify why losses and gains occur and why there is such variability across countries.

The introduction of tariff rate quotas was an important achievement of the Uruguay Round in establishing a framework for improved market access. More analysis of tariff rate quotas is needed. The study by Vanzetti and Sharma makes a significant contribution to the understanding of the impacts of tariff rate quotas and how to include these changes in welfare calculations. It is important that different assumptions be tested, to determine how critical they are to the size of welfare gains.

There is a tendency for supporters of trade reform to exaggerate the benefits. While there is little doubt that the global gains from trade liberalization are positive, they are also modest. Trade liberalization also generates losers, and the transition costs of liberalization are often overlooked. Ignoring the needs of those who are likely to lose and the transition costs of structural change reinforce the opposition to reforms and make future changes more difficult.

NOTES

1. See Hertel (1997) for a description of the GTAP model.
3. See Rosegrant, Meijer, and Cline (2002) for a description of IMPACT.
5. It could have secondary impacts since there is no water left in the tariff. Hence importers and exporters may have less qualms about trade, given the decline in uncertainty about possible changes in tariffs.
7. Though the gains are in 1997 US dollars, they are reported relative to the 2008 baseline. Thus they would be even lower scaled to a 1997 base year.
8. The developed country–developing country split is already highly skewed toward the developed countries. The skew would be even greater if World Bank income classifications were used, since this would switch about $7.5 billion to the developed country aggregate.
9. Data exclude specific tariffs, so the tariff data for the European Union and Japan are biased downward. Ad valorem equivalents are being added for later analysis. EU data for tariff rate quotas include an average of within-quota and outside-quota rates, whereas data for other countries are outside-quota rates.
10. They are scaled by the factor of 1.03 raised to the power of –(2008–1997) = 0.72.
11. No attempt was made to harmonize the definitions of developed and developing countries, although most of the studies assume that developing countries include the Asian newly industrialized countries.
12. The scale factor is 1.03 raised to the power of –(2020–1997) = 0.51.
13. Another somewhat surprising result from the Rosegrant and Meijer model is that Latin American cereal farmers do not benefit in aggregate from increased market
opportunities in either full liberalization or developed country only liberalization scenarios. In the case of developed country only liberalization, net cereal imports by Latin America would actually increase.

14. Krivonos (2003) provides a more in-depth comparison of these other studies.
15. It does not include China's WTO accession commitments since these postdate 2001, though it does include any unilateral liberalization undertaken by China through 2001 in its progress toward accession.
16. The adjustment is based on the global economy growing at 3 percent a year, though projected growth is probably somewhat higher, lowering the adjusted gains.
17. Results from other simulations suggest that these baseline policy changes could account for a 20 percent difference in the results from global reform.
18. Anderson, Martin, and van der Mensbrugge (2005) provide a summary comparison of LINKAGE and GTAP using the new version 6 database. A more in-depth comparison of comparative static and dynamic results can be found in van der Mensbrugge (2004).
19. While the welfare gains in the studies examined have been modest, all of the reported results ignore significant potential dynamic gains in the form of improved productivity and scale economies that are believed to accompany trade liberalization.

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