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Reforming Agricultural Trade for Developing Countries

Alex F. McCalla and John Nash, Editors

VOLUME TWO

QUANTIFYING THE IMPACT OF
MULTILATERAL TRADE REFORM



THE WORLD BANK

Reforming AGRICULTURAL TRADE FOR DEVELOPING COUNTRIES

AGRICULTURE AND RURAL DEVELOPMENT

Reforming AGRICULTURAL TRADE FOR DEVELOPING COUNTRIES

Volume Two: Quantifying the Impact
of Multilateral Trade Reform

Alex F. McCalla & John Nash, editors



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PREFACE

This is one volume of a two-volume set titled *Reforming Agricultural Trade for Developing Countries*. The first volume is subtitled *Key Issues for a Pro-Development Outcome of the Doha Round*, because the chapters are for the most part focused on specific concerns that are being encountered in the agricultural negotiations, and on strategies for dealing with them to arrive at a final agreement that will significantly spur growth and reduce poverty in developing countries. The companion volume is subtitled *Quantifying the Impact of Multilateral Trade Reform*. It comprises chapters that take different approaches to modeling trade reform and quantifying the resulting benefits and costs to various players in the negotiations. The overview chapter of that volume explains the differences in results that come out of these different approaches, and compares them to some other recent estimates of the gains from global trade reform.

With few exceptions, the papers in these two volumes were first presented at a workshop, “The Developing Countries, Agricultural Trade, and the WTO,” sponsored by the International Agricultural Trade Research Consortium, the World Bank, and Agriculture and Agri-Food Canada, held in Whistler, British Columbia, in June 2002. Most of the papers have been revised and updated for this book. At the time of the workshop the Doha Round of multilateral trade negotiations was in its early days and a negotiating framework had not been proposed, so each paper invented its own scenario for evaluation.

Considering the amount of time that has elapsed since the conference, there might be some concern that the papers are now of limited, mainly historical, value. This is not the case. Progress in the Doha Round has been fitful and slow

and is now years behind schedule. The Cancun Ministerial Meeting in 2003 ended without agreement on a negotiating framework as some developing countries walked out because of a lack of movement on agriculture. The next deadline was the Ministerial Meeting in Hong Kong in December 2005. It too ended with a very limited agreement, the most significant accomplishment being the setting of a 2013 deadline for ending agricultural export subsidies. More recently, the WTO was forced to call for a *de facto* suspension of the Round, due primarily to the failure of members to agree on the next steps in the agricultural negotiations. Agricultural issues remain unresolved and continue to be of central importance to getting the Round back on track.

Such delays are not uncommon in trade negotiations. All recent multilateral trade rounds—Uruguay, Tokyo, and Kennedy—have been delayed, always by impasses on agricultural trade liberalization. Agriculture was pulled from the table to enable the Kennedy Round to reach conclusion, minimal progress was made in the Tokyo Round, and only a last minute deal between the United States and the European Union salvaged the Uruguay Round, three years late. The Doha Round is perhaps more complicated because there are new power blocs at the table, but that may also help to get an agreement in the end. In the Kennedy and Tokyo Rounds, agriculture was essentially a bilateral confrontation between the United States and the European Union. What progress there was made in the Uruguay Round in getting agriculture under the rules of the WTO can be attributed in part to the emergence of a third player, the Cairns Group of agricultural exporters. In the Doha Round more groups—such as the Group of 20 developing countries (G-20), the Group of 33, and the Group of Least Developed Countries—have emerged as developing countries themselves have become major players (see chapter 5 by Rashid S. Kaukab in volume 1 for a road map). In the G-20, countries like Brazil, China, India, and South Africa are involved in shaping the negotiations and should play a stronger role in determining the ultimate agreement.

Thus, the issues addressed in these two volumes, policy issues for developing countries, country experience, and the quantitative analysis of potential gains—are if anything more relevant to developing countries now than they were in 2002. The quantitative analyses involved projections of potential gains into the future at least until 2010, so they remain useful.

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CHAPTER ONE

Agricultural Trade Reform and Developing Countries: Issues, Challenges, and Structure of the Volume

Alex F. McCalla and John Nash

On July 27, 2006, the World Trade Organization's (WTO) Director-General, Pascal Lamy, recommended an indefinite time-out in the Doha Round negotiations. Mr. Lamy warned that this could be a lost opportunity to integrate more vulnerable members into international trade, thereby forgoing "the best hope for growth and poverty alleviation," and could lead to a resurgence of protectionism. While the time-out is unfortunate for many reasons, it is important to recognize that it does not imply the death of the Doha Development Agenda. The multilateral trading system has faced challenges before, including similar circumstances and fears during the Uruguay Round, and has reemerged with renewed strength. The challenge now is to find the political will to bridge negotiating gaps and resume negotiations promptly. In any case, there should be no backsliding on progress that had already been made in the negotiations—such as the offer to eliminate agricultural export subsidies by 2013 and provide duty-free/quota-free access for exports from least developed countries—nor on other promises made outside the negotiations per se, such as commitments of Aid for Trade in order to help poor countries integrate into the global economy. At a time like this, it should also be kept firmly in mind that regardless of what happens in the multilateral discussions, all countries can benefit from reforming their own trade regimes. Countries should carefully consider stepping up trade reforms as part of strategies to promote economic efficiency and growth and reduce poverty, or to stem budgetary waste.

This chapter provides a summary of some of the issues that are fundamental to the Doha negotiations themselves and to the eventual implementation of an agreement. The first two sections explore two critical questions: Why are agricultural trade reforms important, and what will it take to ensure a pro-development and pro-poor outcome from the Doha negotiations? But it is not only important to reach agreements on trade reform at the global level. The reform programs also have to be properly designed and executed. So the third section shifts the focus from the multilateral negotiations to the design of agricultural trade policy reforms at the country level. The final section of this introduction provides a road map to the rest of this volume.

WHY ARE AGRICULTURAL TRADE REFORMS IMPORTANT?

Among the many reasons that agricultural trade reforms are important, two stand out: the importance of agriculture in developing countries and the slow growth of agricultural trade from developing countries to developed countries.

Agriculture Is Especially Important to Developing Countries

It is now well established that agricultural development is critical to developing countries, especially the least developed. Agriculture remains the largest employer, the largest source of GDP, and the largest source of exports and foreign exchange earnings in many developing countries. About 75 percent of poor people worldwide reside in rural areas, and most of them are dependent on agriculture. The rural poverty rate exceeds the urban rate by a large margin in almost all developing countries for which Poverty Reduction Strategy Papers have been prepared (table 1.1). While agriculture declines relative to the rest of a growing economy as incomes improve, its growth is absolutely critical at early stages of development, and it can often drive export-led growth.

Table 1.1 Rural-Urban Poverty Gap																								
Poverty Rates	Burkina Faso	Uganda	Mauritania	Tanzania	Mozambique	Niger	Zambia	Gambia	Ethiopia	Ghana	Malawi	Cambodia	Vietnam	Mongolia	Kyrgyzstan	Georgia	Honduras	Nicaragua	Yemen	Nepal	Sri Lanka			
Rural	51	46	68	50	71	66	80	61	47	34	67	40	57	33	70	10	51	69	45	44	27			
Urban	17	16	25	24	62	52	56	48	37	27	55	21	26	39	49	12	57	31	31	23	15			
Difference	34	30	43	26	9	14	24	13	10	7	12	19	31	-6	21	-2	-6	38	14	21	12			

Source: Calculations from Poverty Reduction Strategy papers for each country.

A vibrant agricultural sector is therefore crucial to reducing poverty through economic growth, as well as improving global food security and conserving natural resources (Ingco and Nash 2004). Agricultural trade reform to better integrate this sector into global markets is equally crucial to developing countries for a number of reasons. Trade liberalization fuels prosperity (Ingco and Nash 2004 have a brief survey of this literature). Agriculture has the highest levels of trade distortions and therefore the greatest potential for gains from reform. And domestic reforms necessary to implement trade reforms benefit developing countries more than developed countries.

Relatively Slow Growth of Agricultural Trade from Developing Countries to Developed Countries Is a Problem

World trade has been booming over the past two decades, and developing countries' share of the total pie has been expanding. The share of developing countries in exports of manufactured goods to industrial countries has risen dramatically, as has their share in exports of manufactured goods to developing countries (table 1.2). Their share of agricultural exports in trade to other developing countries has also risen, although not as much as in manufactured products. But the share of developing countries in agricultural exports to the industrial world has stagnated. Of course, simple statistics such as these cannot prove a causal link, but they are consistent with the hypothesis that developed economies' barriers to agricultural trade have effectively stifled this segment of global trade.

So, developing countries potentially have a lot to gain from global trade reform. Recent estimates are that developing country income would be some 0.8 percent higher by 2015 than it otherwise would be if all merchandise trade barriers and agricultural subsidies were removed between 2005 and 2010, with about two-thirds of the total gain coming from agricultural trade and subsidy reform (Anderson, Martin, and van der Mensbrugghe forthcoming; Hertel and Keeney 2006). The high share of the gains attributable to agriculture may seem

Table 1.2 Share of Developing Countries' Exports in World Trade

	1980/81	1990/91	2000/01
Total agricultural exports	35.4	32.2	36.3
To developing countries	9.5	8.9	13.4
To industrial countries	25.8	23.3	22.9
Total manufacturing exports	19.3	22.7	33.4
To developing countries	6.6	7.5	12.3
To industrial countries	12.7	15.2	21.1

Source: United Nations Statistics Division, Comtrade database.

surprising, since agriculture contributes only about 4 percent of world GDP and 9 percent of merchandise trade. But the sector's importance in trade reform is magnified by the much higher protection of agricultural products than manufactured products in countries all over the world.

Some analysts have pointed out that net agricultural importers—particularly net food importers in Africa—will suffer a static balance of payments loss from the negative terms of trade effect as world market prices rise and that many low-income countries that receive preferential access to developed country markets will see their competitive advantage from the preferences reduced (Panagariya 2004). These points are true, of course, but they are only part of the story. First, liberalization will also change the prices of other goods—manufactured goods imported and exported by these countries, as well as their agricultural exports. General equilibrium simulations (taking into account preferences) of a full global liberalization show that these changes will have a positive impact more than large enough to offset the negative terms of trade effect of the rise in food prices, so the net effect will be small, but positive (Anderson, Martin, and van der Mensbrugghe forthcoming). Second, when trade is liberalized, developing countries will benefit from improvements in their market access in other developing countries—particularly important since these barriers are larger than those in the industrial countries, and developing countries are particularly important for developing country exporters. Third, liberalization will benefit the rural sectors of these countries, where poverty is concentrated, because of higher world agricultural prices. Net farm incomes are predicted to rise by an average of 7 percent for Africa as a whole. The bottom line effect on poverty (defined as those earning less than \$1 a day) would be to lift almost 32 million people out of poverty worldwide, about two-thirds of them in Sub-Saharan Africa.

Furthermore, the dynamic impact of improved functioning of world markets on overall growth in GDP in countries that liberalize their markets should help even net food importers. Tangermann (2005), in a recent more comprehensive look at the impact of developed country agricultural trade liberalization on least developed net food importing countries, came to similar conclusions.

While preference erosion is a legitimate concern, it is a major issue for only a few countries. Anderson and Martin (2006b) show that preference erosion will have a significant negative impact on only a handful of countries and that the impact is so small for most poor countries that it could be easily compensated by modest increases in aid. Hoekman, Martin, and Braga (2005), in a review of the literature, cite several studies estimating that the aggregate annual income losses to the least developed economies would be on the order of \$200–\$300 million—not trivial, but not a serious concern for the majority of countries. This consideration does not undermine the case for liberalization, but it does argue that the international community should be ready to provide transitional assistance for negatively affected countries.

WHAT IS IMPORTANT TO ENSURE A PRO-DEVELOPMENT AND PRO-POOR OUTCOME FROM THE DOHA NEGOTIATIONS?

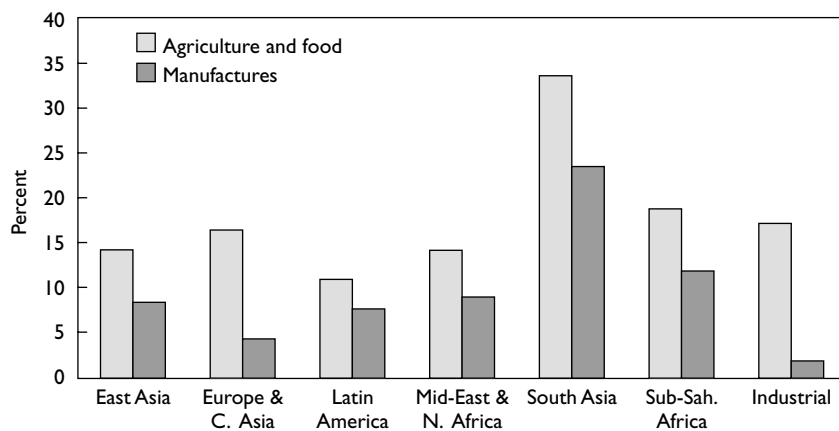
Recognizing the importance of the negotiations, developing countries have emerged as a powerful force. One of the more striking differences between the ongoing Doha Round negotiations and previous multilateral rounds is the much greater leverage of developing countries, due at least in part to their large and growing share of world trade. This became evident, if it had not been before, at the Ministerial Meeting in Cancún in 2003. There the G-20 not only successfully insisted on dropping three of the four “Singapore Issues” (investment, competition, government procurement, and trade facilitation) from the negotiations, but also refused to go along with the proposal on agriculture that had been negotiated in advance by the United States and the European Union (albeit at the behest of other WTO members), leading to the eventual breakdown of the meeting without an agreement. Later, in July 2005, the power of the G-20 was recognized when other WTO members agreed to accept their proposal on market access, which had been elaborated at a meeting of developing countries in Dalian, China, as the basis for further discussions in this sensitive area.

The voices of the developing countries are clearly being heard. This is certainly as it should be, given that Doha is being billed as a “development round.” Nonetheless, it remains to be seen whether this influence will be translated into a final agreement that is truly more development-friendly. What would be the key ingredients in such a final outcome of the negotiations?

A Need for Significant Reductions in Agricultural Barriers and Subsidies in High-Income Countries

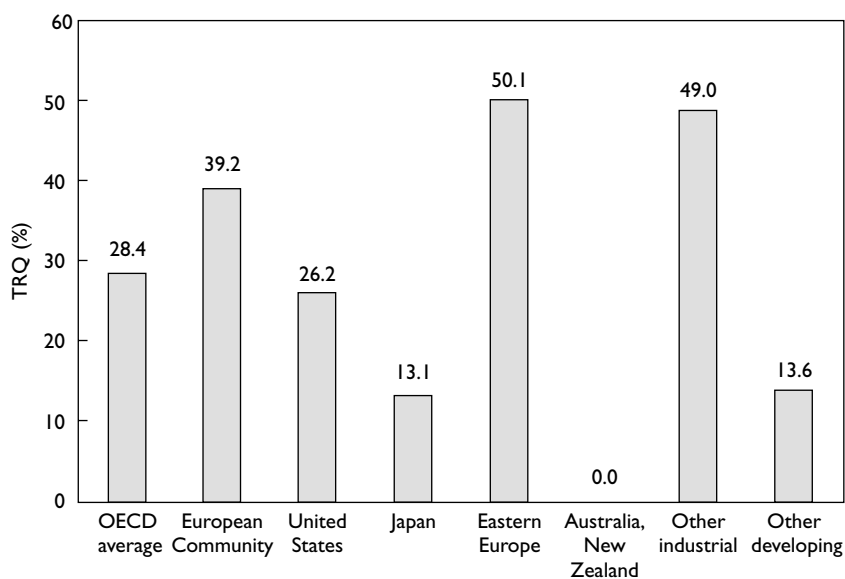
The many loopholes in the Uruguay Round Agreement on Agriculture (URAA) and how they were exploited to keep high-income markets heavily protected, are well documented.¹ Tariffs remain much higher in agriculture than in manufactured products (figure 1.1). While this pattern is characteristic of trade regimes in all regional groups, the discrepancy is most remarkable in high-income countries. But the level of tariffs, while high, greatly understates the degree of protection in the trade regimes in high-income countries because many products are afforded even higher levels of support by nontariff measures such as export subsidies and tariff rate quotas, which are applied to products covering close to 30 percent of agricultural production in these countries (figure 1.2). Tariff rate quota systems and the nontransparent mechanisms through which they operate create an additional layer of protection and more difficulties for developing country exporters (de Gorter and Kliauga 2006). The antidevelopment bias of the trade regimes is amplified by the extent to which tariff structures are escalated, with higher rates applied as the degree of processing increases (figure 1.3), discouraging developing country exporters

Figure 1.1 Average Tariffs, by Region, 2003



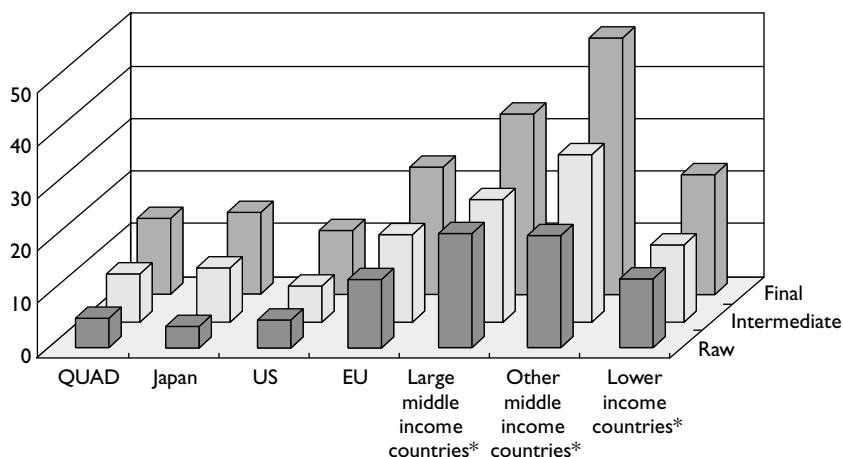
Source: Global Trade Analysis Project, release 6.03.

Figure 1.2 Coverage of Tariff Rate Quotas, 2003



Source: OECD, Agricultural Market Access Database (AMAD).

Figure 1.3 Tariffs Escalate in Final Products



Source: World Trade Organization Integrated Database, 2001.

Note: Tariffs are most recent year reported, 1999–2001.

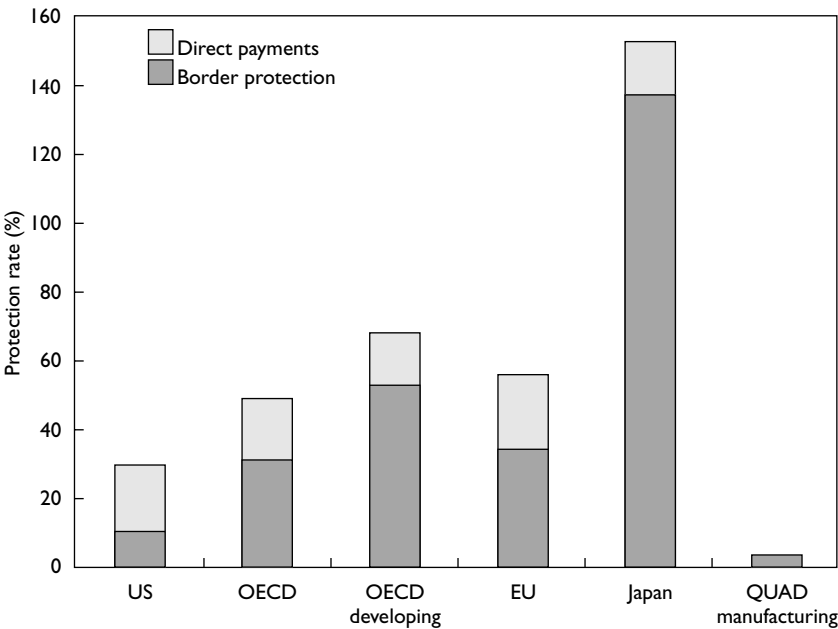
from moving up the value chain. And finally, while most protection is given through some form of trade measure, substantial additional support is provided by direct budgetary payments to farmers (figure 1.4).

One lesson from implementation of the URAA is that the political economy of agricultural protection in high-income countries is such that when reduction is required in one mechanism of trade-distorting support, another mechanism often pops up to replace it. Given the array of support instruments available, it follows that to guarantee increased trade opportunities for developing countries, the agreement must include strict disciplines on all fronts.

The negotiations produced an early breakthrough on *export competition*, one of the three pillars of agricultural negotiations, agreeing that the target should be a complete phase-out of export subsidies. At the Hong Kong Ministerial Meeting in December 2005 one of the few agreements was to fix the date as 2013. Thus, the value of this reform will be spread over a long time frame and will depend on how disciplines are extended to cover indirect forms of export subsidies, including export credit, the operations of state trading enterprises, and food aid. That food aid is a subject of negotiation is surprising to some, but an examination of historical patterns shows clearly that aid has been used as a means of dumping surplus production. Food aid has been most abundant when it has been least needed (when world market prices are low) and vice versa (figure 1.5).

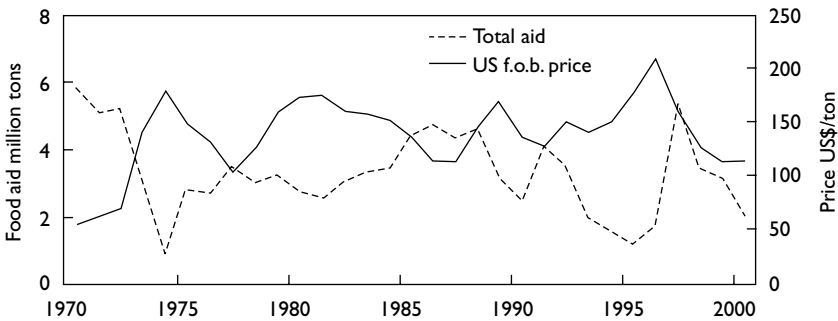
On *market access*, the second pillar, covering tariffs and nontariff barriers to imports, the basic approach has been to reduce tariffs by a tiered formula that reduces higher tariffs proportionately more than lower tariffs. This is poten-

Figure 1.4 Border Protection and Direct Payments in High-Income Countries, 2000–2002



Source: OECD 2003, *Agricultural Policies in OECD Countries: Monitoring and Evaluation*.

Figure 1.5 Food Aid and World Prices



Source: USDA and World Bank.

tially a great improvement over the “average cuts” approach of the URAA, which allowed countries to maintain extremely high tariffs on some crops. But the benefits will be small if the final agreement does not use a numerical formula that requires truly significant cuts in tariffs and forecloses use of the designations “sensitive” and “special” to shield many products from the cuts required under the general formula.

Recent research indicates that if as little as 2 percent of each country’s tariffs lines (on the most sensitive products) were shielded and subjected to relatively small cuts, the benefits of the overall reform would be virtually nil (Jean, Laborde, and Martin 2006). Finally, disciplines on the use of tariff rate quotas will need to be improved (de Gorter and Kliauga 2006). Anderson and Martin (2006b) note that the overwhelming majority of the benefits in an agreement will come from improving market access, although the other pillars remain important, if for no other reason than to avoid “re-instrumentation” of protection when market access barriers are reduced.

On the third pillar, *domestic support*, some of the URAA loopholes were implicitly recognized early. Agreement was reached to impose caps and eventually reduce product-specific support (to prevent the support shifting that characterized the URAA implementation) and to review the rules for classifying support as “green box,” which exempts it from reduction commitments. There was also an early agreement to cut support through a tiered formula, so the countries with the highest levels of support would make larger cuts. Progress since then has been slow. The key to ensuring that the agreement reduces the antitrade distortions created by the domestic support system will be to force significant cuts in the amber box (with cuts that really “bite” for all products), while also imposing more stringent disciplines on the blue box and the green box—where much future support will be channeled—to ensure that domestic support really is “non- or minimally trade distorting,” as it is required to be.

These points are not surprising, but what may not be generally recognized is the magnitude of the cuts that must be imposed to really make much of a difference. The cuts seem likely to be made using as a baseline the end-point values of the URAA. Because this agreement was not very ambitious, most countries are currently using support levels that are far below their allowable ceilings. Thus, simulations indicate that even a cut as seemingly draconian as 75 percent would force the major subsidizing countries to cut their amber box support by relatively small amounts—for example, the European Union by 16 percent and the United States by 28 percent (Jensen and Zobbe 2006).

Liberalization by Developing Countries Is Required as Well

Liberalization is also required by developing countries both because it is in their own direct interest and because it is necessary for progress in the negotiations. Reforms of trade and macroeconomic policies that obstruct trade are incomplete in most developing countries, although many countries have made

substantial progress in recent years. The Doha Round represents an opportunity for developing countries to push their own trade policy reform agenda forward, while at the same time increasing their leverage in the negotiations through full engagement. It would be counterproductive for developing countries to try to opt out of all commitments. Ultimately, you get what you pay for in trade talks. A pro-development outcome is more likely in the WTO framework, in which all countries are involved in the negotiations, than in bilateral negotiations with countries with superior negotiating leverage.

That said, however, it is clear that developing countries need to be accorded special treatment in the negotiations based on their development needs. But such “special and differential treatment” should focus on development objectives, with actions linked to specific institutional or capacity-building problems, rather than on blanket exemptions from obligations to reduce trade barriers. It could also focus on positive obligations of developed countries to provide aid to overcome institutional challenges in developing country efforts to comply with their multilateral trade agreements.

Negotiations Need to Recognize that Structural Food Security Is Generally Reduced, Not Enhanced, by Trade Barriers to Food Imports

Food insecurity is a product of poverty and the consequent insufficient purchasing power. It cannot be adequately addressed by trade measures that restrict imports in order to encourage domestic food production. Trade policy can affect structural food security, properly defined, in several ways. First, global liberalization may cause a structural increase in global food prices, thereby reducing the ability of poor people to buy sufficient food. This is a legitimate concern as a long-term issue, although its importance is often exaggerated. Any structural effects will be realized only gradually, as the agreements reached in the Doha Round are implemented, giving significant adjustment time. In addition, there will be a reduction in the volatility of world prices, so both producers and consumers can manage risks better. Nevertheless, this is an issue that should be taken up in the negotiations, with the objective of finding ways to help the poor deal with higher prices.² Second, trade liberalization (multilateral and unilateral) should increase the purchasing power of the poor by raising incomes. Liberalization resulting from successful negotiations would lift millions out of poverty, greatly improving food security. Third, trade policy at the national level may increase or reduce the price of food, affecting poor producers and consumers in opposite ways.

Unfortunately, rather than focusing on the first two linkages with the global trading system, the concept of food security has been used in the Doha negotiations primarily to suggest that developing countries should be allowed to maintain high barriers to imports of food products as a means of increasing

national production, under the rubric of “special products” or as a component of the “development box.”

This kind of import-substitution policy creates an antiexport bias and is unproductive or counterproductive in the long run for a number of reasons:

- By keeping domestic food prices high, it imposes a regressive tax, undermining the food security of urban and rural poor.
- It encourages farmers to continue to plant low-value food crops instead of diversifying into high-value nontraditional exports, which is often a better road out of poverty.³ In many countries these policies also reduce the demand for labor in rural areas, since import-substitute crops tend to be less labor intensive than exports, particularly nontraditional exports (Valdés and Foster 2003).
- By creating an antiexport bias, it reduces the foreign-exchange earning potential of the country, undermining its structural capacity to import food and other products.
- It diverts attention from methods of support for agriculture that have been proven to be much more productive, such as increased spending on infrastructure or research and extension, and from investments in domestic food distribution systems (Diaz-Bonilla, Diao, and Robinson 2003).
- The rural poor benefit from the protection of food crops less than might appear because the poorest are (in most countries) landless and are therefore harmed in their capacity as net consumers, and the next poorest class are generally self-sufficient (noncommercial) producers, who neither gain nor lose. Of course, to the extent that the rural landless rely for employment on commercial food crop production, raising food prices benefits them as laborers.⁴
- The pure “subsistence” farmers targeted by proponents of “special” products benefit little, if at all, from policies that raise farm prices. They are, by definition, not significant sellers of food.
- It diverts attention from how to use the global trading system to make all consumers more food secure by disciplining the practice of export taxation or controls by food-exporting countries in periods of high world prices and by disciplining abuse of food aid, which has at times made developing countries dumping grounds for the surplus production of rich countries, thereby undermining food production and marketing channels.
- From a global viewpoint, it is particularly damaging for trade among developing countries, which has great potential for many countries.

The Global Cotton Market Requires Special Attention, through Both Trade Reform and Development Assistance

A global deal that curtails trade-distorting subsidies and raises global prices is particularly important for cotton because of its direct effect on improving

incomes of some of the world's poorest farmers. But in addition to trade reform, many of these same countries will need technical and financial assistance to ensure a supply response to new price incentives that a pro-poor Doha deal might bring. Some have suggested targeting such assistance at development of downstream industries dependent on cotton, such as textiles and garments, as a way of helping cotton farmers. But it seems unlikely that such a strategy would yield significant benefits, for several reasons. First, unless the demand created by the local industry is sufficient to absorb all domestic supplies of the raw material, the price will be set at the margin by the export sales. That is, the price to cotton producers would not be increased. In fact, the history of attempts to develop processing industries suggests that the opposite might happen, as governments have often placed controls or taxes on exports of primary products to keep domestic prices low as a means of subsidizing development of the downstream industry. In addition, it appears that there is limited potential for textile and garment industry development in the West African countries in the short run because of infrastructural and institutional constraints. A good strategy for donors, therefore, would be to focus initiatives not on downstream industries, but rather on primary cotton production, while also testing the potential for downstream development with appropriate preferential trade policy.

HOW TO DESIGN, SEQUENCE, AND IMPLEMENT TRADE POLICY REFORM AT THE COUNTRY LEVEL

A perennial issue in agricultural policymaking in developing countries is how to design, sequence, and implement trade reforms—whether a result of unilateral decisions or of multilateral or bilateral negotiations—so as to minimize negative effects on losers and ensure a supply response.⁵ This issue is not unique to agriculture, of course. But it resonates even more strongly in this sector for two reasons: (1) because of the perception that domestic protection that raises internal agricultural prices reduces rural poverty and improves food security, and (2) that it protects domestic producers from the impacts of depressed and volatile world agricultural commodity prices due largely to protectionism and subsidies by high-income countries. This creates pressure for “reactive protectionism” by some developing countries that would otherwise be able to compete in world markets.

Before the 1980s the trade and macroeconomic policies of developing countries had on average an antiexport and antiagricultural bias, due to overvalued exchange rates, heavy protection of industrial sectors, operation of state-owned enterprises, and explicit taxation of export commodities (Krueger, Schiff, and Valdés 1991). Largely as a result of structural adjustment and stabilization programs since the mid-1980s, these biases appear to be weaker

now—perhaps even reversed—although comprehensive empirical evidence awaits collection.

However, implicit barriers—including high tariffs on imports of manufactures—still obstruct primary export sector development in many countries. Although average agricultural tariffs in developing countries have been reduced over the past two decades (from about 30 percent in 1990 to less than 20 percent in 2000), in some countries (especially middle-income countries) relatively high tariffs on agricultural imports still create an antiexport bias in agriculture (see figure 1.1).

In this context, how should developing countries carry out trade reforms? Given the benefits of export-oriented growth, any remaining explicit policy barriers to exports should be removed as a high priority.⁶ Possible exceptions may be cases where exporters cannot be taxed through more efficient mechanisms and are not already being implicitly taxed at high rates (for example, through protection of the country's import-competing sectors). A number of behind-the-border measures—including investment, capacity building, and institutional reforms—are also needed in most developing countries to encourage agricultural export development, especially of nontraditional products.

While reform of import barriers is more controversial, it is clear that governments should not as a long-term strategy maintain high import barriers (tariffs or nontariff barriers) in the name of food security or in support of an import-substitution agricultural development strategy, for the reasons set out above.

Still, immediate deep unilateral reduction in agricultural trade taxes is not always appropriate. Policy design will depend on the characteristics and conditions of the country and commodity. Some considerations on which this design may depend include:

- *The size of the sector.* Where the sector is a modest part of the economy, any unemployed labor may be rapidly reabsorbed, so liberalization will be minimally disruptive.
- *The pattern of protection.* Where agricultural protection is uneven (high protection focused on a few “sensitive” commodities), the case for reducing it is stronger, since it will be easier for farmers and laborers to move to the large number of commodities that are not experiencing a reduction in price, subject to technical substitutability and the availability of start-up capital.
- *Effects on labor markets.* Many export crops—especially nontraditional ones—are more labor-intensive than import substitutes, and so the net effect on labor demand should be positive when protection of import substitutes is reduced. (But to facilitate development of these markets, behind-the-border measures may be especially important.) It is also essential to consider whether urban and rural labor markets are well integrated, and whether rural areas have other employment opportunities outside of agriculture.

Off-farm employment in food processing and services may have a bigger impact on the wages of unskilled labor than does agriculture (Valdés and Foster 2003).

- *A realistic assessment of the degree of protection needed to compensate for global distortions.* It is often argued that protective tariffs are needed to compensate for world prices that are artificially depressed by protectionist policies in other countries. Since these prices will rise with global liberalization, the argument goes, tariffs are needed until global liberalization occurs in order to avoid irreparably damaging a production base that will be competitive in the long run—or to avoid adjustment costs when capital and labor markets are imperfect. The argument itself is of dubious economic merit, but if it is used to justify tariffs, the size of the tariffs should have some analytical underpinning. For most commodities the price increases with global liberalization are expected to be moderate—on the order of 10 percent or less, so that the tariffs implied by this argument would be fairly modest. For some of the most distorted markets—sugar and dairy are examples—the increases from full liberalization would be larger, but these are unlikely to be fully liberalized soon in any case.
- *Fiscal implications.* In a few countries trade taxes, while an inefficient way to raise revenue, are important. In such cases tariff reductions may need to be more gradual and coordinated with fiscal adjustments.
- *Complementary behind-the-border policies.* Such policies may be needed to provide safety nets and facilitate adjustment. High-income countries have compensated farmers for reductions in protection through direct, decoupled (and WTO-compliant) area-based payments. In countries where this is feasible, tariff reductions (and phase-outs of other subsidies) can be carried out quickly.⁷ Mexico and Turkey show that this is a practical approach even in some developing countries.⁸ However, in developing countries with liquidity constraints, direct payments may not be affordable, or the necessary institutions (in particular, a land registration system) may not be in place. Reductions in protection may need to be more gradual. Whatever compensatory policies are adopted, other policy reforms and investments—both inside and outside the agricultural sector—should be considered to complement trade policy reforms. Some investments of this kind could be important components of the “Aid for Trade” agenda associated with the Doha Round.
- *The characteristics of the production structure.* When production is mainly by small, resource-poor farmers who will have difficulty adjusting their cropping patterns or diversifying their income sources, reduction of protection may need to be more measured, with greater attention to collateral policies. Where large commercial farmers hire a large quantity of labor, there may be some transient negative impact on the poor, particularly if labor markets are not functioning well. In the medium run, however, commercial farmers would generally be expected to have less difficulty moving into other crops and, as noted above, a switch to export crops should absorb more labor.

ROADMAP FOR THE VOLUME

The remaining seven papers in this volume present six different analyses of potential impacts of trade liberalization using two different modeling approaches and six different models. These chapters are preceded by a review and synthesis chapter which will allow the reader to probe those papers of greatest interest. The six analytic papers address one of the most frequently asked questions about liberalization: What would developing countries gain if the Doha Round resulted in significant progress in liberalizing under each of the three pillars? Three chapters report results from partial equilibrium models, two use general equilibrium models, and one uses both.

Chapter 2 by H. Bruce Huff, Ekaterina Krivonos, and Dominique van der Mensbrugghe presents a comprehensive overview and synthesis of the following six chapters. The authors note the rich diversity in the papers in regional and commodity coverage, the time dimension (static or dynamic), elasticities used in the models, and model specifications regarding the nature of competition. They use either general or partial equilibrium theoretical frameworks and therefore provide rich comparative insights into the different impacts of these various dimensions.

Yet despite these differences this chapter finds that the quantitative analyses reach several similar conclusions. All conclude that global welfare increases with liberalization, and the studies find gains of similar magnitude for agriculture. However, the gains are generally small and regional gains go mainly to regions where countries have participated in the multilateral process and have engaged in domestic reform as well. Commodity prices all rise, but the magnitudes of the increases vary significantly across products. And developing countries have much more to gain from increased market access to developed country markets than they do from developed countries' reducing domestic support or export subsidies. Overall, then the following papers offers many insights into who gains and who loses in trade liberalization.

Chapters 3, 4, and 5 all use partial equilibrium analysis to explore impacts. **Chapter 3** by Bernard Hoekman, Francis Ng, and Marcelo Olarreaga uses a partial equilibrium model containing 119 countries and 158 products to explore two scenarios: a 50 percent reduction in agricultural tariffs and a 50 percent reduction in domestic support. Their conclusion is that tariff reductions are five times more valuable to developing countries than are comparable reduction in domestic support.

The next three chapters all address the same scenarios: (1) full liberalization by developed countries only, (2) full liberalization by developing countries only, (3) full liberalization in all countries, and (4) partial (50 percent) liberalization in all countries.

Chapter 4 by Mark W. Rosegrant and Siet Meijer uses the International Food Policy Research Institute's (IFPRI) International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) with 36 countries and

regions and 16 commodities to analyze the four scenarios. The commodity richness of the model allows concluding that global liberalization has stronger effects on volume, prices, and the regional distribution of trade in milk and dairy products as compared to cereals. Full liberalization generates global benefits of \$24.4 billion, \$10 billion to developed countries and \$14.4 billion to developing countries.

Chapter 5 by David Vanzetti and Ramesh Sharma looks at the same four scenarios using Food and Agriculture Organization's (FAO) partial equilibrium model, which contains 161 countries and 36 commodities. Their models contain by far the largest number of countries and commodities and present a rich array of distributional insights. They confirm the IFPRI model's conclusions that livestock products, particularly dairy products, and wheat experience the largest price increases with full liberalization. This should be expected as these are highly protected sectors. Their estimate of global welfare gain from full liberalization is also \$24 billion but it is distributed very differently, \$6 billion to developing countries and \$18 billion to developed countries.

The next three chapters use general equilibrium analysis for some or all of their analysis.

Chapter 6 by Betina V. Dimaranan, Thomas W. Hertel, and Will Martin presents the first general equilibrium (GE) analysis using the Global Trade Analysis Project (GTAP) model with 23 regions and 28 sectors to explore the impacts of the same four scenarios as were used in chapters 4 and 5. One advantage of a general equilibrium approach is that economy-wide effects can be explored. This paper, for example, produces results that suggest that with full liberalization, global agricultural exports would increase by more than 10 percent while those of manufacturing and services would increase by 5 percent. Clearly removal of the much higher levels of protection in agriculture have strong impacts on trade levels. The estimated level of global welfare gains using a GE approach is double those generated by the preceding two partial models. The estimate is \$58 billion overall gains, with \$42.3 billion to developed countries and only \$15.8 billion to developing countries.

The next two chapters are reprints of papers whose results were presented at the Whistler conference. **Chapter 7** reprints a paper by Ivan Roberts, Benjamin Buetre, and Frank Jotzo of the Australian Bureau of Agricultural and Resource Economics (ABARE) that uses ABARE's Global Trade and Environment Model (GTEM) general equilibrium model with 66 regions and 62 sectors to evaluate six scenarios. The scenarios range from modest reductions in both developed (30 percent) and developing (20 percent) countries to 20 percent increases in both. The scenario with the largest reductions only generates gains in GDP, \$7 billion in developed countries and \$5 billion in developing countries. Under this scenario developing country exports increase 8 percent to developed countries and 4 percent to developing countries. The analysis supports the notion that reductions have to be substantial before major gains for developing countries will occur.

Chapter 8 reprints a comprehensive Organization for Economic Co-operation and Development (OECD) paper that uses a combination of OECD (Aglink) and FAO partial equilibrium models which are rich in detail on OECD countries and comprehensive in coverage of 115 developing countries. It also compares these results with the GTAP model. Their scenarios analyze another round of cuts in the three pillars of the same magnitude as the URAA. The combination of the two partial models allows for a complex number of comparisons of impacts among 11–14 types of countries. These produce a rich menu of insights. The comparison of the partial equilibrium analysis with GTAP shows that both analyses of liberalization produce only modest changes in prices; however, the partial analysis shows livestock prices increasing more than cereals (2–7 percent vs. 1 percent) while GTAP suggests the opposite, that is, cereal prices rising more than livestock product prices. The great advantage of this paper is the detailed comparisons that are presented.

A CLOSING COMMENT: PUTTING THIS QUANTITATIVE ANALYSIS IN A BROADER PERSPECTIVE

While it is of considerable interest to compare results among the several studies included in the present volume, it is of equal importance to place these in the context of other quantitative studies of the effects of global trade reform. The overview chapter also does this, examining why even studies carried out by the same institution—in this case, the World Bank—sometimes arrive at seemingly very different results. This can be due to differing underlying assumptions regarding key parameters of the models themselves (e.g., the Armington elasticities, which govern the response of trade flows to changes in prices), or because some databases capture the effects of trade preferences. But differences also arise because studies use different baseline years from which the prospective “gains” are measured. Recent studies based on the Global Trade Analysis Project (GTAP) database use 2001 as the baseline, rather than 1997, the baseline for earlier GTAP studies. Global trade reform made considerable progress between 1997 and 2001, so some of the gains that were in the future from the perspective of 1997 have already been captured in the baseline of 2001. Thus, it is not the case that the gains from trade were overestimated in the earlier analyses, nor underestimated in the later ones, as some have suggested. Viewed in this light, any “reduction in benefits” from trade reform in more recent studies is more ephemeral than real.

NOTES

1. Both World Bank (2004b) and Ingco and Nash (2004) document and quantify this in detail. See also the World Bank Trade website www.worldbank.org/trade, especially de Gorter and others (2003); de Gorter, Ingco, and Ignacio (2003); de Gorter, Ingco, and Ruiz (2003); and Martin (2004).

2. At the end of the Uruguay Round, when this problem was recognized, the WTO convened a committee to seek solutions. While this has not been an urgent issue, given that the URAA did not lead to sweeping liberalization, it may become more pressing if the Doha Round does.
3. See World Bank (2003, pp. 48–50) for a discussion of export and food crop production.
4. This is not to say that such support increases the aggregate demand for labor, since it also reduces employment in other industries. The net effect is not obvious.
5. For discussions of the World Bank's trade policy advice for agricultural trade, see World Bank (2004a).
6. For a recent discussion of the advantages of export-oriented agricultural growth to accelerate sectoral growth and reduce poverty, see Valdés and Foster (2003).
7. To the extent possible, this needs to be done with a credible commitment to keep tariffs low. Otherwise, it may set up perverse incentives for lobbying to raise tariffs in the future not only to collect the initial rents, but also to collect the compensation when the tariffs are later reduced.
8. Care must be taken to ensure that these do not become permanent drains on the budget or distract from more productive forms of public expenditure in the sector. The medium-term vision should be a phase-out of such payments and gradual integration of poor farmers into a national targeted safety net system. Baffes and de Gorter (2005) examine lessons of experience in direct income support, which can be useful in designing new schemes.

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CHAPTER TWO

Review and Synthesis of Empirical Results of Studies of World Trade Organization Agricultural Trade Reform

**H. Bruce Huff, Ekaterina Krivonos,
and Dominique van der Mensbrugghe**

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.¹ 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.⁴ 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, Buetre, 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-

Box 2.1 Comparing Model Results—Methods and Pitfalls

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.⁷ 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.⁸ 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,⁹ 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, Buetre, 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

Table 2.1 Comparison of Welfare Impacts of Five Studies (US\$ billions)

Study	Full agricultural liberalization			Partial agricultural liberalization			Year
	Developed countries	Developing countries	Total	Developed countries	Developing countries	Total	
Dimaranan, Hertel, and Martin	35	−5	30	22	−1	21	2008
<i>Adjusted</i>	25	−3	21	16	−1	15	1997
Hoekman, Ng, and Olarreaga				15	2	17	Comparative static
Rosegrant and Meijer	10	14	24	5	7	11	2020
<i>Adjusted</i>	5	7	12	2	3	6	1997
Vanzetti and Sharma	18	6	24	15	3	19	Comparative static
Roberts, Buetre, and Jotzo	—	—	—	7	5	12	2010
<i>Adjusted^a</i>	—	—	—	10	7	16	1997

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 Mensbrugghe 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.¹⁵ 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 model¹⁶ 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.¹⁷

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

Box 2.2 Consistency of Model Studies in the Volume with Other General Equilibrium Results

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 LINK-AGE 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)

Study	Model	Time framework	Scenario	Welfare effects (US\$ billions)		
				Global	Developed countries	Developing countries
Beghin and van der Mensbrugghe (2005)	LINKAGE	2015	All sectors	385	188	196
		Adjusted, 1997	Agriculture 100%	265	137	128
			Agriculture 100%	155	80	75
Bouët and others (2003)	Mirage	Comparative static/ increasing returns to scale	Harbinson proposal ^a	0.42–0.74 ^b		
Francois, van Meijl, and van Tongeren (2003)	GTAP variant	Steady-state/ comparative static	Agriculture 50%; constant returns to scale	28	17	11
		Steady-state/ comparative static	Agriculture 100%; increasing returns to scale	97	39	58
Tokarick (2003)	GTAP	Comparative static	100%	128	98	30

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.

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 Mensbrugghe'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 Mensbrugghe 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.¹ 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 to 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.

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.¹⁹ 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.
2. See Hoekman, Ng, and Olarreaga (2002) for a description of the World Bank model.
3. See Rosegrant, Meijer, and Cline (2002) for a description of IMPACT.
4. See documentation for Aglink in OECD (1996).
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.
6. See documentation for GTEM at www.abareconomics.com/research/models/GTEM/GTEM.htm.
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 Mensbrugghe (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 Mensbrugghe (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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CHAPTER THREE

Reducing Agricultural Tariffs or Domestic Support: Which Is More Important for Developing Countries?

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Developing country agricultural exports are limited by high tariffs in many countries. Domestic support for farmers in high-income economies also hurts developing country exporters to the extent that it boosts domestic production, depresses world prices, exacerbates the volatility of world prices, and reduces the scope for import competition. High tariffs and domestic support policies may, however, benefit net importers of agriculture products in developing countries by providing access to the subsidized commodities at lower prices.¹

Thus, national interests regarding reform of agricultural trade and support policies by industrial countries will differ.² Most analyses conclude, however, that the overall gain to developing countries from reforming agricultural policies greatly outweighs the potential costs to countries that are significant net importers of subsidized agricultural products. An important policy question for developing countries, therefore, is to determine which instruments of agricultural protection are most detrimental to their interests and where to direct their negotiating efforts in the current World Trade Organization (WTO) negotiations on agriculture.

This chapter assesses the relative impact of tariffs and domestic support policies on exports and welfare in developing countries. Specifically, it assesses

the impact of a 50 percent global reduction in agricultural tariffs and compares this to a 50 percent cut in domestic support.³ In welfare terms tariffs matter significantly more than subsidy policies—tariff reductions generate substantially greater welfare gains.⁴ In large part this is because of high tariff peaks in industrial countries and because developing countries also use tariffs to protect domestic production. But this is not to imply that negotiations should therefore emphasize tariffs over domestic support policies.

A major political economy problem confronting WTO negotiators is how to create incentives for countries to liberalize agricultural trade. Most developing countries oppose further liberalization in an environment of continuing large-scale support for industrial country farmers. Experience has demonstrated that the market-segmenting effect of industrial country subsidy policies has attenuated the gains from the country's own liberalization. In some cases a country's own liberalization has proven to be politically unsustainable because farmers are subjected to large world price swings and surges in imports of subsidized commodities—India is an example (see chapter 9 in volume 1 by Gulati and Narayanan). Substantial reductions in agricultural support in industrial countries are therefore important both for generating direct benefits for the many (potential) net exporting developing economies and for creating the conditions to allow developing countries to pursue domestic reforms and benefit from them.

The analysis here uses a partial equilibrium framework and a sample of 120 countries to estimate the impact of policy changes on world prices of agricultural commodities that benefit from domestic support in at least one WTO member. Only products that benefit from domestic support are included so as not to bias the findings. Because most countries apply tariffs to all agricultural products, not just those that are subsidized, any comparison of the effect of reducing tariffs on all agricultural goods with the effect of reducing support measures would conclude that tariffs are more important for developing countries. The partial equilibrium approach permits isolating the effects of policy changes on individual countries, including the low-income and least developed economies that are of particular concern to the development community (most of these countries are subsumed in regional aggregates in applied general equilibrium models). The partial equilibrium approach also allows the use of disaggregated trade and protection data—in this case at the six-digit level of the Harmonized System (HS).

TARIFFS AND DOMESTIC SUPPORT IN AGRICULTURE

Agricultural products are often subject to tariff peaks of 100 percent or higher (Hoekman, Ng, and Olarreaga 2002). In the majority of industrial countries the average most-favored nation tariff is more than twice as high for agricultural products as for manufactures. Many high-income countries also subsidize domestic agriculture. According to WTO data, 158 commodities at the HS

six-digit level benefit from domestic support in at least one WTO member. Large-scale domestic support is used primarily by industrial countries, especially the European Union, Japan, and the United States. Industrial countries account for 88 percent of domestic support payments. If the Republic of Korea and transition economies such as Poland are excluded, developing countries account for only 10 percent of domestic support reported to the WTO during 1995–96 (table 3.1). Major subsidizers among developing countries include Brazil, Thailand, and Venezuela. Not surprisingly, the least developed countries report virtually no domestic support. Meat, dairy, cereal, and sugar account for the lion's share of domestic support, representing almost 80 percent of reported nonexempt domestic support (WTO categories DS4-9; table 3.2).

The average tariff on these subsidized products is about 18 percent, with peaks of 100–200 percent in many countries (table 3.3). Average tariffs are distributed fairly uniformly across major product categories, with the highest applying in dairy and sugar (and alcoholic beverages—a special case given the use of tariffs for excise purposes; table 3.4). These sectors also have the highest levels of domestic support. A number of countries make intensive use of specific tariffs for agricultural imports. As a consequence, statutory average ad valorem most-favored nation tariffs understate tariff protection, especially for the European Union and Japan.⁵ The analysis in this chapter estimates ad valorem equivalents of specific tariffs for the 158 tariff lines examined, drawing on data reported in Stawowy (2001) and OECD (2000). Because estimates of ad valorem equivalents for Switzerland are incomplete and unreliable, Switzerland is excluded from the analysis (Switzerland relies almost completely on specific tariffs).

The global pattern of agricultural protection and support has different effects on net producers and net consumers of the affected commodity. A first cut at identifying the likely implications of protectionist policies for individual countries is to calculate the relative importance of exports and imports of the products that are subsidized by at least one WTO member. These data reveal that the least developed countries are much more affected than other countries: subsidized goods constitute 18 percent of their exports on average compared with 3–4 percent for other countries (table 3.5) and 9 percent of their imports compared with 3–4 percent for other countries. For many least developed countries the potential incidence of subsidies is very high. Thus, for countries such as Benin, Burkina Faso, Burundi, Chad, Malawi, Mali, Rwanda, Sudan, Tanzania, Uganda, and Zimbabwe goods that constitute 60–80 percent of their total exports are subsidized by one or more WTO members. Since these countries also tend to have preferential access (mostly duty-free) to the European market through the Generalized System of Preferences and the Everything but Arms initiative, this pattern suggests that subsidies are an important issue for WTO negotiations (subsidies are not covered by preferential access agreements).⁶ However, this inference ignores the depressing effects of tariffs by major WTO members on world prices, as well as the impact of countries' own tariffs—issues that are explored empirically below.

For some countries the ratio of imports of subsidized goods to total imports is higher than the ratio of exports of subsidized goods to total exports (see table 3.5). Affected economies are quite varied in per capita income and include Bangladesh, Comoros, Egypt, The Gambia, Guinea, Jordan, the Republic of Korea, Maldives, Mauritania, Morocco, Nigeria, Oman, Saudi Arabia, Senegal, Taiwan (China), Tunisia, and Venezuela. In such cases global liberalization may have short-run negative effects on the terms of trade or welfare to the extent that import prices are lower because of subsidies.

Domestic agricultural support measures reported to the WTO comprise a mix of instruments and measures. The major distinction is between measures that are exempted from WTO reduction commitments under the Uruguay Round Agreement on Agriculture and those that are not.⁷ Exempted measures include green box support measures whose use is permitted for developing countries, and payments under production-limiting programs (including blue box measures), which include measures that directly support production.

Because the focus here is on comparing the effect of border protection (tariffs) with domestic subsidies on a product-by-product basis, WTO aggregate measurement of support data is used for the analysis because it does not include the effect of border barriers. Several limitations of these data should be recognized, however (see appendix). One problem is the short time period for which data are available. Another is the incomplete reporting, especially for more recent years. In addition, the economic relevance of the time series is limited by the use of the fixed 1986–88 benchmark for calculating price support. However, assuming that changes in world prices over time have a proportional effect on the aggregated measurement of support figures of all WTO members, the double log specification used to estimate import demand and export supply and the focus on percentage changes in variables should avoid a major bias in the results.

ANALYTICAL FRAMEWORK

A simple partial equilibrium model is used to estimate the impact on exports and welfare of a reduction in tariffs and domestic support. World markets are assumed to be perfectly competitive and integrated, with no further scope for arbitrage across countries. Products traded in world markets under the same HS six-digit classification are considered to be perfectly homogeneous.⁸ Each six-digit product category represents only a small share of the economy, so that the effect on other product markets of changes in a particular category is negligible.⁹

Import demand for each HS six-digit product of country c is given by:

$$m_c = \frac{a_c}{[p_w(1 + t_c)(1 + \tau_c)]^{\varepsilon^d} s_c^{\lambda^d}} \quad (1)$$

Table 3.1 Total Domestic Support Notifications to WTO by Country Income Group, 1995–98 (US\$ millions)

Income group and country ^a	Green box (exempt) ^b DS1–DS3				Domestic support ^b DS4–DS9				Total (DS1–DS9) ^{b, c}			
	1995	1996	1997	1998	1995	1996	1997	1998	1995	1996	1997	1998
Industrial countries (9)	145,069	139,650	77,971	4,730	119,094	114,118	37,725	3,980	264,163	253,767	115,696	8,711
Canada	1,529	1,463	n.a.	n.a.	1,482	5,306	n.a.	n.a.	3,011	6,769	n.a.	n.a.
European Union (15)	51,833	55,360	n.a.	n.a.	66,743	65,905	n.a.	n.a.	118,577	121,265	n.a.	n.a.
Japan	33,691	25,905	21,919	n.a.	37,686	30,952	26,544	n.a.	71,377	56,858	48,464	n.a.
Norway	1,771	1,762	1,562	1,560	1,559	1,645	1,505	1,459	3,329	3,407	3,068	3,019
Switzerland	2,299	2,404	2,121	2,191	3,625	2,964	2,374	2,257	5,924	5,368	4,494	4,448
United States	53,071	51,825	51,249	n.a.	7,699	7,074	7,050	0	60,770	58,899	58,299	
Developing countries^d (81)	21,484	18,468	17,439	7,208	16,418	7,269	13,279	10,971	37,902	25,737	30,718	18,179
Brazil	5,241	2,872	3,739	n.a.	295	363	307	n.a.	5,536	3,235	4,046	n.a.
Colombia	450	719	426	n.a.	58	4	14	n.a.	508	723	441	n.a.
Israel	292	414	338	n.a.	533	559	554	n.a.	825	973	892	n.a.

Korea, Rep.	5,200	6,481	6,133	3,858	3,057	2,872	2,711	1,674	8,257	9,353	8,844	5,532
Poland	436	549	878	851	254	227	292	302	691	776	1,170	1,154
South Africa	763	525	544	n.a.	617	654	542	n.a.	1,380	1,179	1,086	n.a.
Thailand	1,568	2,106	1,738	1,160	633	510	534	397	2,202	2,616	2,272	1,556
Venezuela	730	657	675	n.a.	3,064	794	1,054	n.a.	3,793	1,450	1,730	n.a.
Least developed countries (30)	12	112	3	61	0	0	0	0	12	112	3	61
All countries	166,565	158,230	95,413	11,999	135,512	121,387	51,004	14,951	302,077	279,617	146,417	26,950
As share of total												
Industrial countries (9)	87.1	88.3	81.7	39.4	87.9	94.0	74.0	26.6	87.4	90.8	79.0	32.3
Developing countries (81)	12.9	11.7	18.3	60.1	12.1	6.0	26.0	73.4	12.5	9.2	21.0	67.5
Least developed countries (30)	0.0	0.1	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2

Source: Based on WTO (2000).

n.a.—Not applicable.

a. Number of countries in parentheses. A total of 120 countries notified to WTO during 1995–98. (European Union is counted as one.)

b. Measures that are exempt for developing countries and policies covered by production-limiting program.

c. Includes price support. See text for discussion and description.

d. Excludes least developed countries.

Table 3.2 WTO Member Commitments and Average Levels of Direct Domestic Support for 1995–98 (nonexempt)

Product at Harmonized System two-digit level	Value (US\$ millions)		Share of total (percent)	
	Commitment	Average 1995–98	Commitment	Average 1995–98
01 Live animals	250	63	0.1	0.1
02 Meat and edible meat offal	60,155	14,907	22.3	18.5
04 Dairy products; birds' eggs; honey	39,372	11,557	14.6	14.3
06 Live trees and other plants, bulbs; cut flowers	0	14	0.0	0.0
07 Edible vegetables and roots and tubers	10,326	3,975	3.8	4.9
08 Edible fruit and nuts; melons	7,879	3,474	2.9	4.3
09 Coffee; tea; maté; and spices	1,272	50	0.5	0.1
10 Cereals	104,109	27,953	38.5	34.6
11 Milled products; malt; starches	421	142	0.2	0.2
12 Oilseed; oleaginous fruits	8,577	447	3.2	0.6
13 Lac; gums, resins, and other vegetables	0	0	0.0	0.0
15 Animal and vegetable fats and oils and products	1,899	1,050	0.7	1.3
17 Sugars and sugar confectionery	12,370	5,304	4.6	6.6
18 Cocoa and cocoa preparations	16	0	0.0	0.0
20 Preparations of vegetable, fruit, and nuts products	892	529	0.3	0.7
21 Miscellaneous edible preparations	0	0	0.0	0.0
22 Beverages, spirits, and vinegar	4,306	1,172	1.6	1.5
23 Residues and waste from food industry	382	192	0.1	0.2
24 Tobacco and manufactured tobacco substitutes	2,662	735	1.0	0.9
50 Silk	416	14	0.2	0.0
51 Wool, fine and coarse animal hair	124	17	0.0	0.0
52 Cotton	3,411	655	1.3	0.8
53 Other vegetable textile fibers and yarns	34	71	0.0	0.1
98 Nonproduct specific	11,276	8,392	4.2	10.4
Total	270,151	80,714	100.0	100.0

Source: Based on WTO (2000).

Note: Direct domestic support is defined as the sum of WTO DS4–DS9 categories; see text.

Table 3.3 Most-Favored-Nation Tariff and Maximum Tariff on Products Benefiting from Domestic Support, 1995–98
Average by Country (including ad valorem equivalent of specific tariffs; percent)

Country	Applied most-favored-nation tariff	Maximum tariff
Developed countries	19	1,403
Australia	1	7
Canada	30	1,403
EU 15	22	219
Iceland	9	61
Japan	51	865
New Zealand	1	10
Norway	19	555
United States	14	121
Developing countries^a	17	1,050
Albania	14	30
Algeria	24	45
Antigua and Barbuda	27	40
Argentina	9	21
Bahrain	7	120
Barbados	22	40
Belize	24	40
Bolivia	10	10
Brazil	9	33
Cameroon	23	30
Chile	11	11
China	28	114
Colombia	14	20
Congo, Rep.	21	30
Costa Rica	13	103
Côte d'Ivoire	17	35
Cuba	9	30
Czech Republic	11	124
Dominica	22	40
Dominican Republic	17	35
Ecuador	13	20
Egypt, Arab Rep	31	1,050
El Salvador	13	25
Gabon	23	30
Ghana	19	25
Grenada	20	40
Guatemala	12	20
Guyana	25	100
Honduras	14	30
Hungary	30	85
India	28	185
Indonesia	13	104

(continued)

Table 3.3 (Continued)

Country	Applied most-favored-nation tariff	Maximum tariff
Iran, Islamic Rep.	3	15
Israel	4	22
Jamaica	25	40
Jordan	23	180
Kenya	22	50
Korea, Rep.	46	284
Latvia	10	45
Lithuania	8	71
Malaysia	8	257
Malta	3	40
Mauritius	20	80
Mexico	15	171
Morocco	45	362
Nicaragua	8	38
Nigeria	27	75
Oman	2	5
Pakistan	36	70
Panama	11	50
Papua New Guinea	38	85
Paraguay	9	25
Peru	16	25
Philippines	22	58
Poland	14	44
Romania	21	144
Russian Federation	9	25
Rwanda	25	100
Saudi Arabia	11	65
Slovenia	9	49
South Africa	7	55
Sri Lanka	33	60
St. Kitts and Nevis	21	40
St. Lucia	22	40
Suriname	22	50
Taiwan, China	18	50
Thailand	41	65
Trinidad and Tobago	20	40
Tunisia	33	43
Turkey	28	145
Uruguay	10	24
Venezuela	13	20
Zimbabwe	26	68
Least developed countries	20	300
Bangladesh	40	300
Burkina Faso	21	37
Central Africa	20	30

(continued)

Table 3.3 (Continued)

Country	Applied most-favored-nation tariff	Maximum tariff
Chad	22	30
Madagascar	7.5	20
Malawi	18	45
Maldives	16	50
Mali	19	30
Mozambique	15	35
Solomon Islands	40	100
Sudan	8	30
Tanzania	29	40
Uganda	13	36
Zambia	17	25
All listed countries	18	1,403

Sources: UNCTAD TRAINS tariff data (through World Bank WITS), OECD (2000), and Stawowy (2001).

Note: Economies with zero tariffs not reported (Brunei, Estonia, Hong Kong, Kyrgyz Republic, and Singapore).

a. Excludes least developed countries.

where ε^d is import demand elasticity (common to all countries), p_w is price in the world market, t_c is the tariff in country c , τ_c is the average transport cost from country c to the world market,¹⁰ s_c is the producer support in country c ¹¹ λ^d is the elasticity of import demand to the producer support through domestic supply (common to all countries), and a_c is a demand parameter in country c that captures size and all other factors influencing import demand.

Export supply for each HS six-digit product of country c is given by:

$$x_c = b_c \left[\frac{p_w}{(1 + \tau_c)} \right]^{\varepsilon^s} s_c^{\lambda^s} \quad (2)$$

where ε^s is the export supply elasticity (common to all countries), λ^s is the elasticity of export supply with respect to domestic support (common to all countries),¹² and b_c is a supply parameter that captures size and other determinants of export supply. The transport cost to world markets is also common among exporters and importers of the same product. The presence of tariffs and domestic support measures may lead to both imports and exports of a homogeneous product for a country.

The equilibrium world price is obtained under these world market clearing conditions:

Table 3.4 Most-Favored-Nation Tariff and Maximum Tariff on Products with Domestic Support, 1995–98 Average by Product (percent)

Product at Harmonized System two-digit level	Most-favored-nation tariff	Maximum tariff
01 Live animals	11.6	555.0
02 Meat and edible meat offal	21.0	361.5
04 Dairy products; birds' eggs; honey	29.4	349.5
06 Live trees and other plants, bulbs; cut flowers	16.2	249.0
07 Edible vegetables and roots and tubers	24.0	865.4
08 Edible fruit and nuts; melons	20.0	238.9
09 Coffee; tea; maté; and spices	16.7	559.3
10 Cereals	21.8	719.1
11 Milled products; malt; starches	31.1	1,402.8
12 Oilseed; oleaginous fruits	11.2	686.0
13 Lac; gums, resins, and other vegetables	10.8	65.0
15 Animal and vegetable fats and oils and products	15.3	188.0
17 Sugars and sugar confectionery	26.6	209.0
18 Cocoa and cocoa preparations	9.0	55.0
20 Preparations of vegetable, fruit, and nuts products	23.0	162.8
21 Miscellaneous edible preparations	32.1	302.4
22 Beverages, spirits, and vinegar	36.7	1,050.0
23 Residues and waste from food industry	7.1	45.0
24 Tobacco and manufactured tobacco substitutes	20.1	257.3
50 Silk	23.4	235.8
51 Wool, fine and coarse animal hair	6.3	54.9
52 Cotton	5.2	35.3
53 Other vegetable textile fibers and yarns	5.9	52.5
Total (all items with positive domestic support)	18.4	1,402
All agricultural products	19.8	1,772

Sources: UNCTAD TRAINS tariff data (through World Bank and UNCTAD WITS), OECD (2000), and Stawowy (2001).

**Table 3.5 Trade in Domestically Supported Agricultural Products
by Country, 1995–98 Averages**

Country	Value (US\$ millions)		Share of total (percent)	
	Exports	Imports	Export	Imports
Albania	24	74	8.8	8.2
Algeria	5	1,902	0.0	20.0
Angola	12	139	0.3	7.2
Antigua and Barbuda	3	9	6.0	2.8
Argentina	6,251	603	25.6	2.3
Australia	9,384	843	17.0	1.4
Bahrain	2	71	0.1	3.7
Bangladesh	90	805	2.2	12.7
Barbados	46	40	21.9	5.9
Belize	70	16	46.6	5.9
Benin	230	57	84.7	5.9
Bolivia	137	95	11.3	5.2
Brazil	6,494	3,968	13.1	6.7
Brunei	1	56	0.0	1.8
Bulgaria	333	276	6.9	5.4
Burkina Faso	130	35	75.5	7.9
Burundi	76	19	72.8	10.9
Cameroon	422	114	24.7	8.6
Canada	7,023	3,918	3.4	2.1
Central African Republic	48	5	24.8	4.4
Chad	109	5	82.5	3.5
Chile	2,225	542	14.2	3.2
China	3,243	5,471	1.9	4.0
Colombia	3,460	1,031	32.0	7.2
Comoros	0	13	0.1	24.3
Congo, Dem. Rep.	147	76	10.6	8.6
Congo, Rep.	21	35	1.1	3.9
Costa Rica	1,361	257	37.5	5.9
Côte d'Ivoire	1,835	299	48.7	11.0
Croatia	101	411	2.2	5.0
Cuba	745	337	50.7	13.4
Cyprus	115	160	24.5	4.2
Czech Republic	443	1,001	1.9	3.6
Djibouti	3	34	9.5	9.9
Dominica	21	7	57.7	7.1
Dominican Republic	469	414	10.2	7.4
Ecuador	1,457	258	31.2	5.7
Egypt, Arab Rep.	387	2,319	11.0	17.1
El Salvador	485	236	42.0	8.3
Estonia	158	237	6.3	6.3
EU15	17,375	38,075	2.2	4.9
Fiji	222	46	37.9	6.5
Gabon	2	43	0.1	4.9
Gambia, The	2	41	11.0	17.5

(continued)

Table 3.5 (Continued)

Country	Value (US\$ millions)		Share of total (percent)	
	Exports	Imports	Export	Imports
Ghana	494	115	32.4	4.7
Grenada	4	12	14.5	7.2
Guatemala	1,081	271	48.6	7.2
Guinea	38	99	7.8	19.1
Guinea-Bissau	31	4	39.8	4.2
Guyana	182	27	33.1	6.7
Haiti	29	127	12.2	14.9
Honduras	385	194	43.9	9.0
Hong Kong, China	22	2,964	0.1	1.5
Hungary	955	455	5.6	2.3
Iceland	148	54	7.9	2.6
India	2,782	964	8.4	2.4
Indonesia	1,394	3,396	2.8	8.9
Iran, Islamic Rep.	163	1,102	1.0	10.3
Israel	876	938	4.1	3.3
Jamaica	229	136	12.1	5.5
Japan	312	15,850	0.1	4.9
Jordan	53	397	6.2	12.3
Kazakhstan	0	0	0.0	0.0
Kenya	790	210	48.7	8.4
Korea, Rep.	400	4,727	0.3	3.6
Kuwait	4	277	0.0	4.0
Kyrgyz Republic	83	24	24.1	4.7
Latvia	32	143	2.0	5.7
Lithuania	227	244	6.7	5.0
Macao	6	51	0.3	2.5
Madagascar	77	45	26.6	7.8
Malawi	361	17	75.7	4.4
Malaysia	354	2,457	0.5	3.4
Maldives	1	26	2.1	8.3
Mali	255	35	84.5	5.8
Malta	20	81	1.2	3.0
Mauritania	4	72	0.7	13.8
Mauritius	401	185	24.6	8.5
Mexico	3,066	4,317	3.0	4.3
Mongolia	48	10	12.0	2.2
Morocco	481	1,204	9.0	13.8
Mozambique	0	0	0.0	0.0
Myanmar	284	27	23.6	1.0
New Zealand	3,194	412	24.1	3.0
Nicaragua	239	110	40.0	8.7
Niger	34	48	17.2	12.9
Nigeria	277	431	1.8	7.5
Norway	116	980	0.3	2.8
Oman	45	281	0.7	5.8
Pakistan	536	543	7.0	6.7
Panama	244	121	38.8	4.1

(continued)

Table 3.5 (Continued)

Country	Value (US\$ millions)		Share of total (percent)	
	Exports	Imports	Export	Imports
Papua New Guinea	351	36	15.1	2.6
Paraguay	568	109	55.1	3.5
Peru	1,144	778	19.3	9.6
Philippines	1,468	1,388	5.6	4.5
Poland	672	1,917	2.7	4.9
Qatar	1	64	0.0	2.3
Romania	403	424	4.9	3.8
Russian Federation	931	3,227	1.4	6.9
Rwanda	42	40	59.0	18.2
Saudi Arabia	77	2,045	0.1	6.3
Senegal	44	221	7.6	16.1
Sierra Leone	12	17	6.6	8.7
Singapore	677	1,449	0.6	1.2
Slovak Republic	197	332	2.1	3.0
Slovenia	79	343	0.9	3.6
Solomon Islands	20	2	9.1	1.7
South Africa	1,496	902	6.4	3.2
Sri Lanka	81	405	2.1	9.1
St. Kitts and Nevis	14	6	77.5	5.6
St. Lucia	45	17	63.8	5.3
St. Vincent and Grenadines	28	13	57.3	10.5
Sudan	290	127	60.1	8.6
Suriname	46	23	11.6	5.5
Switzerland	398	2,496	0.5	3.2
Taiwan, China	247	3,820	0.2	3.6
Tanzania	448	63	67.8	5.0
Thailand	3,938	1,715	7.0	2.8
Togo	103	40	42.5	6.3
Trinidad and Tobago	50	160	2.1	6.4
Tunisia	223	553	4.0	6.9
Turkey	2,565	2,147	10.5	5.0
Uganda	349	73	63.3	7.5
United Arab Emirates	225	782	1.0	3.1
United States	31,450	15,475	5.2	1.8
Uruguay	575	211	23.0	6.2
Venezuela	171	938	0.8	8.0
Zambia	76	30	8.1	4.0
Zimbabwe	1,057	61	59.3	3.0
All listed countries (129 countries)	136,483	151,021	3.6	3.7
Industrial countries (9 countries)	69,400	78,103	3.1	3.3
Developing countries (90 countries)	63,781	70,616	4.2	4.2
Least developed countries (30 countries)	3,302	2,302	17.8	8.9

Source: Based on UN Comtrade statistics.

$$p_w^e = \underset{p_w}{\operatorname{argsol}} \left[\sum_c m_c - \sum_c x_c = 0 \right] = \left[\frac{\sum_c \frac{a_c}{[(1+t_c)(1+\tau_c)]^{\epsilon^d} s_c^{\lambda^d}}}{\sum_c \frac{b_c s_c^{\lambda^s}}{(1+\tau_c)^{\epsilon^s}}} \right]^{1/(\epsilon^s + \epsilon^d)} \quad (3)$$

The change in the world equilibrium price following a reduction in tariffs is obtained by taking the total differential of equation 3 with respect to τ_c . The percentage change in the world price with respect to a common percentage change in tariffs in all countries is then:

$$\hat{p}_w^e = - \frac{\epsilon^d}{\epsilon^d + \epsilon^s} \hat{t} \left[\frac{\sum_c \frac{t_c}{(1+t_c)} \frac{a_c}{[(1+t_c)(1+\tau_c)]^{\epsilon^d} s_c^{\lambda^d}}}{\sum_c \frac{a_c}{[(1+t_c)(1+\tau_c)]^{\epsilon^d} s_c^{\lambda^d}}} \right] \quad (4)$$

where \wedge denotes the percentage change in the variable.

Similarly, the percentage change in world prices following a common percentage change in subsidies is:¹³

$$\hat{p}_w^e = - \frac{\hat{s}}{\epsilon^d + \epsilon^s} \left[\lambda^d \frac{\sum_c \frac{s_c - 1}{s_c} \frac{a_c}{[(1+t_c)(1+\tau_c)]^{\epsilon^d} s_c^{\lambda^d}}}{\sum_c \frac{a_c}{[(1+t_c)(1+\tau_c)]^{\epsilon^d} s_c^{\lambda^d}}} + \lambda^s \frac{\sum_c \frac{s_c - 1}{s_c} \frac{b_c s_c^{\lambda^s}}{(1+\tau_c)^{\epsilon^s}}}{\sum_c \frac{b_c s_c^{\lambda^s}}{(1+\tau_c)^{\epsilon^s}}} \right]. \quad (5)$$

The change in export and import revenue associated with a change in tariffs or domestic support is given by:

$$\begin{aligned} \hat{x}_c^r &= (1 + \epsilon^s) \hat{p}_w + \lambda^s \hat{s}_c \frac{s_c - 1}{s_c} \\ \hat{m}_c^r &= -(\epsilon^d - 1) \hat{p}_w - \epsilon^d \hat{t} \frac{t_c}{1+t_c} - \lambda^d \hat{s}_c \frac{s_c - 1}{s_c} \end{aligned} \quad (6)$$

where x_c^r is the percentage change in export revenue in country c , and m_c^r is the percentage change in import revenue in country c . Note that if there is no producer support or tariffs in country c , there will be no change in export or import revenue in the country, apart from those induced by the change in world price after other countries have reduced their tariffs or producer support.

Finally, the change in welfare in an importing and exporting country can be measured by taking the integral of the import demand and export supply functions with respect to world prices and tariffs (it is assumed that domestic support is a transfer from government revenue to producers). The change in exporters' and importers' welfare relative to their initial export and import revenue is then given by:

$$\begin{aligned}\hat{w}_c^x &= \frac{1}{1 + \varepsilon^s} \left((1 + \hat{p}_w)^{\varepsilon^s+1} - 1 \right) \left(1 + \hat{s} \frac{s_c - 1}{s_c} \right)^{\lambda^s} \\ \hat{w}_c^m &= \frac{1}{(\varepsilon^d - 1)} \left(\frac{1}{\left(1 + \hat{p}_w + \hat{t} \frac{t_c}{1 + t_c} \right)^{\varepsilon^d-1}} - 1 \right) \frac{1}{(1 + t_c)^{\varepsilon^d} \left(1 + \hat{s} \frac{s_c - 1}{s_c} \right)^{\lambda^d}} + \quad (7) \\ &\quad t_c \hat{m}_c^r + \hat{t} \frac{t_c}{1 + t_c}\end{aligned}$$

where w_c^x is the change in welfare in an exporting country relative to initial export revenue,¹⁴ and w_c^m is the change in welfare in an importing country relative to the initial import revenue. The first term on the right side of equation 7 is the change in import consumer surplus and the second term is the change in tariff revenue. Note that changes in welfare in equation 7 take into account shifts of domestic import demand and export supply functions following changes in domestic tariffs and domestic support (when relevant). The overall change in welfare can be obtained by adding the two expressions in equation 7 after normalizing the two terms to the same base (exports, imports, total trade, or dollars per capita).

EMPIRICAL METHODOLOGY

First, import demand and export supply elasticities are estimated with respect to prices and subsidies (ε^d , ε^s , λ^d , and λ^s). Next, demand and supply parameters (a_c and b_c) are calibrated for each country and product (at the HS six-digit level). Finally, the elasticities and calibrated parameters are used to measure the changes in world prices, export revenue, import revenue, and welfare following a 50 percent reduction in agriculture tariffs and domestic support in all countries.

While the elasticities could be estimated from import demand and export supply functions 1 and 2, these are simultaneously determined in a country. Moreover, "world" prices are not observed, only export and import unit prices in each country, which include transport costs. If traded quantities are measured with error (which is likely as customs generally are more concerned with value), unit prices will also be measured with error, which may bias the results. To avoid these problems, the net import demand function is estimated as the log difference of import demand and export supply. With the import demand

and export supply functions in equations 1 and 2, this translates into estimating a stochastic version of:

$$\log(m^r) - \log(x^r) = \log(a_c) - \log(b_c) - \varepsilon^d \log(1 + t_c) - (\varepsilon^d - \varepsilon^s) \log(1 + \tau_c) - (\lambda^d + \lambda^s) \log(s_c). \quad (8)$$

GDP and population in each country are used as controls for a_c and b_c . Product dummy variables at the HS six-digit level are also included.

The elasticities estimated using a stochastic version of equation 8 is then used to calibrate a_c and b_c using equations 1 and 2. Changes in world prices, import revenue, export revenue, and welfare are estimated using equations 4–7.

Data on import and export revenue and tariffs are from the World Bank and United Nations Conference on Trade and Development World Integrated Trade Solutions (WITS) database at the HS six-digit level. The WTO aggregate measurement of support data is from the WTO, based on member notifications (WTO document G/AG/NG/S/1, April 13, 2000). These data, which are based on an arbitrary product classification, were concorded to the HS classification (see the appendix). Nine categories of domestic support are to be notified to the WTO (box 3.1).

Only 30 WTO members have made domestic support reduction commitments under the Uruguay Round Agreement on Agriculture (URAA), but all members are required to notify domestic support. Compliance is weak, however. Only 75 percent of WTO members that were required to notify did so in 1997 and the share dropped to about 50 percent in 1996 and 1997—and to only 28 percent in 1999 (as of March 2000). However, most countries that did not notify in 1997–98 had very little or no support in 1995–96, so coverage of the data spans the major users. To address the incomplete reporting problem, average aggregate measurement of support values are used for whatever years are available. The empirical analysis therefore involves an unbalanced panel.

There are two problems with estimation of equation 8. Transport costs are not directly observable, and the elasticity of import demand and export supply with respect to subsidies cannot be empirically determined separately but only their sum. Assuming that transport costs to the world market are equal for exporters and importers, these costs can be proxied by the ratio of export and import unit prices. As long as the measurement error in unit prices is identical for exports and imports, the problems described above are addressed. On the second issue, elasticities of import demand and export supply are assumed to be equal with respect to subsidies. A justification for this is that in both cases their effect occurs *only* through domestic supply.¹⁵

RESULTS

Estimations of the price and domestic support elasticity of export supply and import demand are reported first and then the results of the simulation exercise.

Box 3.1 Domestic Support Categories under the WTO Aggregate Measurement of Support

Domestic support notified to the WTO includes exempt and nonexempt measures in nine categories, designated DS1 through DS9:

Exempt categories

DS1: Measures that WTO members have placed in the green box and that are therefore exempt from reductions.

DS2: Measures in developing countries that are exempt from reduction commitments under Article 6.2 of the URAA relating to development programs.

DS3: Direct payments under production-limiting programs under Article 6.5 of the URAA.

Not necessarily exempt categories

DS4 Refers to nonexempt support that is below the *de minimis* level (as set out in Article 6.4 of the URAA).

DS5: Market price support.

DS6: Nonexempt direct payments.

DS7: Other product-specific support.

DS8: Any support measured by the equivalent measurement of support methodology.

DS9: Where relevant, a total figure for non-product-specific support.

Estimating Elasticities

The results of estimation of equation 8 using different measures of domestic support are reported in table 3.6. Results using notifications by WTO members of nonexempt support (categories DS4–DS9) are shown in column 1. These are (generally) product specific and include market price support (calculated according to the methodology in annex 3 of the URAA) and nonexempt direct payments (denoted as s_e^{DS4-9}). Results using notifications on exempt domestic support (categories DS1–DS3) are shown in column 2. These are not product specific and include measures that WTO members have placed in the green box and that are exempt in developing countries as well as direct payments under production-limiting programs (blue box). For estimation purposes such non-product-specific support is allocated across products using the distribution of domestic support commitments by product (the idea being that exempt support is likely to be higher in sectors where nonexempt support is higher, following a political-economy logic). This type of domestic support is denoted

as s_c^{DS1-3} . Column 3 reports results for the two types of domestic support entered separately, and column 4 reports results using the sum of both types of support.

Because of the unbalanced nature of the data set, a between estimator is used, taking as observations the average across the four-year period for which support data are available, rather than the annual data.¹⁶ The elasticities are then identified using the cross-country variation for each product.¹⁷ Results across the four specifications generally yield an elasticity of import demand of about 1.36–1.45 and an elasticity of export supply of about 0.19–0.28. The (sum of the) elasticities of domestic support vary from almost 0 for DS1–DS3 (column 3) to 0.10 for DS4–DS9 (column 1). That the results for DS1–DS3 are

Table 3.6 Estimates of Price and Domestic Support Elasticities				
	(1) Based on DS4–DS9	(2) Based on DS1–DS3	(3) Based on DS4–DS9 and DS1–DS3 entered separately	(4) Based on sum of DS4–DS9 and DS1–DS3
$\log(\text{GDP})$	0.26 (0.03)**	0.24 (0.03)**	0.26 (0.03)**	0.24 (0.03)**
$\log(\text{Pop})$	−0.35 (0.03)**	−0.33 (0.03)**	−0.35 (0.03)**	−0.33 (0.04)**
$\log(1 + t) - (\epsilon^d)$	−1.36 (0.27)**	−1.46 (0.31)**	−1.37 (0.27)**	−1.42 (0.31)**
$\log(1 + \tau) - (\epsilon^d - \epsilon^s)$	−1.17 (0.08)**	−1.17 (0.08)**	−1.17 (0.08)**	−1.17 (0.08)**
$\log(s^{DS4-9}) - (\lambda^d + \lambda^s)$	−0.10 (0.02)**		−0.10 (0.03)**	
$\log(s^{DS1-3}) - (\lambda^d + \lambda^s)$		−0.05 (0.02)**	−0.00 (0.03)	
$\log(s^{DS1-3} + s^{DS4-9}) - (\lambda^d + \lambda^s)$				−0.06 (0.02)**
Product dummy variables	Yes	Yes	Yes	Yes
Adjusted R ²	0.136	0.135	0.136	0.135
Number of observations	7610	7610	7610	7610
Number of HS six-digit lines	158	158	158	158

Source: Authors' estimation based on data described in the text.

Note: Estimated using ordinary least squares. Numbers in parentheses are White robust standard errors.

**Significant at the 1 percent level.

insignificant may be due to collinearity problems arising from the methodology used to construct this variable (general domestic support is distributed across products using product-specific support commitments). When both types of domestic support are summed, the (sum of the) elasticity of domestic support is statistically significant (column 4).

To determine whether the two types of domestic support can simply be added up, a nonlinear specification of equation 8 was run. The results are reported in equation 9, with standard errors in parenthesis and * indicating statistically significant at the 5 percent level and ** at the 1 percent level:

$$\begin{aligned} \log(m^r) - \log(x^r) = & 0.29 + 0.34 \log(gdp_c) - 0.45 \log(pop_c) - 0.34 \log(1 + t_c) - \\ & (0.42) \quad (0.04)** \quad (0.04)** \quad (0.05)** \\ & -1.17 \log(1 + \tau_c) - 0.04 \log\left(s_c^{DS4-9} + 0.00 s_c^{DS1-3}\right) \\ & (0.08)** \quad (0.02)* \quad (0.00) \end{aligned} \quad (9)$$

Equation 9 suggests that general domestic support DS1–DS3 can be dropped from the estimation, since the coefficient on s_c^{DS1-3} is not significantly different from zero. The specification employed in the following simulations therefore use only nonexempt domestic support s_c^{DS4-9} , as reported in column 1 of table 3.6. Thus, the 50 percent reduction in domestic support used in the simulations pertains only to nonexempt domestic support (exempt domestic support does not seem to affect trade flows and therefore should have no—or little—impact on world prices).¹⁸

The estimation reported in column 1 of table 3.6 is done across the 158 HS six-digit commodities, with the elasticities assumed to be common across these products. This is not necessarily the case, of course, since there may be heterogeneity across products. Table 3.7 reports results of the estimation in column 1 of table 3.6 letting the elasticity vary across groups of products (a seemingly unrelated regression technique was used to provide standard error estimates that control for a common explanatory variable omitted from the regression). While the variations in import demand and export supply elasticities are quite large, the elasticity with respect to domestic support is similar across sectors (it varies between -0.07 and -0.16). The product group-specific elasticities are used below as the base estimates for the simulation exercises. The overall estimates in column 1 of table 3.6 are used to test for the robustness of the results.¹⁹

Because the information on cross-country variation is used to estimate the different elasticities, it is assumed that these elasticities do not vary across countries. If this constraint were to be relaxed, the solution to the model would be nonlinear. To determine the restrictiveness of this assumption the equation estimated in column 1 of table 3.6 is estimated for the three major users of domestic support separately: the United States, the European Union, and Japan. The results (not reported) suggest heterogeneity in the price elasticities across countries, but the imprecision in the parameter estimates did not allow rejections of the hypothesis that they are equal across countries. Estimates of

Table 3.7 Estimates of Price and Domestic Support Elasticities by Product Groups

	(1) HS 01– HS 04 Animal products	(2) HS 06– HS 09 Vegetables, fruits, and nuts	(3) HS 10– HS 14 Cereals and other grains	(4) HS 15– HS 24 Food processed products	(5) HS 50– HS 53 Silk, cotton, and other fibers
$\log(GDP)$	–0.21 (0.08)**	0.51 (0.05)**	0.10 (0.06)	0.18 (0.06)**	0.56 (0.16)**
$\log(Pop)$	0.14 (0.09)	–0.67 (0.05)**	–0.18 (0.07)*	–0.20 (0.07)**	–0.19 (0.17)
$\log(I + t) - (\varepsilon^d)$	–0.70 (0.51)	–2.16 (0.53)**	0.06 (0.62)	–2.35 (0.53)**	–0.44 (2.74)
$\log(I + \tau) - (\varepsilon^d - \varepsilon^s)$	–0.86 (0.18)**	–1.12 (0.13)**	–1.25 (0.14)**	–1.44 (0.20)**	–0.98 (0.42)*
$\log(s^{DS4-9}) - (\lambda^d + \lambda^s)$	–0.07 (0.05)	–0.11 (0.04)*	–0.07 (0.04)	–0.16 (0.05)**	–0.11 (0.10)
Product dummy variables	Yes	Yes	Yes	Yes	Yes
Adjusted R ²	0.104	0.164	0.164	0.109	0.09
Number of observations	1128	3028	1698	1448	308
Number of HS six-digit lines	28	55	38	27	10

Source: Authors' estimation based on data described in the text.

Note: Estimated using seemingly unrelated regression procedure. Group-specific elasticities estimated using the information in the whole sample, letting the elasticities vary by group of products. Numbers in parentheses are White robust standard errors.

**Significant at the 1 percent level. *Significant at the 5 percent level.

elasticities with respect to domestic support were relatively homogeneous (–0.10 for the United States, –0.08 for the European Union, and –0.12 for Japan). Thus, the elasticity of net import demand with respect to domestic support seems to be relatively small (about 0.1), suggesting that a reduction in domestic support across WTO members is likely to have a small impact on world prices.²⁰

Simulation Results

The baseline simulations use the estimated coefficients in table 3.7 to calibrate import demand and export supply in each country. Then changes in export

revenue, import revenue, and welfare following a 50 percent cut in tariffs and domestic support to farmers across all WTO members are calculated for each country using equations 6 and 7. The change in terms of trade is also calculated by weighting the changes in prices by export and import shares in each country. Recall that the simulations are done for the 158 tariff lines at the HS six-digit level for which at least one country provides domestic support to its farmers. (The overall agriculture universe includes more than 900 tariff lines at the HS six-digit level.)

The increase in trade across all country groups is much larger for the 50 percent tariff cut than for the 50 percent reduction in domestic support (table 3.8). Exports of developing countries (excluding the least developed countries) increase by \$4.2 billion, or 6.7 percent of the initial export revenue for the 158 product categories. Exports increase by \$116 million, or 3.7 percent, for the

Table 3.8 Impact of 50 Percent Cuts in Tariffs and Domestic Support for 158 Products

Country group	Tariff cut		Cut in domestic support		Change in welfare	
	Change in exports	Change in imports	Change in exports	Change in imports	With cut in tariffs	With cut in domestic support
Industrial countries	3,262	7677	314	121	14,464	541
Developing countries ^a	4,146	4136	504	-92	2,293	-273
Least developed countries	116	118	64	-4	52	36

	Tariff cut		Cut in domestic support		Change in welfare	
	Percent	Percent	Percent	Percent	\$ per capita	\$ per capita
Industrial countries	4.7	9.8	0.5	0.2	18.37	0.69
Developing countries ^a	6.7	6.0	0.8	-0.1	0.56	-0.07
Least developed countries	3.7	5.3	2.0	-0.2	0.12	0.08

Source: Authors' estimations based on data described in the text and appendix.

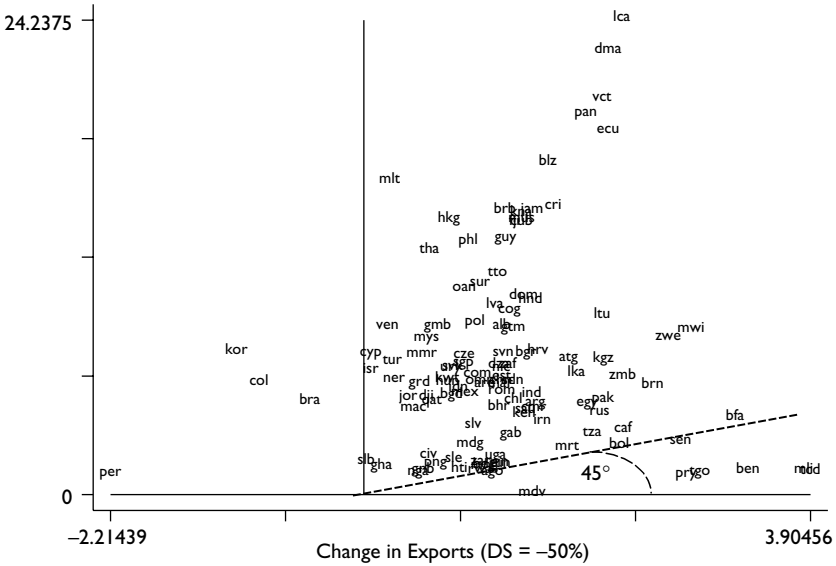
a. Excludes least developed countries.

least developed countries and by \$3.3 billion, or 4.7 percent, for industrial countries. There is also an increase in the import bill following the 50 percent tariff reduction. In industrial countries the increase in imports is double the increase in exports (due to both an expansion in demand and higher world prices). The increase in imports in developing and least developed countries is roughly equal to the increase in exports.²¹

In relative terms many developing countries see a significant expansion in exports following a 50 percent cut in tariffs (figure 3.1). The highest percentage of increases in exports are found in the Caribbean and Central American region reflecting specialization in commodities such as edible fruits and vegetables, processed foods, and sugar—the categories with the largest expansion in demand in percentage terms (appendix table 3A.1).²² Mauritius, the Philippines, and Thailand, all producers of such commodities, also see increases in exports of more than 10 percent. With a few exceptions such as the Republic of Congo and Malawi, African countries tend to register only limited increases in exports.

The increase in exports following a 50 percent cut in domestic support is 10 times lower than the increase generated by cutting tariffs (see table 3.8). Developing country exports increase by \$0.5 billion, or 0.8 percent of the 1995–98

Figure 3.1 Changes in Exports by Country for a 50 Percent Cut in Tariffs and a 50 Percent Cut in Domestic Support



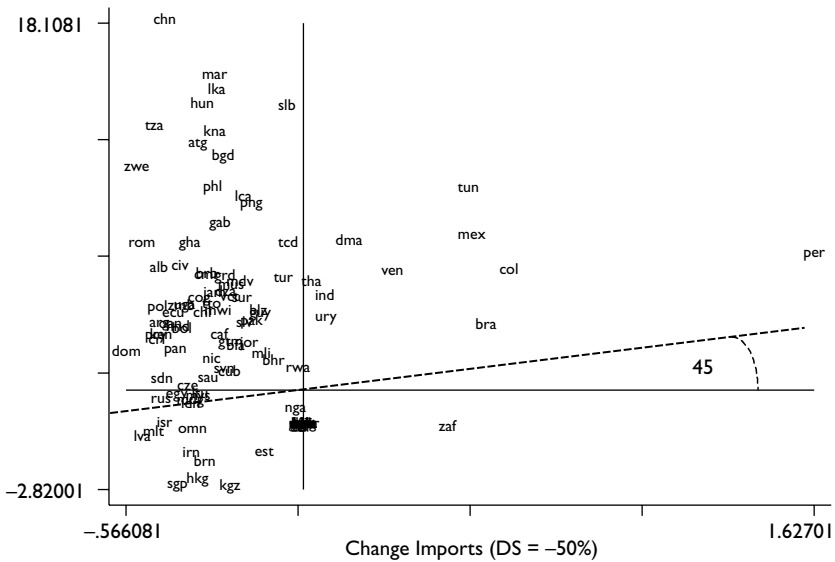
Source: Authors' estimations based on the data described in the text and appendix.
Note: The vertical and horizontal lines indicate zero change in exports due to a cut in tariffs and domestic support.

average level of exports. Exports rise by \$64 million, or 2 percent, for least developed countries and by \$314 million, or 0.5 percent, for industrial countries. More striking, the import bill decreases in developing countries and least developed countries after a 50 percent cut in domestic support (figure 3.2). The reason for this is that world prices increase after the cut—import demand functions being relatively elastic, the import bill necessarily decreases.

Welfare increases in all groups of countries after multilateral tariff reforms (see table 3.8). For developing countries welfare increases following the 50 percent tariff cut not only because exports increase, but also because of liberalization in these countries (and the absence of domestic support). In contrast, developing countries as a group see a small reduction in welfare following a cut in domestic support. The relatively high tariffs in many of these countries explain the 10 to 1 difference in welfare impact from tariff cuts and reductions in domestic support. The potential negative implication of a cut in domestic support illustrates the importance of also cutting tariffs.

The ratio between gains is quite different for the least developed countries, at only 2 to 1. Moreover, the simulations suggest that these countries obtain welfare gains from both types of reform. These differences between the two

Figure 3.2 Changes in Imports by Country for a 50 Percent Cut in Tariffs and a 50 Percent Cut in Domestic Support



Source: Authors' estimations based on the data described in the text and appendix.
 Note: The vertical and horizontal lines indicate zero change in exports due to a cut in tariffs or domestic support.

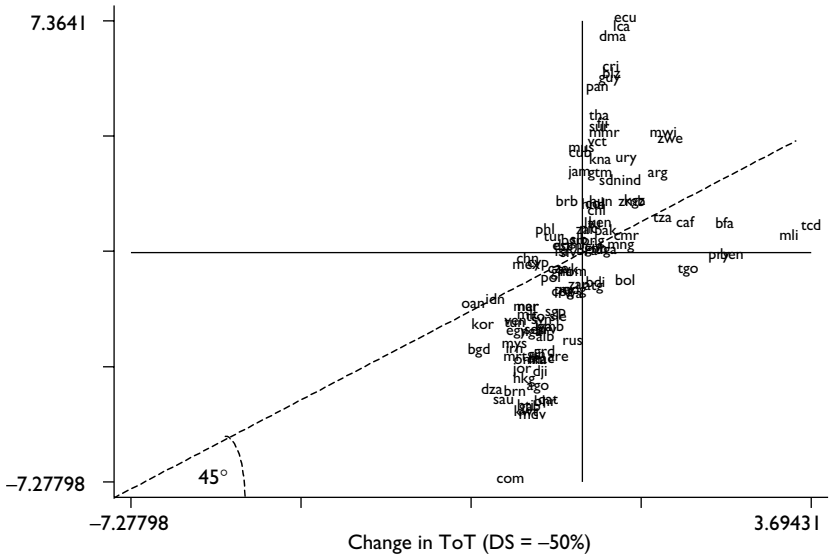
country groups reflect both the greater sensitivity of the least developed countries to industrial country support policies and different patterns of production and trade in the various products.

There is substantial heterogeneity across countries, reflecting differences in export and import bundles. Variations in the levels of tariffs and domestic support across different products in large trading partners also partly explain this heterogeneity. A cut of 50 percent in tariffs generates a relatively large increase in developing country exports of edible vegetables, fruits, and nuts (HS07–HS08), sugar (HS17), prepared vegetables and fruits (HS 20–HS21), and tobacco (HS24). In the case of least developed countries the largest increases occur in meat (HS02) and sugar and miscellaneous edible preparations (HS21; see appendix table 3A.1).²³

Many countries in the sample experience a deterioration in terms of trade after a 50 percent cut in tariffs or domestic support (figure 3.3 and appendix table 3A.2). Changes in terms of trade seem to be positively correlated across the two types of cuts: countries that see their terms of trade improve after a tariff cut will also see their terms of trade improve after a domestic support cut.

A deterioration in terms of trade does not necessarily imply a reduction in welfare since countries' own reforms tend to increase welfare. Nonetheless,

Figure 3.3 Changes in Terms of Trade by Country for a 50 Percent Cut in Tariffs and a 50 Percent Cut in Domestic Support



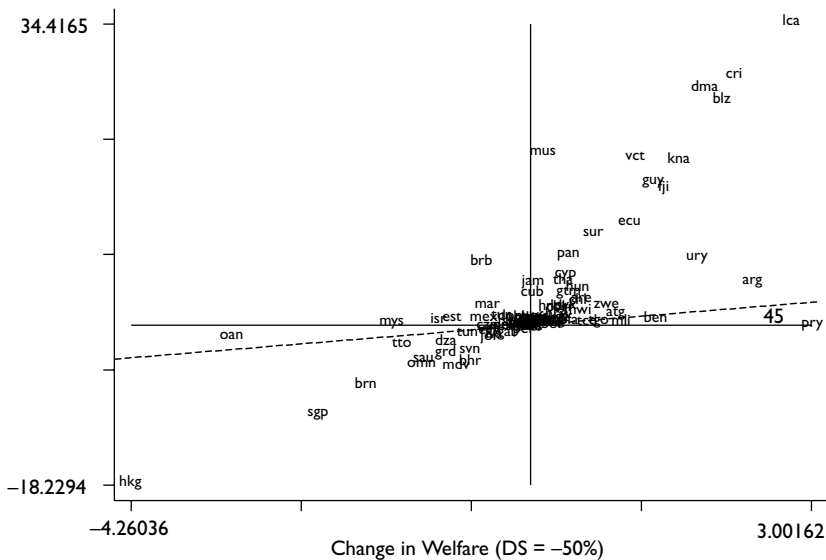
Source: Authors' estimations based on the data described in the text and appendix.
 Note: The vertical and horizontal lines indicate zero change in exports due to a cut in tariffs or domestic support.

welfare does decline in a number of instances, especially for oil producers and large net importers such as Algeria, Bahrain, Brunei, Egypt, Gabon, Oman, the Russian Federation, Saudi Arabia, and Venezuela. Welfare losses are generally much smaller for the 50 percent cut in domestic support than for a cut in tariffs (figure 3.4). Many countries see their welfare increase under both types of reforms (northeast quadrant of figure 3.4). There are no cases where a country's welfare rises under the cut in domestic support but declines under the tariff cut (southeast quadrant). Losers under both types of reforms include the large net importers mentioned previously.

Sensitivity Analysis

Several sensitivity analyses were performed to test for the effects of the various assumptions made about elasticities. First, changes in exports and imports (as given in equation 6) and changes in welfare (as given by equation 8) were recalculated using the elasticity estimates for the whole sample (from table 3.6, column 1) instead of the elasticity estimates by product (from table 3.7). The equations were also reestimated using extreme values (for example, either zero or the total value of the estimated coefficient instead of half of the estimated

Figure 3.4 Changes in Welfare by Country for a 50 Percent Cut in Tariffs and a 50 Percent Cut in Domestic Support (US\$ per capita)



Source: Authors' estimations based on the data described in the text and appendix.
 Note: The vertical and horizontal lines indicate zero change in exports due to a cut in tariffs or domestic support.

coefficient in table 3.8) for the elasticities of domestic support on the import and export side. Finally, results were compared with the case in which only industrial countries reduce their tariffs and domestic support.

With the elasticities estimated for the whole sample, the increase in exports after a 50 percent tariff cut is 25 percent lower for developing countries and 15 percent lower for the least developed countries. The increase in exports after a 50 percent cut in domestic support is 25 percent higher for developing countries, but 20 percent lower for the least developed countries. Thus the imbalance in gains is partly reversed. However, the qualitative results remain: the increase in exports by developing countries is five times larger under the 50 percent cut in tariffs than under the 50 percent cut in domestic support. Similarly, for the least developed countries the increase in exports is two times larger for the cut in tariffs than for the cut in domestic support. Developing countries experience welfare gains when tariffs are cut and welfare losses when domestic support is cut. For the least developed countries the welfare increase is 50 percent higher under the tariff cut than under the cut in domestic support.

As noted, the elasticity of domestic support on import demand and export supply cannot empirically be determined separately; only their sum. To test the sensitivity of the assumption that the two are equal, each in turn is assumed to be zero so that the coefficient identifies the other. The estimated changes in export revenue, imports, and welfare of a 50 percent tariff cut are not affected by these modifications (as import demand and export supply are recalibrated accordingly). For a 50 percent cut in domestic support, the increase in exports by developing countries is 30 percent higher under the assumption that the domestic support elasticity of export supply is zero and 80 percent lower under the assumption that the domestic support elasticity of import demand is zero. In terms of developing countries' welfare the loss is 22 percent lower when the elasticity of export supply is zero and 25 percent higher when the elasticity of import demand is zero. For the least developed countries the estimated change in exports is marginally affected under both scenarios. For both groups of developing countries, however, the qualitative results remain the same.

Finally, the results were compared with a scenario in which the 50 percent cuts in tariffs and in domestic support are undertaken only by industrial countries. For the cut in domestic support, the increase in exports of developing countries is only 3 percent lower, suggesting that for this group of countries almost all the impact of the reduction in domestic support comes from actions by industrial countries. However, the increase in exports is 25 percent lower for the least developed countries, suggesting that domestic support in other developing countries affects least developed country exports more than it does exports of other developing countries. This is also the case for tariff cuts. When industrial countries cut their tariffs by 50 percent, the increase in least developed country exports is only 30 percent of the increase in exports when all WTO members cut their tariffs by 50 percent. For other developing countries the increase in exports under a tariff cut by industrial countries only

is half of the \$4.2 billion generated if all WTO members reduce their tariffs by 50 percent. These results illustrate the importance of more general liberalization of trade in the commodities concerned.

CONCLUSION

The least developed countries are disproportionately affected by agricultural support policies—as they are by tariff peaks (Hoekman, Ng, and Olarreaga 2002). Reducing domestic support is therefore important. However, tariffs have a far greater impact on world prices than subsidies do. The positive welfare effect of reducing tariffs on products that are also affected by agricultural support is a multiple of what can be achieved from an equivalent percentage cut in domestic support only. This reflects the high tariff peaks in industrial countries and developing country use of tariffs to protect domestic production. Developing countries generally have low levels of domestic agricultural support, reflecting budget constraints and a more neutral policy stance toward protection of this sector of the economy.

The analysis thus suggests that the primary focus of reform should be on reducing border protection in both industrial and developing countries. The negotiating challenge is how to achieve this. For developing countries, tariffs are an important—indeed often the only—instrument of intervention for responding to the effects of industrial countries subsidy policies.

An important dimension of agricultural support policies that has been ignored in this analysis—the impact on price volatility—plays a major role here (Foster and Valdés; chapter 6 of volume 1). Tariff protection can shelter farmers from import surges when world prices drop significantly. Whatever the source of the exogenous shock that drives prices down, adjustment falls disproportionately on residual markets (nonindustrial countries) because support policies shelter industrial country farmers from the shock. Unilateral liberalization of agricultural trade in countries such as India proved to be politically unsustainable when farmers were subjected to large world price swings and import surges of subsidized commodities (Gulati and Narayanan in volume 1). Many developing countries therefore oppose further agricultural trade liberalization as long as industrial countries continue to provide large-scale support to their farmers. Substantial reduction in industrial countries' agricultural subsidies is therefore important not only because it generates direct benefits for the many developing economies that are net exporters of agricultural products, but also because it is critical for creating the political support that will allow developing countries to continue to pursue welfare-improving domestic agricultural trade policy reforms.

The simulations show that a number of countries could lose from reforms. That suggests that liberalization and removal of domestic support should be accompanied by compensation mechanisms, which could include additional

“aid for trade” (Hoekman 2002). This analysis has been limited to a few, heavily subsidized commodities. The Doha Round negotiations span all trade, including nonsubsidized agricultural products and manufactures. Thus the actual welfare effects generated by the analysis are not particularly relevant, except to indicate that the countries that lose from reforms that affect the subsidized products will need to identify other areas in which they can generate offsetting gains. In principle, this should be straightforward given the large negotiation set that was established in Doha.

ANNEX. DATA SOURCES

All trade data are from the United Nations Statistics Division’s Commodity Trade Database (Comtrade) (both value figures and unit prices). For countries that did not report trade data to Comtrade, notifications by their trading partners are used to mirror their data. Tariffs are drawn from UNCTAD and WTO as provided in World Bank and UNCTAD World Integrated Trade Solution (WITS) system. This database does not include the ad valorem equivalents of specific tariffs, which come from Stawowy (2001) for Canada, the European Union, Japan, and the United States and from OECD (2000) for other industrial countries. For tariff rate quotas the average of within- and outside-quota tariffs is generally taken, although in some cases only the outside-quota tariff is available. The ad-valorem equivalents of specific tariffs for industrial countries use exclusively outside-quota tariffs. This may bias results of some estimates since some import prices may be higher if exporters benefit from lower within-quota tariffs.

The source for domestic support data is WTO (2000). National currency data were converted to US dollars using the period average exchange rate reported in the International Monetary Funds’ *International Financial Statistics*. Product classifications, which differed by country, were mapped to the HS six-digit classification, generally in a one-to-one mapping. In cases where reported domestic support covers several six-digit tariff lines, the subsidy was distributed across the tariff lines using the share of the reporting country’s exports as weights. The concordance file is available from the authors on request.

Exempt subsidies, which are not product specific, were mapped into product-specific subsidies using as weights the product-specific commitments that each country made in the Uruguay Round. Non-product-specific support is divided evenly into all products exported by the country concerned. All products shown in notifications to the WTO are included, even when the support is below the *de minimis* level for the member concerned. Thus, the total aggregate measurement of support for a country may exceed its total WTO commitments. GDP (in US dollars) and population data are drawn from the World Bank’s World Development Indicators database.

Table 3A.1 Impact of 50 Percent Cuts in Tariffs and Domestic Support, by Product Group

Product at Harmonized System two-digit level	Value change (US\$ thousands)				Percentage change			
	Tariff cut		Cut in domestic support		Tariff cut		Cut in domestic support	
	Change in exports	Change in imports	Change in exports	Change in imports	Change in exports	Change in imports	Change in exports	Change in imports
<i>Impact on developing countries^a</i>								
01 Live animals	26,116	21,278	-916	1,035	4.8	2.1	-0.2	0.1
02 Meat and edible meat offal	31,104	40,741	4,569	2,526	4.7	4.4	0.7	0.3
04 Dairy products; birds' eggs; honey	157,823	338,591	25,782	32,685	8.5	5.7	1.4	0.5
06 Live trees and other plants, bulbs; cut flowers	28,293	26,664	24,664	-2,178	2.1	7.3	1.8	-0.6
07 Edible vegetables and roots and tubers	442,019	169,647	22,424	-3,387	10.1	6.3	0.5	-0.1
08 Edible fruit and nuts; melons	1,138,841	234,312	106,692	-34,114	12.3	4.9	1.2	-0.7
09 Coffee; tea; maté; and spices	110,458	116,167	-32,060	-6,439	1.2	7.6	-0.3	-0.4
10 Cereals	353,031	1,739,555	126,545	-40,021	3.9	7.6	1.4	-0.2
11 Milled products; malt; starches	25,671	57,062	86	511	9.6	5.8	0.0	0.1
12 Oilseed; oleaginous fruits	87,943	501,554	46,149	3,421	1.9	7.9	1.0	0.1
13 Lac; gums, resins, and other vegetables	43	3,176	0	1	3.3	4.0	0.0	0.0
15 Animal and vegetable fats and oils and products	195,152	122,296	6,290	-2,105	7.3	6.2	0.2	-0.1
17 Sugars and sugar confectionery	693,521	131,776	9,157	-18,079	14.3	4.8	0.2	-0.7
18 Cocoa and cocoa preparations	15,787	22,191	93	57	0.6	3.8	0.0	0.0
20 Preparations of vegetable, fruit, and nuts products	196,982	72,345	25,567	-7,897	13.8	9.4	1.8	-1.0
21 Miscellaneous edible preparations	246,069	59,568	-117	3,008	18.7	2.3	0.0	0.1
22 Beverages, spirits, and vinegar	32,659	76,229	13,423	-5,818	4.4	14.0	1.8	-1.1
23 Residues and waste from food industry	2	61,389	-7,552	-15,189	0.0	4.0	-0.5	-1.0
24 Tobacco and manufactured tobacco substitutes	329,093	221,150	53,926	-30,836	11.6	10.5	1.9	-1.5
50 Silk	6,574	503	975	116	23.7	5.3	3.5	1.2
51 Wool, fine and coarse animal hair	6,425	30,319	1,954	69	1.6	2.7	0.5	0.0
52 Cotton	21,523	83,998	76,658	30,440	1.1	1.2	3.8	0.4
53 Other vegetable textile fibers and yarns	409	5,330	134	189	1.3	4.4	0.4	0.2

(continued)

Table 3A.1 (Continued)

Product at Harmonized System two-digit level	Value change (US\$ thousands)				Percentage change			
	Tariff cut		Cut in domestic support		Tariff cut		Cut in domestic support	
	Change in exports	Change in imports	Change in exports	Change in imports	Change in exports	Change in imports	Change in exports	Change in imports
<i>Impact on least developed countries</i>								
01 Live animals	3,593	204	57	6	4.8	1.7	0.1	0.1
02 Meat and edible meat offal	3,188	203	26	2	19.2	1.0	0.2	0.0
04 Dairy products; birds' eggs; honey	252	11,101	47	489	7.5	4.9	1.4	0.2
06 Live trees and other plants, bulbs; cut flowers	432	68	616	-4	2.4	5.0	3.4	-0.3
07 Edible vegetables and roots and tubers	18,426	17,035	1,035	-108	7.4	12.6	0.4	-0.1
08 Edible fruit and nuts; melons	1,835	8,184	417	-191	1.5	24.1	0.3	-0.6
09 Coffee; tea; maté; and spices	7,561	973	6,809	-61	1.1	2.2	1.0	-0.1
10 Cereals	3,234	31,639	1,603	-2247	3.4	3.0	1.7	-0.2
11 Milled products; malt; starches	38	815	0	-1	9.0	1.9	0.1	0.0
12 Oilseed; oleaginous fruits	13,423	10,066	274	-285	6.0	12.4	0.1	-0.4
13 Lac; gums, resins, and other vegetables	10	30	0	0	3.3	0.9	0.0	0.0
15 Animal and vegetable fats and oils and products	368	1,490	8	-46	7.3	3.3	0.2	-0.1
17 Sugars and sugar confectionery	14,042	17,677	1,373	-652	14.4	12.6	1.4	-0.5
18 Cocoa and cocoa preparations	278	0	3	0	0.6	0.0	0.0	0.0
20 Preparations of vegetable, fruit, and nuts products	99	302	40	-25	7.1	2.4	2.8	-0.2
21 Miscellaneous edible preparations	379	1,814	4	-28	18.7	3.7	0.2	-0.1
22 Beverages, spirits, and vinegar	12	362	5	-18	4.4	3.0	1.8	-0.1
23 Residues and waste from food industry	0	114	127	-20	0.0	4.8	1.5	-0.8
24 Tobacco and manufactured tobacco substitutes	33,855	4,485	11,518	-559	8.9	8.4	3.0	-1.1
50 Silk	2	1	0	0	23.7	0.5	3.5	0.1
51 Wool, fine and coarse animal hair	0	0	1	0	0.8	0.0	1.0	0.0
52 Cotton	10,712	11,036	39,801	135	1.1	5.2	3.9	0.1
53 Other vegetable textile fibers and yarns	4,223	12	650	0	4.5	1.3	0.7	0.0

Source: Authors' estimations based on data described in the text and appendix.

a. Excludes least developed countries.

Table 3A.2 Impact of 50 Percent Cuts in Tariffs and Domestic Support, by Country (percent)

Country	Tariff cut		Cut in domestic support		Change in terms of trade		Change in welfare	
	Change in export revenue	Change in import revenues	Change in export revenue	Change in import revenue	Cut in tariffs	Cut in domestic support	Cut in tariffs (US\$ per capita)	Cut in domestic support (US\$ per capita)
Albania	8.5	7.0	1.2	-0.5	-2.8	-0.6	-0.4	-0.1
Algeria	6.5	5.9	1.2	-0.2	-4.5	-1.4	-2.1	-0.9
Angola	1.0	0.0	1.1	0.0	-4.4	-0.7	0.0	0.0
Antigua and Barbuda	6.8	12.6	1.8	-0.3	-1.2	0.2	1.3	0.9
Argentina	4.6	4.5	1.5	-0.5	2.4	1.2	4.9	2.4
Australia	4.8	-3.5	1.0	-0.4	3.1	1.2	17.5	6.5
Bahrain	4.3	2.8	1.2	-0.1	-4.9	-0.6	-4.4	-0.6
Bangladesh	5.0	12.0	0.8	-0.3	-3.2	-1.7	0.0	-0.1
Barbados	14.4	6.7	1.2	-0.3	1.5	-0.3	7.1	-0.5
Belize	16.9	5.1	1.6	-0.1	5.6	0.5	25.5	2.0
Benin	1.2	0.0	3.4	0.0	-0.2	2.4	0.4	1.3
Bolivia	2.4	4.2	2.2	-0.4	-1.0	0.7	-0.2	0.2
Brazil	4.7	4.4	-0.5	0.6	0.0	0.1	0.1	0.1
Brunei	5.5	-1.7	2.5	-0.3	-4.5	-1.1	-7.0	-1.8
Bulgaria	7.1	0.0	1.4	0.0	0.3	-0.2	1.8	0.4
Burkina Faso	3.8	3.5	3.3	-0.2	0.8	2.3	0.3	0.4
Burundi	1.4	0.0	1.0	0.0	-1.1	0.2	0.1	0.1
Cameroon	4.3	6.7	1.5	-0.3	0.4	0.7	0.3	0.3
Canada	3.9	11.3	1.0	-0.5	0.8	0.8	26.9	2.9

(continued)

Table 3A.2 (Continued)

Country	Tariff cut		Cut in domestic support		Change in terms of trade		Change in welfare	
	Change in export revenue	Change in import revenues	Change in export revenue	Change in import revenue	Cut in tariffs	Cut in domestic support	Cut in tariffs (US\$ per capita)	Cut in domestic support (US\$ per capita)
Central African Republic	3.3	4.0	2.3	-0.3	0.8	1.7	0.2	0.3
Chad	1.1	8.1	3.9	0.0	0.8	3.7	0.1	0.6
Chile	4.7	4.9	1.3	-0.3	1.2	0.2	2.6	0.5
China	5.7	18.1	1.2	-0.4	-0.3	-0.9	0.5	0.0
Colombia	5.7	6.9	-0.9	0.7	1.4	0.2	1.8	0.3
Comoros	6.1	0.0	1.0	0.0	-7.3	-1.2		
Congo, Dem. Rep.	1.5	0.0	1.0	0.0	-1.1	-0.1	0.0	0.0
Congo, Rep.	9.3	5.6	1.3	-0.3	-1.3	-0.3	-0.1	0.0
Costa Rica	14.6	3.8	1.7	-0.5	5.8	0.5	28.4	2.2
Côte d'Ivoire	1.9	7.0	0.6	-0.4	0.1	0.2	0.5	0.3
Croatia	7.2	0.0	1.5	0.0	-2.6	-0.6	1.0	0.3
Cuba	13.8	2.3	1.4	-0.2	3.1	0.0	3.4	0.0
Cyprus	7.1	0.0	0.1	0.0	-0.4	-0.7	5.7	0.4
Czech Republic	7.0	1.7	0.9	-0.4	-0.6	-0.4	-0.3	-0.5
Djibouti	4.9	0.0	0.5	0.0	-3.9	-0.7	0.4	0.0
Dominica	22.6	8.2	2.1	0.1	6.8	0.5	26.9	1.9
Dominican Republic	10.0	3.2	1.4	-0.6	0.1	-0.2	0.7	-0.2
Ecuador	18.5	5.0	2.1	-0.4	7.4	0.7	11.5	1.1
Egypt, Arab Rep.	4.6	1.3	2.0	-0.4	-2.6	-1.0	-0.9	-0.4
El Salvador	3.4	4.5	1.0	-0.2	-0.1	-0.2	0.1	-0.2
Estonia	5.9	-1.3	1.2	-0.1	0.1	-0.3	0.6	-0.8
EU15	6.9	9.3	-0.3	0.7	-0.8	-0.4	13.9	-0.2

Fiji	13.8	0.0	1.3	0.0	4.0	0.3	15.4	1.4
Gabon	3.0	9.0	1.3	-0.3	-5.0	-0.8	-1.2	-0.2
Gambia, The	8.5	0.0	0.7	0.0	-2.5	-0.5	0.1	0.0
Ghana	1.4	8.1	0.2	-0.4	-0.7	-0.3	-0.1	0.0
Grenada	5.6	6.6	0.5	-0.2	-3.2	-0.6	-3.4	-0.9
Guatemala	8.4	3.7	1.3	-0.2	2.4	0.3	3.6	0.4
Guinea	1.5	0.0	1.2	0.0	-3.4	-0.7	0.1	0.1
Guinea-Bissau	1.1	0.0	0.5	0.0	0.0	0.2	0.2	0.1
Guyana	13.0	5.0	1.3	-0.1	5.5	0.5	16.2	1.3
Haiti	1.2	0.0	0.8	0.0	-5.0	-0.9	0.0	0.0
Honduras	9.8	4.3	1.5	-0.4	1.4	0.2	1.9	0.2
Hungary	5.7	14.3	0.7	-0.3	1.5	0.3	4.0	0.5
Iceland	0.4	3.4	1.4	-0.6	-1.0	0.3	-4.5	2.3
India	5.0	5.7	1.5	0.1	2.2	0.8	0.1	0.0
Indonesia	5.3	0.9	0.8	-0.4	-1.6	-1.4	-0.3	-0.3
Iran, Islamic Rep.	3.6	-1.4	1.6	-0.4	-3.2	-1.1	-0.4	-0.2
Israel	6.3	0.0	0.1	-0.4	-0.1	-0.3	0.3	-1.0
Jamaica	14.4	5.9	1.5	-0.3	2.5	0.0	4.7	0.0
Japan	9.6	18.1	0.7	-0.1	-2.8	-1.4	64.8	-0.5
Jordan	4.9	3.6	0.4	-0.2	-3.8	-1.0	-1.6	-0.4
Kenya	4.0	3.9	1.4	-0.5	0.9	0.3	0.3	0.1
Korea, Rep.	7.2	18.1	-1.1	-0.1	-2.4	-1.6	18.0	-1.2
Kuwait	5.8	0.0	0.7	0.0	-5.2	-0.9	0.1	0.0
Kyrgyz Republic	6.8	-2.8	2.1	-0.2	1.5	0.9	0.6	0.3
Latvia	9.6	-0.6	1.2	-0.5	-2.5	-0.6	-1.3	-0.4
Lithuania	9.1	1.3	2.1	-0.3	0.8	0.2	1.8	0.3
Macao	4.3	0.0	0.4	0.0	-3.5	-0.6	0.6	0.1
Madagascar	2.5	1.0	0.9	-0.4	-1.3	-0.1	-0.1	0.0
Malawi	8.4	5.0	2.9	-0.3	3.7	1.3	1.5	0.5
Malaysia	7.9	1.2	0.6	-0.3	-3.0	-1.1	0.2	-1.5
Maldives	0.0	6.3	1.5	-0.2	-5.3	-0.8	-4.8	-0.8
Mali	1.2	3.1	3.8	-0.1	0.4	3.3	0.1	1.0

(continued)

Table 3A.2 (Continued)

Country	Tariff cut		Cut in domestic support		Change in terms of trade		Change in welfare	
	Change in export revenue	Change in import revenues	Change in export revenue	Change in import revenue	Cut in tariffs	Cut in domestic support	Cut in tariffs (US\$ per capita)	Cut in domestic support (US\$ per capita)
Malta	16.0	-0.4	0.2	-0.5	-2.1	-0.9		
Mauritania	2.3	0.0	1.8	0.0	-3.4	-1.1	0.0	0.0
Mauritius	13.9	6.2	1.4	-0.2	3.2	0.0	19.5	0.1
Mexico	5.1	8.4	0.9	0.5	-0.5	-0.9	0.6	-0.5
Mongolia	1.3	0.0	1.1	0.0	0.1	0.6	0.3	0.2
Morocco	5.5	15.7	1.2	-0.3	-1.8	-0.9	2.1	-0.5
Myanmar	7.1	0.0	0.5	0.0	3.7	0.3	0.3	0.0
New Zealand	6.3	-4.5	1.0	-0.7	4.4	0.7	42.7	6.5
Nicaragua	6.4	2.9	1.2	-0.3	0.7	0.1	0.7	0.1
Niger	5.8	0.0	0.3	0.0	-1.8	-0.9	0.1	0.0
Nigeria	1.0	0.7	0.5	0.0	-2.6	-0.8	0.0	0.0
Norway	5.0	3.0	1.0	-0.6	-2.5	-0.8	1.5	-1.6
Oman	5.7	-0.3	1.0	-0.4	-3.5	-0.9	-4.6	-1.2
Pakistan	4.8	4.6	2.1	-0.2	0.6	0.4	0.1	0.0
Panama	19.4	3.4	2.0	-0.4	5.2	0.3	7.9	0.4
Papua New Guinea	1.5	9.9	0.6	-0.2	0.3	0.2	0.5	0.2
Paraguay	0.9	4.0	2.8	-0.5	-0.2	2.2	-0.1	3.0
Peru	1.0	7.7	-2.2	1.6	-1.3	-0.3	-0.7	-0.1
Philippines	12.8	10.6	0.9	-0.3	0.6	-0.6	0.6	-0.2
Poland	8.7	5.3	1.0	-0.5	-0.9	-0.5	-0.3	-0.3
Qatar	4.6	0.0	0.6	0.0	-4.8	-0.5	0.1	0.0
Romania	5.2	8.1	1.2	-0.5	-0.7	-0.2	0.1	0.0
Russian Fed.	4.1	1.1	2.1	-0.5	-2.9	-0.1	-0.4	0.0

Rwanda	1.2	2.5	1.0	0.0	-1.4	-0.2	0.0	0.0
Saudi Arabia	4.2	2.0	1.4	-0.3	-4.8	-1.2	-4.1	-1.1
Senegal	2.6	0.0	2.8	0.0	-2.5	-0.7	0.1	0.1
Sierra Leone	1.7	0.0	0.8	0.0	-2.1	-0.4	0.0	0.0
Singapore	6.6	-2.7	0.9	-0.4	-2.0	-0.4	-10.3	-2.2
Slovak Republic	6.4	0.0	0.8	0.0	-0.6	-0.2	2.0	0.4
Slovenia	7.1	2.5	1.2	-0.2	-2.3	-0.6	-3.1	-0.6
Solomon Islands	1.6	14.2	0.0	-0.1	0.3	0.0	0.5	0.0
South Africa	6.5	-0.2	1.3	0.5	0.6	0.1	0.5	0.1
Sri Lanka	6.1	15.0	1.9	-0.3	-3.5	-0.7	-0.2	-0.1
St. Kitts and Nevis	14.3	13.1	1.4	-0.3	2.8	0.3	18.7	1.6
St. Lucia	24.2	10.2	2.3	-0.2	7.1	0.6	34.4	2.8
St. Vincent/Grenadines	20.1	5.7	2.1	-0.2	3.4	0.2	19.0	1.1
Sudan	5.7	2.0	1.3	-0.4	2.2	0.5	0.4	0.1
Suriname	10.7	5.6	1.0	-0.2	3.9	0.3	10.3	0.7
Taiwan, China	10.4	4.5	0.9	-0.4	-1.7	-1.8	-1.4	-3.2
Tanzania	3.0	13.3	2.0	-0.5	1.0	1.3	0.2	0.2
Thailand	12.4	6.4	0.6	0.0	4.2	0.3	4.8	0.3
Togo	1.0	0.0	2.9	0.0	-0.6	1.7	0.2	0.7
Trinidad and Tobago	11.2	5.4	1.2	-0.3	-2.1	-0.8	-2.3	-1.4
Tunisia	1.4	10.5	1.2	0.5	-2.3	-1.1	-1.1	-0.7
Turkey	6.7	6.5	0.2	-0.1	0.4	-0.5	0.8	-0.3
Uganda	1.9	5.3	1.2	-0.4	0.0	0.4	0.0	0.1
United Arab Emirates	5.6	0.0	1.1	0.0	-3.4	-0.4	2.8	0.6
United States	3.3	6.0	0.5	-0.5	0.3	1.0	1.7	1.7
Uruguay	6.4	4.8	0.8	0.1	2.9	0.7	7.6	1.8
Venezuela	8.5	6.8	0.2	0.3	-2.3	-1.1	-0.8	-0.4
Zambia	6.0	5.3	2.3	-0.4	1.5	0.8	0.2	0.1
Zimbabwe	7.9	11.5	2.7	-0.5	3.5	1.4	2.1	0.8

Source: Authors' estimations based on data described in the text and appendix.

NOTES

The authors are grateful to Gopi Gopinath, Ashok Gulati, Tim Josling, Will Martin, and participants at the Whistler Conference for helpful comments and suggestions. They are also indebted to Lili Tabada for assistance in constructing the agriculture subsidy database from World Trade Organization member notifications; to Bijit Bora and Wojciech Stawowy for estimates of ad valorem equivalents of specific tariffs in Quad countries; and to Morvarid Bagherzadeh for information on Organisation for Economic Co-operation and Development estimates of ad valorem equivalents. An earlier version of this paper was published as Hoekman, Ng, and Olarreaga (2004).

1. This potential national welfare benefit is offset by the higher price volatility created by support policies as country-specific shocks may be transferred to world markets. This chapter ignores the extent to which price volatility is transmitted to world markets.
2. Industrial countries are defined as high-income OECD countries.
3. The policy simulation can be motivated by a conservative interpretation of the Doha declaration: "we commit ourselves to comprehensive negotiations aimed at: substantial improvements in market access, reduction of, with a view to phasing out, all forms of export subsidies; and substantial reductions in trade-distorting domestic support" (WTO Doha Ministerial Declaration, para. 13, November 2001).
4. Note that export subsidies are left outside the analysis but these are relatively small as they represent only 8–10 percent of total domestic support.
5. Fontagné, Guérin, and Jean (2002) report that at the six-digit level the United States has 1,148 tariff lines that are subject to specific tariffs, the European Union has 1,059, and Japan has 418.
6. It is difficult to assess to what extent Everything but Arms offers actual preferential access to least developed countries as rules of origin and other nontariff barriers may erode the preferential access granted on paper. Brenton and Manchin (2002) show evidence that EU preferential access schemes have offered limited benefits because of restrictive rules of origin. For the US African Growth and Opportunity Act (AGOA), publicly available data show small actual gains for African countries (Mattoo, Roy, and Subramanian 2002).
7. See Hoekman and Kostecki (2001) for a review of the WTO Agreement on Agriculture.
8. In practice there may be heterogeneity even at the six-digit level in that imports may be of a higher quality than exports or exports may be of higher quality than imports. In some developing countries high-quality imports may have only a limited degree of competition with low quality domestic production. If so, this will imply that traditional measures of protection such as the ratio of the import price to the domestic price of the product will overstate protection. The analysis here uses only tariffs, not the nominal rate of protection.
9. The setup is similar to that in Zietz and Valdés (1986) and to that in Hoekman, Ng, and Olarreaga (2002), which discusses some of the caveats associated with the use of this type of model. Note that no account is taken of the potential impact of exchange rate overvaluation, indirect taxes, and other factors that may result in an overall antiagriculture bias and thus offset the effect of tariff protection and subsidy policies. Schiff and Valdés (1998) suggest that in many developing countries antiagriculture bias due to such policies has declined, implying that direct instruments such as tariffs and subsidies are the major determinants of protection.

10. This explains differences in import prices across countries as observed in the data.
11. So that the import demand function is not undetermined, a \$1 value is attributed to countries with no domestic support.
12. So that the export demand function is not undetermined, a \$1 value is attributed to countries with no domestic support.
13. The \$1 domestic support subsidy attributed to countries with no domestic support is retained.
14. The change in welfare is exactly equal to the percentage change in world prices if the elasticity of export supply is nil.
15. Changes in world prices, tariffs and transport costs will affect both domestic demand and supply. In the simulations, we test the robustness of our results by letting the elasticities with respect to domestic support on the demand and supply side vary.
16. This is also due to the fact that ad valorem equivalents of specific tariffs were estimated only for 1999 in OECD (2000) and Stawowy (2001).
17. Thus, the variation in import and export prices across countries, which is explained by transport cost to the world market, permits identification of the different elasticities.
18. Exempt domestic support is generally delinked from production and is more likely to affect the production decision rather than the level of production as measured when working with trade flows.
19. For animal products, cereals and other grains, and silk, cotton, and other fibers, the coefficient capturing the import demand elasticity is insignificant, whereas the difference between the import demand and export supply price elasticities is significant. In these three cases, the hypothesis that the export supply elasticity is zero cannot be rejected. The export supply elasticities are therefore set to zero in the simulations for these products and the import demand elasticities are calibrated accordingly.
20. The implicit assumption here is that domestic support affects only the variable cost of the farmers receiving the subsidy, moving along the export supply and import demand functions. If domestic support affects fixed costs (or the production decision), as is probably the case with subsidies that are decoupled from production, work would need to be along the domestic supply function. Production data are not available for such a large number of countries at the disaggregated level required. This suggests that only nonexempt subsidies (which are generally not decoupled from production) should be considered.
21. The increase in exports is not necessarily equal to the increase in imports at the aggregate level for two reasons. Increases in export and import revenue are measured at customs and therefore include transport cost. Data were missing for some countries, so it is assumed that the rest of the world also adjusts to changes in world prices.
22. To the extent that these countries enjoy tariff preferences in some products in these categories, results may overstate their gains. But again, preferential access on paper does not necessarily mean actual preferences granted. Furthermore, these are very small countries that only marginally affect the overall picture for developing countries.
23. The analysis does not consider the effects of sanitary or phytosanitary barriers and other nontariff barriers that may also be hindering trade.

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CHAPTER FOUR

Projecting the Effects of Agricultural Trade Liberalization on Trade, Prices, and Economic Benefits

Mark W. Rosegrant and Siet Meijer

Integration into the world economy has accelerated economic growth in many developing countries, providing an essential impetus to poverty reduction (IMF 2001). Continuing growth and integration of world markets, however, has reduced the distinction between domestic and international policies and provoked criticism of the trade-restricting measures of developed countries. The highly protected agricultural sectors of the European Union, Japan, and the United States are often criticized by developing countries and by competitive producers such as Australia and Canada. Protectionism is expensive for the governments that provide it and damaging to the developing countries whose farmers do not enjoy the same level of government support and may therefore face unfair competition.

Agricultural protection includes economic regulations (quotas, contingent protection measures, domestic content requirements), social regulations (food safety measures, environmental trade measures, quality standards), and administrative regulations (customs valuation, classification, and clearance procedures; licensing requirements). While social measures were initially intended to protect consumers against products that did not meet health, quality, safety, or

environmental standards (Roberts, Josling, and Orden 1999), these policies often came to be used as covert protection of domestic producers.

It seems undeniable that protectionism in industrial countries has discriminated against agricultural production and exports from developing countries (Diaz-Bonilla, Thomas, and Robinson 2002). And while open trade policies and related reforms are a key to economic growth in developing countries (Sachs and Warner 1995 cited in Diaz-Bonilla and others 2002), there is also concern that trade liberalization may reduce food security, impede poverty reduction, increase the food bill for poor developing countries that are net food importers, and erode developing country trade preferences (Diaz-Bonilla, Thomas, and Robinson 2002).

This study uses a partial equilibrium agricultural sector model to assess the effect of four trade liberalization scenarios. It reports regional results for cereal and meat trade, the impact on world prices, and net economic benefits.

MODELING FRAMEWORK

Four alternative agricultural trade liberalization scenarios were projected to 2020 using the International Food Policy Research Institute's International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT). IMPACT is a partial equilibrium model, specified as a set of country-level supply and demand equations that are linked to the rest of the world through trade. It includes 16 agricultural commodities and divides the world into 36 countries and regions. For each commodity in each country, area planted is a function of crop prices and investments, and yield is a function of crop price, input price, irrigation investment, and rate of productivity growth. Future productivity growth is estimated by its component sources, including crop management research, conventional plant breeding, wide-crossing and hybridization breeding, and biotechnology and transgenic breeding. Food demand is a function of commodity prices, income, and population, and feed demand is a function of livestock production, feed prices, and feeding efficiency. Interdependence across commodities, including complementarities and substitutability, is captured through cross-price elasticities of area planted and demand.

World and domestic prices of agricultural commodities are endogenous. World prices are determined annually at levels that clear world markets. Domestic prices are a function of world prices, adjusted by the domestic marketing margin and by the effect of trade and price policies, expressed as trade-distorting price wedges on producer and consumer subsidy prices. Marketing margins and trade-distorting price wedges are expressed as percentages of the world price. Marketing margins reflect factors such as transport and marketing costs. Trade-distorting price wedges measure the implicit level of taxation or subsidy of producers and consumers relative to world prices and account for the wedge between domestic and world prices.

Comprehensive estimates of trade-distorting price wedges are not available from a single source. For Organisation for Economic Co-operation and Development (OECD) countries the wedges were estimated as the trade-distorting portion of producer and consumer subsidy equivalents (OECD 1999). For developing countries the wedges were estimated from various studies of nominal or effective rates of protection.¹ The impacts of changes in trade policy are thus simulated by changes in the trade wedges, which in turn alter the commodity prices that consumers and producers face. (For a more detailed description of the model see Rosegrant, Meijer, and Cline 2002 and Rosegrant and others 2001.)

SPECIFICATION OF AGRICULTURAL TRADE LIBERALIZATION SCENARIOS

Four scenarios were run to assess different levels of trade liberalization:

- Full multilateral liberalization of agricultural trade that completely removes trade-distorting price wedges between domestic and world prices in all countries between 2005 and 2006.
- Removal of all price wedges in developed countries while retaining baseline protection levels in developing countries.
- Removal of all price wedges in developing countries only while retaining baseline protection levels in developed countries.
- Partial multilateral liberalization of agricultural trade that reduces price wedges in all countries by 50 percent.

Because IMPACT is a partial equilibrium model, it does not account for the cross-sectoral links that would accompany widespread trade liberalization. A general equilibrium model is needed for that (see, for example, Diao, Somwaru, and Roe 2001). Nevertheless, the direction and relative magnitude of the changes that result from the four scenarios are instructive in assessing the importance of the agricultural trade liberalization agenda.

TRADE LIBERALIZATION IMPACTS ON CEREAL AND LIVESTOCK TRADE

Under full trade liberalization trade shifts for cereals vary in the developing world, but they are not particularly large overall (table 4.1). The direction and magnitude of the trade response to liberalization depends on the relative degree of protection in a country or region compared with others and on supply and demand elasticities. Net cereal imports rise by 27 percent over the baseline in Southeast Asia, 8 percent in West Asia and North Africa, and 3 percent in Sub-Saharan Africa; decline by 1 percent in East Asia; and remain virtually

unchanged in Latin America. Net cereal exports rise by 4 percent in developed countries, with increased exports from the United States, Australia, the former Soviet Union, Eastern Europe, and other developed countries² offsetting a decline in exports by the European Union and an increase in imports by Japan.

Under the scenario of developed country only liberalization, trade balances change only slightly, with Latin America and West Asia and North Africa importing slightly more cereals compared with the baseline and the rest of the developing world importing slightly less. Developed countries as a whole experience a negligible decrease in their exports, the result of an increase in imports in Japan and a decline in EU exports balanced by small increases in exports in other developed countries, Eastern Europe, and the former Soviet Union.

Under the scenario of developing country trade liberalization almost all developing countries import more cereals compared with the baseline—even more than under the full trade liberalization scenario. Imports decline only in Latin America, because imports decrease by a greater amount in the rest of Latin America than exports increase in Argentina and Brazil. Overall, developing countries increase imports by 9 million metric tons (mmt), a 5 percent rise.

As expected, the partial multilateral trade liberalization scenario results lie between the baseline and full trade liberalization projections. Only South Asia and Sub-Saharan Africa have slightly higher net cereal imports under this scenario than under full multilateral liberalization of agricultural trade.

Full trade liberalization has a relatively greater effect on meat trade, production, and demand than on cereals because protection levels are generally higher for livestock products. Of the major livestock exporting regions, Latin

Table 4.1 Net Cereal Trade in 2020 under Baseline and Four Agricultural Trade Liberalization Scenarios (millions of metric tons)					
Region	Baseline	Full multilateral liberalization	Developed countries only liberalize	Developing countries only liberalize	Partial (50 percent) multilateral liberalization
West Asia and North Africa	-74.3	-80.1	-76.2	-78.2	-77.0
Latin America	-3.7	-3.7	-4.9	-2.5	-3.7
Sub-Saharan Africa	-23.7	-24.5	-22.7	-25.4	-23.9
East Asia	-62.8	-62.2	-61.0	-64.0	-62.7
South Asia	-19.5	-19.7	-19.4	-19.8	-19.9
Southeast Asia	-8.2	-10.4	-7.7	-10.9	-9.2
Asia	-90.5	-92.3	-88.1	-94.6	-91.8
Developed countries	193.3	201.7	193.0	202.9	197.5

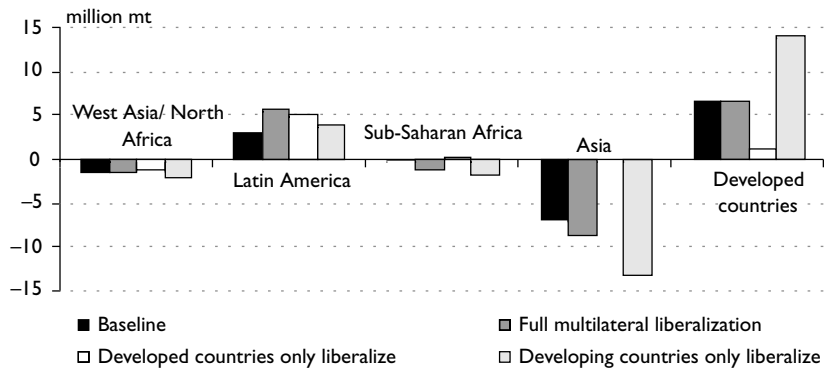
Source: Authors' estimation using IMPACT.

America sees a substantial increase in meat exports from the opening of both developed and developing country markets, with a large part of the increase coming from Argentina and Brazil. However, meat exports from developed countries remain about the same, with the increase in meat imports caused by the reduction in Asian and other developing countries’ protection offsetting the increase in Latin American meat exports (figure 4.1). The net meat trade projections under the partial multilateral trade liberalization (not shown in figure 4.1) are between the baseline and full trade liberalization results, except for West Asia and North Africa, East Asia, and developed country regions, where trade hardly changes.

The most dramatic impacts on meat trade arise from the developed and developing country only scenarios. Developed country trade liberalization causes Asian imports to drop dramatically, with the largest decline in East Asia, where imports plunge from 5.9 mmt to 0.3 mmt compared with the baseline. Sub-Saharan Africa shifts from being a net importer to being a net exporter of meat products, while Latin American exports increase over the baseline. These outcomes in developing countries reduce developed countries’ exports to a sixth of their baseline levels.

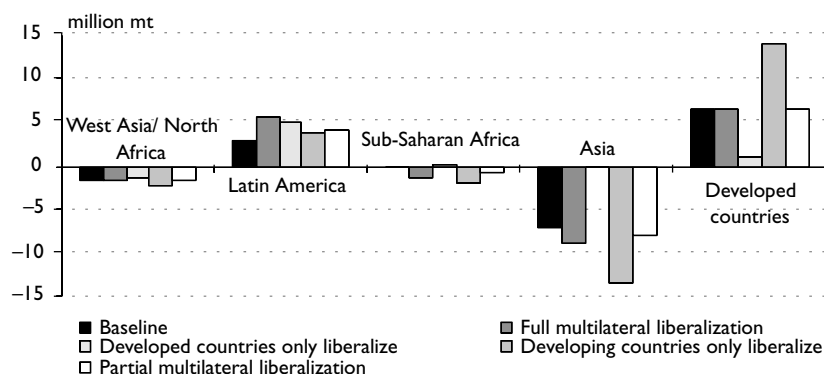
If only developing countries eliminate trade barriers and subsidies, meat imports into developing countries increase sharply. Only Latin America has higher imports than in the baseline because Argentina and Brazil improve their competitiveness relative to other developing countries. Compared with results under the other two scenarios, however, Latin America’s trade position worsens. With the elimination of trade protection and subsidies, Asian meat imports nearly double from 7 mmt to 13 mmt compared with the baseline, while West Asia and North Africa’s meat imports rise by about 25 percent.

Figure 4.1 Net Meat Trade in 2020 under Baseline and Three Agricultural Trade Liberalization Scenarios



Source: Authors’ estimates using IMPACT.

Figure 4.2 Net Milk Trade in 2020 under Baseline and Three Trade Liberalization Scenarios



Source: Author's estimation using IMPACT .

Milk is also substantially affected by changes in trade policy (figure 4.2). While all major developing regions are net importers under the baseline scenario, most become net exporters under the full and developed country only agricultural trade liberalization scenarios. Only West Asia and North Africa remains a net importer under the full multilateral liberalization scenario, but its imports fall from 6.6 mmt to 5.1 mmt.

Under the developing country-only liberalization scenario, only Sub-Saharan Africa becomes a net exporter, while all other developing regions at least double their milk imports compared with the baseline as they remove protection while the developed world does not. The partial liberalization scenario (not shown in figure 4.2) again generates results that fall between the baseline and the full trade liberalization scenario. This means that Latin America, West Asia and North Africa, and Asia remain net importers, and Sub-Saharan Africa becomes a net exporter.

IMPACTS ON COMMODITY PRICES

Removing trade barriers in all countries could substantially boost cereal prices in 2020, with increases of 8–13 percent above the projected baseline levels (table 4.2). Rice prices increase 13 percent, followed by maize, wheat, and other coarse grains. Meat and milk prices respond to full trade liberalization with even sharper price increases above baseline levels because price distortions under the baseline scenario are greater than for cereals. For meat the smallest price increase is for pork, at 10 percent. Poultry prices rise 12 percent, beef 18

Table 4.2 World Prices in 2020 under Baseline and Four Trade Liberalization Scenarios (Percentage change from baseline)

	Baseline (US\$ per metric ton)	Full multilateral liberalization	Developed countries only liberalize	Developing countries only liberalize	Partial (50 percent) multilateral liberalization
Beef	1,748	18.0	5.2	12.4	8.1
Pork	2,245	9.5	0.4	7.2	3.5
Poultry	716	11.9	3.8	8.1	5.6
Sheep and goat	2,841	18.9	5.2	13.2	8.6
Milk	292	32.5	19.2	11.6	14.0
Wheat	123	8.1	0.8	8.1	4.1
Rice	252	13.1	1.6	11.5	6.0
Maize	104	9.6	2.9	6.7	4.8
Other coarse grains	89	7.9	1.1	7.9	4.5

Source: Authors' estimation using IMPACT.

percent, and sheep and goat meat 19 percent. Milk prices increase at a steep 33 percent. The removal of the price distortions therefore has a greater impact on livestock producers and consumers than on cereal producers and consumers.³

As expected, full trade liberalization has bigger impacts on world prices than the other scenarios do. When only developing countries liberalize, rice changes average about two-thirds of those under full trade liberalization. Price impacts are even smaller under the developing countries only and partial trade liberalization scenarios.

ECONOMIC BENEFITS OF TRADE LIBERALIZATION

Although trade and prices are important indicators for evaluating the effects of the various trade liberalization scenarios, most important are the net economic benefits under each scenario. In the partial equilibrium analysis undertaken here, the net economic benefits from full trade liberalization are estimated as the net benefits to producers (change in producer surplus) plus the net benefits to consumers (change in consumer surplus) plus the tax savings from removal of subsidies compared with the baseline results in 2020.

Full multilateral liberalization of trade for the 16 commodities in the model would generate estimated annual global benefits of \$24.4 billion in 2020 (table 4.3). Both developed regions and developing regions benefit. Developed regions gain \$10 billion, and developing regions gain \$14.4 billion. Latin America is the

Table 4.3 Net Economic Benefits in 2020 under Baseline and Trade Liberalization Scenarios (US\$ billions)

	Full multilateral liberalization	Developed countries only liberalize	Developing countries only liberalize	Partial (50 percent) multilateral liberalization
West Asia and North Africa	1.9	−0.2	2.4	0.9
Latin America	3.7	2.9	1.2	1.6
Sub-Saharan Africa	3.3	0.8	2.2	1.3
East Asia	3.0	1.3	1.1	1.1
South Asia	2.0	6.9	−2.1	1.3
Southeast Asia	0.4	0.3	0.2	0.1
Developing countries	14.4	12.0	4.9	6.3
Developed countries	10.0	4.7	13.3	4.8
World	24.4	16.7	18.2	11.1

Source: Authors' estimation using IMPACT.

biggest single gainer at \$3.7 billion, followed by Sub-Saharan Africa at \$3.3 billion. Latin America's benefits come primarily from the beef and milk sectors. Sub-Saharan Africa gains broadly through meat, milk, and cereal commodities. Amounting to nearly 8 percent of the 2020 annual production value of the commodities assessed here, the high benefits are due to reduced competition from subsidized exports from developed countries and to the removal of the costly subsidies and taxes imposed on food production and consumption in many African countries.⁴

Under developed country only trade liberalization, the global gains, at \$16.7 billion, are not as high as those under full trade liberalization, but the developing country share is 72 percent, substantially higher than under full trade liberalization. West Asia and North Africa is the only region to experience negative net economic benefits under this scenario, reflecting large losses for consumers in the cereal sector. South Asia is the only region that gains more than under full liberalization (\$4.9 billion more), while the other developing regions experience lower benefits than under the full trade liberalization scenario.

Similarly, under developing country only trade liberalization, developed countries are the big winners, with projected annual benefits in 2020 of \$13.3 billion, compared with \$4.9 billion for developing countries. South Asia (predominantly India) is the only region experiencing net economic losses (\$2.1 billion), again mainly because of losses to consumers, although in the livestock and milk sectors rather than the cereal sector. The partial trade liberalization scenario generates net economic benefits that are between a fourth and a half of those under full trade liberalization.

CONCLUSION

This partial equilibrium analysis of four agricultural trade liberalization scenarios finds little change in cereal trade under the four scenarios but substantial change in livestock trade. Agricultural commodity prices increase under all scenarios, with the largest increase under full multilateral trade liberalization. The analysis of net economic benefits shows that both developing and developed countries are harmed by trade protection and that full agricultural trade liberalization would generate significant economic benefits. Global net economic benefits are highest under the full multilateral trade liberalization scenario, and developing and developed countries broadly share these benefits. Sub-Saharan Africa, the world's poorest region, is among the biggest winners from agricultural trade liberalization.

An important finding is that the net economic benefits for developing countries from liberalizing their own agricultural economies without comparable trade liberalization by the developed countries are far lower than gains for developed countries and far lower than developing country gains under full liberalization. The same is true for developed countries, which benefit far less than developing countries from developed country only liberalization and far less than under full liberalization. The asymmetrical benefits of unilateral trade liberalization show the importance of the WTO in facilitating mutually beneficial trade liberalization. As a negotiating, coordinating, and monitoring institution, the WTO can alleviate concerns over unequal benefits from unequal implementation of agricultural trade liberalization and facilitate mutually beneficial reciprocal liberalization.

NOTES

1. These sources include Ingco and Ng (1998); Fan and Tuan (1998); Finger, Ingco, and Reincke (1996); McDougall, Elbehri, and Truong (1998); UNCTAD (various years); Valdés (1996); and Valdés and Schaeffer (1995a, b, c, d).
2. Other developed countries include Canada, Iceland, Israel, Malta, New Zealand, Norway, South Africa, and Switzerland.
3. The net effect on consumers of an increase in prices due to full multilateral trade liberalization depends on the distortions consumers face under the current trading regime. While international cereal and livestock prices will increase under trade liberalization, consumers living in countries that heavily tax agriculture will pay lower prices overall.
4. The estimated world price and global net benefits are similar to those estimated by Diao, Somwaru, and Roe (2001) using a general equilibrium model for full agricultural trade liberalization and including a few additional commodities such as sugar and fruits and vegetables. Diao, Somwaru, and Roe estimate static welfare net benefits of \$31.1 billion and an 11.6 percent increase in the index of world agricultural prices. However, the results here show a considerably larger share of benefits accruing to developing countries—59 percent compared with 8 percent for Diao, Somwaru, and Roe.

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CHAPTER FIVE

Projecting the Effects of Agricultural Trade Liberalization on Developing Countries Using the ATPSM Partial Equilibrium Model

David Vanzetti and Ramesh Sharma

The Doha Development Agenda clearly recognizes that progress in multilateral trade negotiations requires giving greater consideration to the interests of developing countries than they have received so far. To help developing countries evaluate negotiating proposals, this chapter identifies the sources of gains and losses to developed and developing countries and their commodity sectors from trade liberalization using the Agricultural Trade Policy Simulation Model (ATPSM), a deterministic, comparative static, partial equilibrium trade model.¹ ATPSM provides detailed coverage of agricultural products, a high degree of country disaggregation and information on tariffs and quota rents, export subsidies, and domestic support policies. It also identifies the interaction between industries and policies.

The model is used to quantify the impacts on prices, welfare, and trade flows of partial and complete multilateral agricultural trade liberalization by developed countries, developing countries, and both groups of countries. Simulation results suggest that global welfare gains from partial liberalization are relatively small, at about \$19 billion. Most gains come from reforms of

temperate-zone basic foods, and little from tropical products. Many developing and least developed countries experience a welfare loss from the rise in world prices and the loss of quota rents, but all experience increased exports.

TARIFF RATE QUOTAS AND QUOTA RENTS

Changes in trading rules and policies introduced by the Uruguay Round created new challenges in modeling liberalization's gains and losses. In the case of market access, for example, the Agreement on Agriculture led to the establishment of a two-tier tariff system based on import quotas—the tariff rate quota system—for 1,371 tariff lines. Tariff rate quotas complicate the modeling of market access because a simple tariff reduction may have little impact on trade flows, for several reasons:

- Where the applied rate is below the bound rate, reductions in bound rates may have no impact on domestic prices or trade flows.
- Where there is water in the tariff, tariff reductions may have little or no impact on trade flows.
- Where the tariff quota is filled and the outside-quota tariff is prohibitive, changing the tariff may have no impact on imports.
- The quota may not be filled, but administrative problems may nonetheless limit imports.

Data needs are also greater, calling for information on within-quota and outside-quota tariffs, import quotas, and fill rates.

Quotas and other quantitative restrictions generate rents, as importers can import at one price and sell at a higher price.² The shares of quota rents and tariff revenue depend on the relative difference between the within-quota and outside-quota tariffs and on the size of the import quota. Because tariff rate quota policy differs by country, it is difficult to determine whether an increase in import quotas or a decrease in tariffs will have a greater liberalizing effect on trade. Therefore, there is no general rule on how quota rents and tariff revenues will change with trade liberalization.

Any of the tariff rate quota system's three instruments—within-quota tariffs, import quotas, and over-quota tariffs—may be binding at any one time, with different effects on quota rents³:

- If the within-quota tariff is binding, the quota is unfilled, domestic prices equal world prices plus the within-quota tariff, and there is no quota rent.
- If the quota is binding, imports equal the quota and the rent is positive but indeterminate.
- If the outside-quota tariff is binding, imports exceed the quota and the rent is the quota times the difference between the within-quota and outside-quota tariff rates.

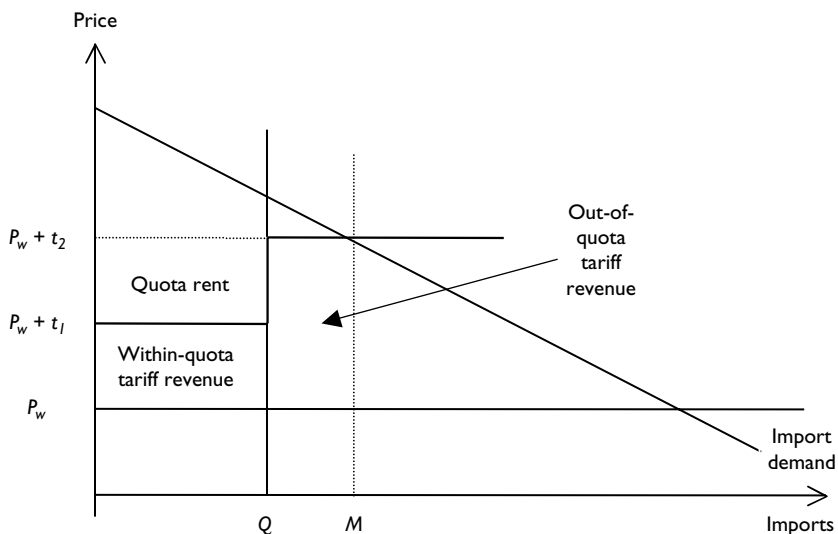
The third case appears to be the most relevant. Of particular interest is what happens to rents and tariff revenue in this situation as within-quota tariffs, outside-quota tariffs, and import quotas are altered (figure 5.1):

- A reduction in within-quota tariffs will increase quota rents and decrease tariff revenue.
- A reduction in outside-quota tariffs will decrease quota rents and outside-quota tariff revenue.
- An increase in the import quota may merely increase quota rents and decrease tariff revenue. With a large enough increase the quota rather than the outside-quota tariff becomes binding and the outside-quota tariff revenue is eliminated.

Quota rents are large enough to have economic effects. Measuring the rents requires data on global quotas, bilateral quotas, within-quota and outside-quota tariffs, world market prices, imports, and the rent capture rate.

Ideally, the import quota fill rate determines the domestic price. If the quota is unfilled, domestic prices should be determined by the within-quota tariffs, and prices should be high only if the quota is filled or overfilled. Yet it is often the case that quotas are unfilled, but domestic prices are nonetheless high. This may be because administrative constraints impede filling the quotas. Countries with high domestic prices are unlikely to accept price erosion caused by a rise in the supply of imports. As a result, the assumption here is that the outside-quota tariff (or possibly the applied tariff) determines the domestic market

Figure 5.1 Quota Rents with a Binding Outside-Quota Tariff



price. This implies that global quotas should not exceed imports. Calculation of tariff revenues and rents is based on this assumption.

THE MODELING FRAMEWORK

ATPSM is a deterministic, comparative static, partial equilibrium model that also accounts for the distribution of quota rents. This means that there are no stochastic shocks or other uncertainties, and there is no specific time dimension for implementation of the policy measures or the maturing of their economic effects. The comparative static nature of the model does not imply that the policies take effect instantaneously. Rather, it enables comparing two states at a similar point in time, one with the policy change and one without it. Finally, whereas the model aims at estimating far-reaching details of the agricultural economy, it does not deal with the repercussions of barrier reductions on other parts of the national economy. Thus, there is no analysis of the effects on the government budget (except for tariff revenues and subsidies to exports and domestic production) or on the industrial and service parts of the economy or the labor market.

Simplifying the model in these respects allows for detailed specification of policies in a large number of countries for numerous commodities. ATPSM features a high level of disaggregation by agricultural commodity (36) and country (161). A feature of the model is two-way trade: each country may import and export the same product. An Armington specification is issued to determine changes in imports and exports.

Model Equations

The equation system for all countries has four basic equations:

$$\hat{D}_{i,r} = \eta_{i,i,r} \left[\hat{P}_{wi} + \left(1 + \hat{t}_{ci,r} \right) \right] + \sum_{\substack{j=1 \\ i \neq j}}^J \eta_{i,j,r} \left[\hat{P}_{wj} + \left(1 + \hat{t}_{cj,r} \right) \right] \quad (1)$$

$$\hat{S}_{i,r} = \varepsilon_{i,i,r} \left[\hat{P}_{wi} + \left(1 + \hat{t}_{pi,r} \right) \right] + \sum_{\substack{j=1 \\ i \neq \varphi}}^J \varepsilon_{i,j,r} \left[\hat{P}_{wj} + \left(1 + \hat{t}_{pj,r} \right) \right] \quad (2)$$

$$\Delta X_{i,r} = \Delta M_{i,r} - D_{i,r} \hat{D}_{i,r} + S_{i,r} \hat{S}_{i,r}; \quad (3)$$

$$\Delta M_{i,r} = \frac{A_{new}}{1 + A_{new}} D_{i,r} \hat{D}_{i,r} - \left(\frac{A_{init}}{1 + A_{init}} - \frac{A_{new}}{1 + A_{new}} \right) D_{i,r}, \text{ where } A_y = \left(\frac{\alpha_m}{\alpha_d} \left(\frac{P_d}{P_m} \right)^y \right)_{i,r}^\sigma; \quad (4)$$

where D , S , X , and M are demand, supply, exports, and imports respectively and \wedge denotes relative changes and Δ absolute changes; P_w is world price; t_c is the domestic consumption tariff and t_p denotes the domestic production tariff; ε is the supply elasticity; η is the demand elasticity; γ is the ratio of exports to production; i and j are commodities indexes; r is a country index; and $(P_d/P_m)_y = [P_w(1 + t_d)/(P_w(1 + t_m))]_y$, with: $y = init$ indicates initial values, $y = new$ indicates values after the policy changes, and σ denotes the Armington elasticity between imports and domestically produced goods.

Equation 4 specifies that the relationship between imports and domestic supply is determined by the price ratio of domestic supply and imports:

$$\frac{M}{D - M} = \left(\frac{\alpha_m}{\alpha_d} \frac{P_d}{P_m} \right)^\sigma. \quad (5)$$

Equation 3 clears the market, so that production plus imports equals domestic consumption and exports.

These equations can be transformed into matrix notation and the equation system solved for world prices by matrix inversion. A market equilibrium requires that, globally, the sum of the change in exports equals the total change in imports for each commodity:

$$\sum_{n=1}^N (\Delta X_n - \Delta M_n) = 0. \quad (6)$$

Prices

It can be observed from equations 1 and 2 that domestic prices are functions of the world market price and border protection or special domestic support measures. Thus, domestic price data are not required and transaction costs (such as wholesale and retail margins) are not taken into account. All protection measures are expressed in tariff rate equivalents.

The relationship between world and domestic prices is complicated by the existence of two-way trade of the one (aggregated) good. To accommodate heterogeneous goods with one price, composite tariffs are estimated for determining the domestic consumption and production prices. Products are divided into three groups—imports, exports, and production supplied to the domestic market (S_d)—to derive a composite price.

First, a domestic market price wedge (t_d) is computed as the weighted average of the export tariff (t_x) and the import tariff (t_m), where the weights are exports (X) and imports (M):

$$t_d = (X t_x + M t_m)/(M + X). \quad (7)$$

A consumer price wedge is computed as the weighted average of the import tariff and the domestic market price wedge, where the weights are imports and domestic supply:

$$t_c = (M t_m + S_d t_d) / D. \quad (8)$$

A producer price wedge is computed as the weighted average of the export tariff and the domestic market price wedge, where the weights are exports and domestic supply plus the domestic support tariff:

$$t_s = (X t_x + S_d t_d) / S + t_p. \quad (9)$$

The consumer and producer price wedges are added to the border price to give domestic prices. These calculations are applied to both the baseline and the final tariffs.

Trade Revenue and Welfare Effects

Once changes in world prices and domestic prices are determined from the model solution, volume changes can be derived from equations 1–4. Given the volume responses ΔX , ΔM , ΔS , and ΔD , the trade revenue and welfare effects can be computed. The trade revenue effect of the policy changes is computed for each country and each commodity from (with $P_{w\text{-new}}$ as the new world price):

$$\Delta R = (P_{w\text{-new}})[(X + \Delta X) - (M + \Delta M)] - P_w(X - M). \quad (10)$$

Welfare comprises producer and consumer surpluses plus change in government revenue. The producer surplus includes quota rents, U , calculated for each country and each commodity as the volume of imports times the world price times the difference between the within-quota and outside-quota tariffs:

$$U = QP_w(t_{m2} - t_{m1}) \quad (11)$$

where Q is the import quota, P_w is the world price, t_{m1} is the within-quota tariff, and t_{m2} is the outside-quota or applied tariff. Rent accrues only if the importing country is applying the outside-quota tariff. A capture rate, c , determines the proportion of the rent captured by exporting producers. This change in quota rent received is added to the producer surplus, as in equation 12. For each country and commodity, changes in producer surplus and consumer surplus are determined as follows:

$$\Delta PS = \Delta P_p[S + 0.5(\Delta S_d)] + c\Delta U \quad (12)$$

$$\Delta CS = -\Delta P_c[D + 0.5(\Delta D_d)]. \quad (13)$$

The third part is the change in net government revenue, ΔNGR . For each country and commodity ΔNGR is calculated as the change in tariff revenue, the change in export subsidy expenditure, and the change in domestic support expenditure:

$$\begin{aligned}
\Delta NGR &= \Delta TR - \Delta ES - \Delta DS + (1 - c)\Delta U \\
&= \underbrace{(t_w + \Delta t_w)(Q + \Delta Q) - t_w Q}_{\text{Change in within-quota revenue}} + \underbrace{(t_o + \Delta t_o)[(M + \Delta M) - (Q + \Delta Q)] - t_o(M - Q)}_{\text{Change in out-of-quota revenue}} \\
&\quad - \underbrace{[(t_x + \Delta t_x)(X + \Delta X) - t_x X]}_{\text{Change in export subsidy expenditure}} - \underbrace{[(t_d + \Delta t_d)(S + \Delta S) - t_d S]}_{\text{Change in domestic support expenditure}} \\
&\quad + \underbrace{(1 - c)\Delta U}_{\text{Change in quota-rent-forgone.}}
\end{aligned} \tag{14}$$

The total welfare effect is the sum of the changes in the producer surplus, consumer surplus, and net government revenue:

$$\Delta W = \Delta PS + \Delta CS + \Delta NGR. \tag{15}$$

For the 20 countries for which there is no information on agricultural trade policies, there is no change in net government revenue and changes in producer and consumer surplus occur only as a result of changes in the world price.

APTSM is able to estimate the economic effects of changes in within-quota and outside-quota tariffs; import, export, and production quotas; export subsidies and domestic support on production; consumption; prices; trade flows; trade revenues; quota rents; producer surplus; and welfare.

Country and Commodity Coverage

The model covers 161 economies, with the European Union-15 counted as one (table 5.1). Most of the countries that are not covered are small island economies. Each country's economy is represented, except for members of the European Union. Policy changes are assumed to occur in 141 countries for which policy data are available, including several countries that are not WTO members. Countries designated as developed are defined by the World Bank (2001) as high-income countries with per capita GNP greater than \$9,266 in 2000. The model includes 42 of the 50 countries designated as least developed countries.

ATPSM commodity coverage includes temperate-zone products that have particularly high trade and other protectionist barriers (table 5.2). Also included are products of interest to many developing countries, referred to here as tropical-zone products even though some are nontropical products.

Data

Quantity data are for 2000 and are compiled from Food and Agriculture Organization (FAO) supply utilization accounts. The price data, from FAOSTAT, are averages for 1996–98. Parameters on elasticities and feed shares are from FAO's World Food Model. These are based on a trawling of the literature and are not

Table 5.1 Country Coverage in ATPSM

Developed countries	Developing countries		Least developed countries
Australia	Albania	Latvia	Afghanistan
Brunei	Algeria	Lebanon	Angola
Canada	Argentina	Libya	Bangladesh
Cyprus	Armenia	Lithuania	Benin
European Union-15	Azerbaijan	Macedonia	Burkina Faso
French Polynesia	Bahamas	Madagascar	Burundi
Hong Kong, China	Barbados	Malawi	Central African Republic
Iceland	Belarus	Malaysia	Cambodia
Israel	Belize	Malta	Cape Verde
Japan	Bolivia	Mauritius	Comoros
Kuwait	Bosnia and Herzegovina	Mexico	Congo, Dem. Rep.
Macao	Botswana	Moldova	Djibouti
Netherlands Antilles	Brazil	Mongolia	Eritrea
New Zealand	Bulgaria	Morocco	Ethiopia
Norway	Cameroon	Namibia	Gambia
Slovenia	Chad	Nicaragua	Guinea
Switzerland	Chile	Nigeria	Guinea Bissau
Taiwan, China	China	Pakistan	Haiti
United Arab Emirates	Colombia	Panama	Lao PDR
United States	Congo, Rep.	Papua New Guinea	Lesotho
	Costa Rica	Paraguay	Liberia
	Côte d'Ivoire	Peru	Malawi
	Croatia	Philippines	Maldives
	Cuba	Poland	Mali
	Czech Republic	Romania	Mauritania
	Dominica	Russia	Mozambique
	Dominican Republic	Saudi Arabia	Myanmar
	Ecuador	Seychelles	Nepal
	Egypt	Slovakia	Niger
	El Salvador	South Africa	Rwanda
	Estonia	Sri Lanka	São Tomé and Príncipe
	Fiji	St. Lucia	Senegal
	Gabon	St. Vincent & Grenadines	Sierra Leone
	Georgia	Suriname	Solomon Islands
	Ghana	Swaziland	Somalia
	Grenada	Syria	Sudan
	Guatemala	Tajikistan	Tanzania
	Guyana	Thailand	Togo
	Honduras	Trinidad and Tobago	Uganda
	Hungary	Tunisia	Vanuatu
	India	Turkey	Yemen
	Indonesia	Turkmenistan	Zambia
	Iran	Ukraine	
	Iraq	Uruguay	
	Jamaica	Uzbekistan	
	Jordan	Venezuela	
	Kazakhstan	Vietnam	
	Kenya	Yugoslavia	
	Korea, DPR	Zimbabwe	
	Korea, Rep. of		
	Kyrgyz Republic		

Note: The least developed countries not included in the model are Bhutan, Chad, Equatorial Guinea, Kiribati, Madagascar, Samoa, Tuvalu, and Timor Leste.

Table 5.2 Commodities Coverage in ATPSM, by Standard International Trade Classification (SITC) Code

SITC code	Product	SITC code	Product
01100	Bovine meat	05730	Bananas
01210	Sheep meat	05790	Other tropical fruits
01220	Pig meat	06100	Sugar
01230	Poultry	07110	Coffee, green
02212	Milk, fresh	07120	Coffee, roasted
02222	Milk, concentrate	07131	Coffee, extracts
02300	Butter	07210	Cocoa beans
02400	Cheese	07220	Cocoa powder
04100	Wheat	07240	Cocoa butter
04200	Rice	07300	Chocolate
04300	Barley	07410	Tea
04400	Maize	12100	Tobacco leaves
04530	Sorghum	12210	Cigars
05420	Pulses	12220	Cigarettes
05440	Tomatoes	12230	Other tobacco, manufactured
05480	Roots and tubers	22100	Oil seeds
05700	Nontropical fruits	26300	Cotton lint
05710	Citrus fruits	42000	Vegetable oils

econometrically estimated specifically for the model. The Armington elasticity, specifying the relationship between consumption of domestic production and imports, is 2.2, taken from the Global Trade Analysis Project (GTAP) database.

Within-quota tariffs, outside-quota tariffs, and global quotas notified to the WTO are obtained from the Agricultural Market Access Database (AMAD) where available and aggregated to the ATPSM commodity level.⁴ Information on applied tariffs is from the United Nations Conference on Trade and Development (UNCTAD) Trade Analysis and Information System (TRAINS) database. Export subsidy and set-aside data are notified to the WTO. Bilateral trade flow data relate to 1995 and are from the United Nations Statistics Division Commodity Trade Statistics database (Comtrade). The trade flow data are used to allocate global quotas to individual countries.

There is uncertainty in the tariff data because some tariffs have been converted from specific or compound tariffs to ad valorem equivalents using some measure of value. As world prices change, the ad valorem equivalents are affected even though the specific tariffs remain unchanged. For this reason, tariffs are revised from time to time.

SIMULATIONS

Several simulations are undertaken to illustrate the source of the gains from trade reform under four agricultural liberalization scenarios:

- Developed countries only liberalize, with a 100 percent reduction in outside-quota tariffs, within-quota tariffs, export subsidies, and domestic support for all 36 commodities in all developed countries.
- Developing countries only liberalize, with a 100 percent reduction in outside-quota tariffs, within-quota tariffs, export subsidies, and domestic support for all 36 commodities in all developing countries.
- Full multilateral liberalization, with a 100 percent reduction in outside-quota tariffs, within-quota tariffs, export subsidies, and domestic support for all 36 commodities in all countries.
- Partial multilateral liberalization, with a 50 percent reduction in outside-quota tariffs, within-quota tariffs, export subsidies, and domestic support for all 36 commodities in all countries. (A 50 percent tariff cut does not necessarily imply that the gap between domestic and world prices is reduced by 50 percent. Applied tariffs are often below the outside-quota rates, so the actual cut may be less than 50 percent and may even be zero.)

All simulations include reductions in export subsidy rates. It is assumed that the rates are binding and that domestic prices are reduced according to the proportion of exports in domestic production.

The major interest is to determine whether developing countries gain most from improved market access from developed country liberalization or whether reform of their own markets is equally or more beneficial. Most of the discussion focuses on tariff reform, as this has the greatest impact on developing countries. Also of interest is identifying commodities for which trade reforms are most beneficial for developing countries. For example, sugar and oilseeds are areas where temperate- and tropical-zone products are substitutable and developed country protection is quite substantial.

The domestic support measures used here are contentious and require a cautionary note. The Uruguay Round Agreement on Agriculture calls for reductions in production-distorting (amber box) domestic support. However, it is not clear to what extent different forms of domestic support distort production and trade. Direct income support and payments to factors of production have less effect on output than payments on output. In addition, some administered prices appear to provide domestic support, but such policies actually rely on border measures for their effect. Double counting can occur where domestic support is conflated with border protection.

The ATPSM database attempts to avoid this by excluding some amber box support as well as all green box and blue box (production limiting) support. The exclusion of blue box items in EU domestic support is debatable, since it is difficult to assess whether the production limits offset the additional support. This approach implies low rates of domestic support for the European Union and the United States and few gains from reform of these policies.

The assumption of filled quotas implies that changes in within-quota tariffs

and import quotas will not have price and quantity effects, as these instruments are not binding. (They do, however, change the distribution of rents.)

Global quotas, specifying the total level of imports at the lower tariff level, are notified to the WTO, but most bilateral quotas are not reported and have to be estimated. The model uses bilateral trade flows to estimate the bilateral quota distribution. The model measures the rents forgone by importers. Global rents forgone equate with rents receivable. Rent is allocated either to exporter producers or importer governments. It is assumed that all rent generated from sugar and half that from bananas accrues to the supplier and that the remainder is captured by importing governments, as if import quotas were auctioned.

ESTIMATION RESULTS

ATPSM generates prices, quantities, quota rents, tariff revenue, and welfare estimates for each of the 36 commodities for each of the 161 countries. Summarizing this information involves aggregating much individual country and commodity data. There are several ways of providing an overview of the impacts of reform. Welfare measures by country or country group indicate whether the higher prices of imported goods outweigh the efficiency effects of reform. Welfare and exports may move in different directions. Negotiators and sometimes industry representatives are inclined to regard trade flows and government revenues as more important than welfare. Countries reducing export subsidies or domestic support are likely to see their exports diminish despite an increase in welfare. As there are adjustment costs associated with changes in production and trade flows, these are relevant considerations.

Welfare Effects

Welfare gains are measured as consumer and producer surpluses, government revenue (within-quota and outside-quota tariff revenue less export subsidies and domestic support), and quota rent. These welfare measures are calculated from initial and final quantities and prices for each commodity and are relative to the base data (2000) for quantities. No account is taken of income effects or of possible interactions between commodities.

Results by Country Group

Many developing countries and least developed countries are net food importers. The importance of domestic reform rather than improved market access as a source of welfare gains is illustrated by the results for the first two scenarios. Developed countries as a group capture all the gains when they alone liberalize (table 5.3). Developing countries and least developed countries are made worse off because the loss in quota rents (in sugar and bananas) and the rising prices for imports are not offset by efficiency gains from liberalization. This result is driven by the removal of export subsidies, which raises prices for

Table 5.3 Changes in Welfare under Four Agricultural Liberalization Scenarios (US\$ millions)

Affected group	Developed countries only liberalize	Developing countries only liberalize	Full multilateral liberalization	Partial (50 percent) multilateral liberalization
Developed countries	25,300	-1,142	17,742	15,248
Developing countries ^a	-1,908	11,373	5,325	2,695
Least developed countries	-356	-239	718	803
World	23,036	9,991	23,784	18,747

Source: Authors' estimation using ATPSM.

a. Excludes the least developed countries.

importers without providing allocative efficiency gains. Developing countries would lose \$1.9 billion from developed country liberalization, whereas they gain \$11.3 billion from their own liberalization. This negative welfare impact on nonliberalizers disappears when all countries liberalize, because developing countries and least developed countries gain from their own liberalization and from improved market access. This result implies that developing countries as a group need to do more than ask developed countries to open their markets.

All groups gain when liberalization is multilateral, either partial or total. The partial liberalization scenario shows the benefit of reducing peak tariffs. Because efficiency losses increase exponentially with tariffs, reducing a tariff from 100 percent to 50 percent gives far greater gains than removing the remaining 50 percent. The gains are less, however, if there is a large difference between applied tariffs and the bound (outside-quota) tariffs from which the cuts are made. If the applied tariff is 50 percent below the bound rate, a 50 percent cut will have no effect. Of the three economies sharing the bulk of the welfare gain from partial multilateral liberalization (the European Union, Japan, and the United States), only Japanese pig meat and sugar have applied rates that are below bound rates.

The distribution of gains from partial liberalization is uneven. Of the \$19 billion in global welfare gains developing countries enjoy \$2.7 billion, or 14 percent. Their share rises to 22 percent under full liberalization. The gains to developing countries seem relatively small, particularly under partial liberalization. One reason is that little or no liberalization occurs in many markets because of the discrepancy between bound and applied rates in many developing countries. Another reason is that domestic support and export subsidies are much lower in developing countries (\$1.2 billion) than in developed countries (\$12 billion), which means that developed countries gain more because they have more protection to remove. This compares with tariff revenues of \$36 billion, of which \$16 billion accrue to developed countries.

Quota rents and tariff revenues contribute to welfare. The elimination of tariffs eliminates both quota rents and tariff revenues. Quota rents of \$788 million on sugar and \$390 million on bananas are assumed to go from developed to (mainly) developing countries. This is treated in the model as a straight transfer with no impact on volumes or prices. This is essentially the impact of preference erosion as most-favored nation rates are reduced toward within-quota rates in the partial liberalization scenario or eliminated altogether in the full agricultural liberalization scenario. However, when developing countries liberalize, they continue to receive rents forgone by developed countries.

The elimination of tariff revenues is a concern to developing countries that rely heavily on this source of revenue. However, tariff revenues decline much less than 50 percent under a partial tariff reduction because of the increase in trade flows. Under the partial liberalization scenario global tariff revenues drop only marginally, from \$36.2 billion to \$34.9 billion, with developing country revenues falling from \$18.8 billion to \$16.7 billion.

Results by Country

The pattern of welfare gains suggests that the bulk of the gains from liberalization can be attributed to the efficiency gains from domestic reform rather than from improved market access. This implies that the economies with the greatest levels of protection will see the greatest gains: the European Union gains \$7.8 billion in the full liberalization scenario, the United States \$2.6 billion, and Japan \$2 billion. Among developing countries Argentina, Mexico, and India each gain \$1.1 billion; Romania gains \$941 million, Malaysia \$675 million, Brazil \$660 million, and Indonesia \$196 million.

However, there are numerous losers among developing countries. Only 69 of the 161 countries in the model appear to gain from full agricultural liberalization. The 20 countries for which there are no policy data are assumed not to liberalize, thus experiencing only rising world prices and loss of quota rents. The five most notable losers are Russia, at \$702 million; Algeria, at \$325 million; Saudi Arabia, at \$321 million; Hong Kong, China, at \$257 million; and Iran, at \$247 million. Total losses for the 92 countries that are worse off after full agricultural liberalization are \$4 billion, whereas the beneficiaries receive \$28 billion.

Trade Flows

Export revenues do not necessarily move in the same direction as welfare. Where protection is removed, such as in the European Union, reduced trade flows are compatible with increased welfare. Where market access is improved, as for New Zealand's beef and dairy products, increased exports lead to increased welfare.

Export revenues increase for all country groups in all four scenarios (table 5.4). Even least developed countries increase their trade flows. Developing countries enjoy a higher share of the global growth in trade than they do of the

Table 5.4 Changes in Export Revenue under Four Agricultural Liberalization Scenarios (US\$ millions)

Affected group	Developed countries only liberalize	Developing countries only liberalize	Full multilateral liberalization	Partial (50 percent) multilateral liberalization
Developed countries	1,143	21,898	19,967	3,228
Developing countries ^a	33,906	17,681	42,995	19,220
Least developed countries	1,825	2,670	3,283	1,617
World	36,874	42,249	66,245	24,065

Source: Authors' estimation using ATPSM.

a. Excludes the least developed countries.

global increase in welfare. For countries that place a greater weight on trade than on welfare, the impact of liberalization appears more beneficial.

Sectoral Effects

Complete elimination of protection seems unlikely in the current round. If uniform average reductions with minimum cuts in sensitive industries are agreed, as in the Uruguay Round, countries need to know which sectors they should protect. In making this decision it is helpful to know the sources of possible gains and losses by sector. Changes in the international market are driven by a combination of large production or consumption levels coupled with significant protection. In other words, the greatest impact in international markets comes from reforms that affect sectors with high levels of production or consumption and high levels of protection. Most of the impact of reform emanates from effects in the European Union and Japan. In some respects, however, developing countries may experience more significant changes, because agriculture constitutes a greater proportion of national output and trade, and exports tend to be less diversified.

Price Impacts by Commodity

Under partial multilateral liberalization the greatest price changes are in dairy products, livestock products, sugar, and wheat (table 5.5). Among tropical products the most significant price change is in tobacco.

In the meat sector sheep meat prices rise the most, reflecting the cuts in domestic prices for sheep meat in the European Union, where the outside-quota tariff is 89 percent in the base data. Changes in the beef sector appear more modest. Although the European Union has a substantial applied tariff of 138 percent, imports are a smaller share of domestic consumption (3 percent) than for sheep meat (15 percent).

Table 5.5 Changes in World Prices by Commodity under Four Agricultural Liberalization Scenarios (percent)

Product	Developed countries only liberalize	Developing countries only liberalize	Full multilateral liberalization	Partial (50 percent) multilateral liberalization
Bovine meat	7.15	4.09	11.57	4.54
Sheep meat	10.01	5.27	15.49	6.66
Pig meat	2.04	5.63	7.82	3.22
Poultry	2.64	7.91	11.04	4.10
Milk, fresh	10.46	4.23	14.88	6.59
Milk, concentrated	17.12	4.22	23.30	9.08
Butter	25.73	3.94	30.18	13.86
Cheese	19.64	1.47	21.43	9.55
Wheat	11.47	4.11	15.93	7.09
Rice	1.93	2.13	4.46	1.71
Barley	0.35	3.30	4.06	1.39
Maize	3.08	4.68	7.79	2.83
Sorghum	0.61	0.65	1.64	0.51
Pulses	0.78	2.94	8.45	1.28
Tomatoes	3.80	1.18	5.11	2.33
Roots and tubers	1.07	2.89	6.24	2.59
Apples	3.48	3.33	6.94	3.17
Citrus fruits	1.36	1.50	3.37	1.24
Bananas	1.23	1.34	2.82	1.13
Other tropical fruits	0.56	7.26	8.03	2.15
Sugar	5.41	8.01	14.00	5.24
Coffee, green	-0.22	1.37	2.63	0.21
Coffee, roasted	0.40	0.64	1.14	0.39
Coffee, extracts	0.48	9.12	10.02	0.75
Cocoa beans	-0.04	1.39	1.52	0.13
Cocoa powder	1.37	2.54	4.10	1.26
Cocoa butter	1.62	0.55	2.23	0.98
Chocolate	3.01	0.75	11.09	1.78
Tea	0.47	3.60	7.05	1.81
Tobacco leaves	3.33	3.54	6.90	3.17
Cigars	0.78	0.40	8.46	0.67
Cigarettes	0.20	0.10	4.71	0.14
Other tobacco, manufactured	0.03	0.76	19.77	0.39
Oilseeds	0.81	3.24	4.20	1.53
Cotton linters	0.19	3.03	3.93	0.82
Vegetable oils	2.56	9.10	12.80	2.32

Source: Authors' estimation using ATPSM.

The rise in dairy product prices reflects the high tariffs on Japanese imports of milk powder and cheese. The European Union also has significant protection on butter and cheese, and reforms in these markets drive the increase in world prices.

In the cereals sector wheat has heavy protection in Japan (224 percent) and the European Union (61 percent). Tariff reform in the European Union coupled with removal of export subsidies implies that wheat exports are reduced by 80 percent with no increase in imports, illustrating the importance of export subsidies in some sectors. China is a potentially significant player in the grains market, but its base-year imports are relatively modest compared with those of other players, although it has a significant applied tariff on wheat of 65 percent. Japanese reform dominates the maize market. Japan has a tariff of 23 percent and by far the largest imports.

Rice is thinly traded internationally but is a politically sensitive market. The initial tariffs are estimated at 409 percent in Japan and 72 percent in the European Union. A 50 percent tariff reduction leads to an estimated fall in domestic prices of 21 percent in Japan and 38 percent in the European Union, leading to a 10 percent drop in production in both cases. Imports increase 20 percent in the European Union (44 percent of consumption) and 200 percent in Japan (20 percent of consumption). Despite these significant domestic changes, world prices rise less than 2 percent. Thus it does not appear that liberalization of the global rice market will lessen food security for most countries.

The bulk of the protection in the sugar industry is also in Japan, where the outside-quota tariff is 116 percent and tariff revenues are an estimated \$497 million. The European Union and the United States also have significant imports and high levels of protection. They allocate their import quotas based on historical patterns and, as noted earlier, all the sugar quota rents are assumed to go to exporting producers. Exporters are assumed to receive prices that are 138 percent above the world price in the European Union and 72 percent above it in the United States. Exports under quota to these countries are nominally 1.39 million metric tons to the European Union and 1.14 million metric tons to the United States, amounting to an initial transfer of rents of \$716 million, most of it to developing countries. This is reduced by 47 percent following liberalization. World prices rise by 5 percent following partial reform.

In the vegetable oils markets India is a major player, importing 4.29 million metric tons under an applied tariff of 86 percent. However, with a bound tariff of 220 percent, a 50 percent reduction leaves the applied tariff unchanged. EU liberalization has the biggest impact on the market of liberalization in any country, although its initial tariff is a modest 11 percent. The impact of partial liberalization on the oilseeds market is dominated by Japan, where imports increase by 858 kilotons; China, at 499 kilotons; and the Republic of Korea, at 254 kilotons. Initially, Japan imports 7 million metric tons over a tariff of 70 percent.

EU policies are also responsible for most of the distortions in the markets for some tropical-zone products, although there are few significant price

movements following partial liberalization. Bananas and tobacco are sensitive commodities. The European Union has outside-quota tariffs of 64 percent on bananas and 14–38 percent on tobacco leaves and tobacco products. There are also high levels of domestic support on bananas (42 percent) and tobacco (76 percent), which has an impact on output. It is assumed that suppliers receive half of the generated quota rents on bananas. In the United States a 94 percent tariff on tobacco leaf significantly distorts the market. Among developing countries Egypt is a significant influence, with an outside-quota tariff of 287 percent on tobacco leaf.

Most tropical-zone products face relatively low tariffs in the major developed country markets of the European Union, Japan, and the United States. Tariffs tend to be low on unprocessed products, such as green coffee, cocoa beans, tobacco leaves, and cotton, but higher on processed products as developed countries attempt to protect their processing industries. Of course, there are exceptions. For example, the United States has a high tariff on tobacco leaves but relatively low tariffs on processed tobacco products.

Welfare Impacts by Commodity

Under developed country only liberalization the major gains are in meats, dairy products, cereals, and sugar (table 5.6). For example, welfare increases by \$3.5 billion in the bovine meat sector. There are relatively few gains in beverages and other purely tropical products. Developing country only liberalization generates gains in poultry, maize, apples, and vegetable oils. Mexico is the major beneficiary in the poultry sector. Argentina, China, India, Mexico, and Turkey gain from cheaper maize prices. Romania imports 21 kilotons of apples over an applied tariff of 200 percent. India and Malaysia experience the major welfare gains in the vegetable oils sector.

Trade Flows and Export Revenue by Commodity

Trade flows tell a different story from the welfare results. As expected, exports increase under each scenario across almost all commodities (table 5.7). Partial liberalization provides less than 40 percent of the increase in trade flows that come with full liberalization—in contrast to the welfare effect, where most of the changes come with the initial 50 percent reduction.

IMPLICATIONS AND CONCLUSIONS

The findings presented here have important implications for trade negotiations. And despite some limitation of the model (mentioned below), the results

Table 5.6 Welfare Effects by Commodity under Four Agricultural Liberalization Scenarios (US\$ millions)

Product	Developed countries only liberalize	Developing countries only liberalize	Full multilateral liberalization	Partial (50 percent) multilateral liberalization
Bovine meat	3,527	88	3,078	2,559
Sheep meat	1,179	207	700	819
Pig meat	400	274	628	425
Poultry	506	2,040	2,364	1,351
Milk, fresh	1,512	365	1,455	1,410
Milk, concentrated	735	34	304	406
Butter	843	-73	613	584
Cheese	1,034	30	626	466
Wheat	4,133	-29	1,874	1,721
Rice	2,954	69	2,582	2,350
Barley	859	54	336	534
Maize	439	2,588	1,012	578
Sorghum	26	3	16	18
Pulses	35	21	94	39
Tomatoes	450	301	666	647
Roots and tubers	54	229	823	612
Apples	806	1,037	1,608	1,221
Citrus fruits	163	193	386	299
Bananas	604	80	299	395
Other tropical fruits	72	432	459	196
Sugar	1,075	236	548	746
Coffee, green	2	13	12	5
Coffee, roasted	0	3	2	1
Coffee, extracts	0	3	3	0
Cocoa beans	0	4	4	1
Cocoa powder	0	3	3	1
Cocoa butter	4	2	6	3
Chocolate	178	18	10	78
Tea	2	43	51	40
Tobacco leaves	845	170	1,079	675
Cigars	275	140	455	170
Cigarettes	1	1	0	1
Other tobacco, manufactured	30	54	74	19
Oilseeds	288	332	448	323
Cotton linters	45	34	54	47
Vegetable oils	-41	993	1,111	9
Total	23,036	9,991	23,784	18,747

Source: Authors' estimation using ATPSM.

Table 5.7 Export Revenue Effects by Commodity under Four Agricultural Liberalization Scenarios (US\$ millions)

Product	Developed countries only liberalize	Developing countries only liberalize	Full multilateral liberalization	Partial (50 percent) multilateral liberalization
Bovine meat	4,863	2,512	5,404	1,984
Sheep meat	1,338	583	1,390	716
Pig meat	690	3,525	1,578	950
Poultry	1,558	5,689	5,789	2,257
Milk, fresh	4,167	1,851	4,212	1,993
Milk, concentrated	1,472	373	1,267	664
Butter	1,209	356	1,155	353
Cheese	1,875	493	2,406	600
Wheat	4,395	2,325	5,818	1,504
Rice	1,294	852	1,525	757
Barley	246	299	538	204
Maize	1,153	1,902	2,773	1,005
Sorghum	34	29	71	24
Pulses	52	225	316	75
Tomatoes	3,019	1,123	3,560	1,700
Roots and tubers	604	1,948	3,388	1,425
Apples	3,364	3,444	5,548	2,145
Citrus fruits	594	1,100	2,173	676
Bananas	526	537	1,044	443
Other tropical fruits	496	3,542	3,696	1,261
Sugar	1,789	1,507	2,791	1,037
Coffee, green	-21	185	339	33
Coffee, roasted	10	26	9	11
Coffee, extracts	1	13	16	1
Cocoa beans	-1	82	82	7
Cocoa powder	19	30	28	15
Cocoa butter	48	21	50	28
Chocolate	281	63	604	153
Tea	24	203	268	86
Tobacco leaves	658	612	752	530
Cigars	177	77	1,547	144
Cigarettes	1	1	15	1
Other tobacco, manufactured	1	17	329	9
Oilseeds	593	1,733	1,753	730
Cotton linters	26	403	389	102
Vegetable oils	319	4,570	3,622	445

Source: Author's estimation using ATPSM.

appear reasonably robust and, with their level of detail on developing countries, provide a useful guide to the likely impacts of liberalization.

Limitations of the Analysis

Partial equilibrium analyses need to be complemented with general equilibrium results to yield deeper insights into the impact of reform, particularly the distribution of gains and losses. Partial equilibrium analysis results in welfare gains that are significant yet hardly substantial, although once the reforms are negotiated, the gains will continue over time. The model is not able to calculate dynamic gains. Trade liberalization is likely to enhance productivity growth by introducing improved technology, increasing the ability to capture economies of scale and improved production efficiencies. Imported goods often embody technologies that are unavailable locally—although, admittedly, this does not apply so much to trade in bulk commodities such as wheat or rice.

The model does not capture intersectoral effects. An expanding agriculture sector in response to liberalization would draw capital, labor, and land from sectors not included in the model. Output in these sectors would decrease. This limitation means that the gains from trade liberalization are overstated when agricultural output is increasing but understated when output falls.

In addition to concerns with partial equilibrium models in general, several assumptions in ATPSM deserve attention, particularly those related to unfilled import quotas. It is assumed here that within-quota tariffs are not relevant, even where quotas are unfilled. This means that the higher outside-quota tariffs are taken as determining domestic prices (where these are also applied tariffs). This assumption overstates the benefits of liberalization, as there may be cases where within-quota rates determine domestic prices.

Estimates obtained from assessing full multilateral liberalization scenarios are more problematic than those from small reductions in protection because large price changes are involved. Elasticities are based on relatively small changes, and it is not clear how consumers and producers may respond to large price changes. This is more likely to be a problem in models with log-linear specifications such as this one, particularly as there are no explicit supply constraints, such as land or water.

Finally, the usual caveats apply to model parameters and policy data, particularly where there are many commodities and countries to deal with. There are also problems in aggregating policy data across several tariff line items, and there is a lack of reliable information for some countries on applied rates, which are not notified to the WTO. There is also uncertainty about the effects of domestic support on output. Where domestic production is limited by quotas, as in the European Union dairy sector, the effect of removing the constraint has not been taken into account. On the other hand, in this database the effect of domestic support on production is assumed to be very limited. It is difficult

to know how the results would be affected by better quality data, but policy-makers should be aware of the limitations.

Conclusions

Recent changes in the regulation of trade following the Uruguay Round have generated quota rents, transferring wealth from government revenue to others, notably foreign exporters. Although it is not clear what share of the rents export producers have captured, the analysis here has assumed, somewhat conservatively, that producers capture all the rents from sugar and half from bananas. This implies that when countries liberalize, exporters to the liberalizing countries may experience a welfare loss rather than a benefit from market opening. This is a major concern to some developing countries.

The simulations suggest that countries that do not liberalize will be worse off when other countries liberalize. In addition to the loss of quota rents, liberalization drives up world prices, which adversely affects consumers in importing countries. Nonliberalizing countries also miss out on the efficiency gains associated with liberalization.

Beneficial reforms are not restricted to one or two sectors, such as sugar and dairy, but extend to a range of commodities, including wheat, rice, and oilseeds. However, there are relatively few gains in tropical-zone products, except for sugar, oilseeds, and vegetable oils that are substitutable for temperate-zone products. A wide range of commodities that benefit from liberalization is an advantage in negotiations because it provides scope for trade-offs and increases the likelihood of mutual benefits.

Tariffs are an important source of government revenue for many developing countries. This source is eliminated if tariffs are reduced to zero. In many cases, however, partial liberalization leads to an increase in tariff revenues, particularly if the current rates are prohibitive.

Trade liberalization results in net gains. Every country can share in the gains if they are distributed appropriately. But while all of the 161 countries or regions modeled have positive trade flow changes with liberalization, only 69 have positive welfare changes, emphasizing the costs of producing additional exports. Few welfare benefits appear to come from improved market access alone, particularly if quota rents are removed. With so many countries losing from agricultural reform, it may be difficult for the WTO to reach a consensus on reform through agricultural negotiations alone. All countries have a greater probability of gaining when negotiations are broadened to include other sectors.

The interests of developing countries appear to have been somewhat neglected in the Uruguay Round of multilateral trade negotiations. Much was promised, but few gains were delivered, largely because little actual liberalization occurred. This reflected the flexibility built into the commitments and the sidelining of developing countries at crucial stages of the negotiations. Devel-

oping countries need to be better prepared to negotiate a superior outcome in the current round.

The Uruguay Round did, however, deliver tariff rate quotas, a new means of regulating trade. This has led to quota rents and the need for new methodologies and data for analyzing liberalization. Quota rents are sufficiently large, at perhaps a quarter of the size of global agricultural tariff revenues, to justify their inclusion in the model. Coupled with the detailed country and commodity coverage, the policy detail makes ATPSM a useful tool in identifying the concerns of individual countries in a wide range of agricultural markets.

If model results are to be credible and useful for trade negotiations and policy, a better job needs to be done of communicating the findings, especially to developing country analysts, trade negotiators, and policymakers. They cannot simply be told that they will gain automatically if they liberalize and will not gain and may even lose if they do not. In particular, it is hard to convey convincingly the result that they will gain more from their own reforms than from greater market access. If that were easy, a multilateral round of trade negotiations on agriculture would have been over in a few weeks. One reason for such an outcome, as the analysis here shows, is that the loss of quota rents offsets the gain from increased exports. It is also important to explain the source of other gains and losses—whether they come from producer or consumer surpluses—since policymakers seem to attach different weights to different sources.

NOTES

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1. The Agricultural Trade Policy Simulation Model (ATPSM) framework was developed by the United Nations Conference on Trade and Development (UNCTAD) and refined by the Food and Agriculture Organization and UNCTAD, with funding from the UK Department for International Development. The model can be downloaded from www.unctad.org/tab.
2. These rents may be captured by the government by auctioning rights to import or export, but often they accrue to importers, exporters, or producers, depending on how quotas are allocated.
3. For detailed analysis of these issues, see Skully (2001).
4. AMAD database www.amad.org.

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CHAPTER SIX

Potential Gains from Post-Uruguay Round Trade Policy Reform: Impacts on Developing Countries

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This chapter responds to specific questions posed to researchers at a special meeting of the International Agricultural Trade Research Consortium on the impact of multilateral trade liberalization on developing countries. These questions are aimed at quantifying and analyzing the potential impacts of a set of stylized trade liberalization scenarios on imports, exports, and welfare in a post-Uruguay Round environment. The impacts of further trade liberalization after the Uruguay Round are assessed using the Global Trade Analysis Project (GTAP) model, a multiregion general equilibrium model. The analysis quantifies the trade impacts and welfare gains from trade liberalization by developed countries alone, by developing countries alone, from full multilateral liberalization, and from partial multilateral liberalization. It goes beyond past modeling of global trade reform by incorporating key tariff preferences.

The simulation results indicate that each liberalizing country group benefits more from liberalization by its trade partners than from its own reforms. Liberalization by developing countries alone would result in expansion of trade two and a half times greater than that resulting from liberalization by developed countries. Developed countries reap a larger share of the gains (73 percent) from full liberalization than their own liberalization contributes (47 percent) to

global gains. They benefit most from agricultural tariff liberalization and the removal of domestic farm support, whereas developing countries benefit most from liberalization of manufactures trade. Developing countries garner only 27 percent of the global gains from full liberalization while their liberalization contributes 53 percent of this total.

Tariff liberalization contributes 84 percent of the global gains from trade liberalization, 35 percentage points of it associated with agriculture and food tariffs and 48 percentage points with manufactures. The remaining 16 percent of the global gains derive primarily from the elimination of domestic support for agriculture. About half of the global gains available from merchandise trade liberalization following completion of the Uruguay Round are associated with food and agriculture—a sector that accounts for just 10 percent of global GDP. This highlights the critical importance of making progress on the agricultural negotiations in the Doha Development Round.

The Doha Development Agenda, which emerged from the November 2001 Ministerial Conference, launched a broader set of World Trade Organization (WTO) negotiations that seek greater balance in addressing the issues of interest to developing countries. Developing countries have indicated their concerns about the constraints to market access in high-income countries and about the world market impacts of large agricultural subsidies in high-income countries. Under the Doha Declaration member governments commit themselves to comprehensive negotiations aimed at major improvements in market access, reductions in and elimination of all forms of export subsidies, and reductions in domestic support measures that distort trade. Further trade liberalization could lead to large gains for developed and developing countries alike. An assessment of the potential gains, and of their sources and distribution, is an important contribution to trade negotiations and those with a stake in their outcome.

DATA AND METHODOLOGY

In keeping with the goal of providing a comprehensive benchmark assessment of the post-Uruguay Round gains available to developed and developing countries from agricultural and nonagricultural trade liberalization, considerable effort has gone into the construction of the associated database and scenarios. This involves projecting the global economy to the post-Uruguay Round period (2008) using the dynamic GTAP applied general equilibrium model (Hertel 1997; Ianchovichina and McDougall 2000) and global database (Dimaranan and McDougall 2002). This projection of the world economy makes use of exogenous macroeconomic forecasts and policy assumptions regarding the Uruguay Round and China's accession to the WTO. The trade liberalization simulations are then conducted on the post-Uruguay Round equilibrium database. To facilitate analysis and improve comparability with other studies, the trade liberalization simulations are conducted as comparative static experiments.¹

The GTAP model of global trade is a fairly standard, multiregion model that includes the explicit treatment of international trade and transport margins, a “global” bank designed to mediate between world savings and investment, and a relatively sophisticated consumer demand system designed to capture differential price and income responsiveness across countries. As documented in Hertel (1997) and on the GTAP website,² the model includes demand for goods for final consumption, intermediate use, and government consumption; demand for factor inputs; supplies of factors and goods; and international trade in goods. The model employs the simplistic but robust assumptions of perfect competition and constant returns to scale in production activities. Key parameters of the model and the equations are set out comprehensively in Hertel (1997) and in the GTAP version 5 documentation (Dimaranan and McDougall 2002).

Protection Data

The GTAP database (as documented in Dimaranan and McDougall 2002) is unique in its integration of domestic databases in the form of regional input-output tables and international data sets on macroeconomic variables, bilateral trade flows, energy usage, and protection. The resulting database provides an internally consistent snapshot of the global economy for the base year 1997.³ As such this is ideally suited to analysis of multilateral trade policy reform.

A key feature of the GTAP database is its tracking of bilateral trade and protection. The bilateral trade data flows, sourced primarily from the United Nations Comtrade database, are reconciled to eliminate discrepancies in reported trade between trading partners (Gehlhar 2002). The protection data set includes ad valorem tariff equivalents for agriculture, food, and manufactures; agricultural export subsidies; domestic support; and estimated export tax equivalent rates (Francois and Spinanger 2002) of the quotas against textile and clothing exports regulated under the Agreement on Textiles and Clothing (ATC).⁴ The agricultural tariff data are drawn from the Agricultural Trade Policy Database (Gibson, Wainio, and Whitley 2002), which is based largely on data from the Agricultural Market Access Database (AMAD) covering 50 countries, including all major agricultural trading members of the WTO. These data include applied tariff rates, when available, and bound rates otherwise, an approach that seems likely to result in an upward bias in the estimated applied rates in developing countries (Gibson and others 2001). Specific tariffs were converted to ad valorem rates by dividing by the world unit value of imports. Data on tariffs in manufactured commodities are from the United Nations Conference on Trade and Development (UNCTAD) TRAINS database, extracted using the World Integrated Trade Solutions (WITS) project software of the World Bank and UNCTAD (Rozanski, Kuwahara, and Amjadi 2002). Unlike the GTAP version 5 database, which includes most-favored nation applied tariff rate data, the database used in this study includes preferential tar-

iff rates provided under the Generalized System of Preferences and European Union preferences for imports from the African, Caribbean, and Pacific (ACP) countries.⁵

Tariff rate quotas are not included in the database and are not modeled in this study. Given the emphasis on projections, this may be a significant limitation. The vast majority of the tariff rate quotas are currently not binding (Abbott and Morse 1999), implying that the tariffs that are relevant to decisions about import levels may be the within-quota tariffs. But if many quotas are unfilled because of constraints associated with administration of tariff rate quotas, such as the constraints addressed in the draft agricultural modalities paper (WTO 2003, p. 10), then the emphasis here on the outside-quota tariffs may be appropriate. With further growth in global demand and trade, there is also the potential for many of these quotas to become binding in the coming years. Unfortunately, an accurate treatment of this issue requires a highly disaggregated approach and is therefore well beyond the scope of this study.

This study uses revised agricultural protection data for China that is not included in the GTAP version 5 database. Revised tariff and export subsidies data for several agricultural commodities were obtained from a study by Huang, Rozelle, and Chang (2003). These estimates are substantially below the statutory tariff rates widely used in earlier studies because they are based on detailed, on-the-ground studies that take into account differences in product quality and the effects of China's state trading regime (see Bhattasali, Li, and Martin 2003 and www.worldbank.org/trade).

Data on agricultural export subsidies were based on the country submissions of export subsidy expenditures to the WTO (Elbehri 2002). Domestic support is based on the producer subsidy equivalent (PSE) data from the Organisation of Economic Co-operation and Development (OECD). All OECD domestic support payments (producer subsidies excluding market support price) were allocated to output subsidies, variable input subsidies, and land and livestock capital-based payments, based on broadly accepted procedures (Jensen 2002; OECD 2001).⁶ Because of the difficulty of distinguishing the amber box policies constituting the aggregate measurement of support that are due for reduction under the WTO, all domestic support was targeted for reductions.⁷ To the extent that some agricultural protection is effectively decoupled from production incentives, this will overstate the level of trade-distorting support provided. However, given the uncertainties about whether support can be effectively decoupled, it would seem premature to exclude all support that is currently classified as decoupled.

Regional and Sectoral Aggregation

The GTAP version 5 database distinguishes 66 regions and 57 sectors in the global economy. This study uses a 23-region, 28-sector aggregation of the GTAP database (table 6.1). The developed country regions—Australia/New Zealand,

Table 6.1 Regional and Sectoral Aggregation

Regional aggregation	Shares of global GDP		Sectoral aggregation	Shares of value added, 1997
	1997	2008		
Developed countries	76.1	73.4	Agriculture and food	7.5
Australia/New Zealand	1.6	1.7	Paddy rice	0.4
Japan	14.7	13.0	Wheat	0.2
North America	30.9	30.2	Feedgrains	0.3
Western Europe	28.9	28.5	Oilseeds	0.2
Developing countries	23.9	26.6	Raw sugar	0.1
China	3.0	4.2	Other agriculture	1.6
Taiwan, China	1.0	1.2	Livestock products	1.1
Other newly industrialized countries			Forestry and fishery	0.6
			Processed rice	0.1
Indonesia	2.3	2.4	Vegetable fats and oils	0.1
Philippines	0.7	0.7	Processed sugar	0.1
Thailand	0.3	0.3	Processed meat	0.3
Other Southeast Asia	0.5	0.6	Processed dairy	0.3
India	0.4	0.5	Other processed food	1.2
Other South Asia	1.4	1.7	Beverages and tobacco	0.8
Brazil	0.5	0.5	Manufactures	21.0
Chile	2.7	2.6	Textiles	0.8
Other Latin America	0.3	0.3	Wearing apparel	0.6
Economies in transition	2.5	2.2	Wood and paper products	2.4
Middle East and North Africa	3.0	3.3	Mining	2.0
Southern African Customs Union			Petrochemical and mineral products	4.2
Zambia	3.2	3.5	Metal products	2.6
Uganda	0.5	0.5	Automobiles	1.5
Other Sub-Saharan Africa	0.0	0.0	Electronics	1.8
Rest of world	0.0	0.0	Other manufactures	5.1
			Services	71.5
			Household utilities	12.3
			Trade and transportation	21.2
			Construction	6.3
			Business and finance	16.3
			Government services	15.4

Source: GTAP version 5 database.

Japan, North America, and Western Europe—accounted for 76 percent of global GDP in 1997. The 19 regions representing the developing country group include both individual countries (such as Brazil, China, and Zambia) and regional groupings (such as Other Latin America and Middle East and North Africa).

Agriculture and food sectors are aggregated into 15 sectors. Primary agricultural commodities are separately specified from processed products to the extent possible. Such separation is important since many farm products (raw

sugar, paddy rice, and raw milk, for example) are largely nontraded. These commodities require further processing before entering world markets—thereby having implications for manufacturing value-added. In cases where both raw commodities and processed goods are tradable, separation permits accounting for the frequently substantial differences in factor intensities and technology levels between production of the raw commodity and the processing stage. Nine manufacturing sectors and five service sectors complete the sectoral aggregation. The global value-added shares reported in table 6.1 indicate the relative size of these sectors in the global economy. Agriculture and food represent 8 percent of total global value-added while manufactures contribute 21 percent and services 72 percent.

Projections to the Post-Uruguay Round Period

External macroeconomic forecasts are used to simulate economic growth in the global economy from the 1997 base year of the database to the post-Uruguay Round period (here 2008). Over the period from 1997, growth rates of real GDP, skilled and unskilled labor inputs, investment and capital accumulation, and population for each region were generated from historical and forecast data in the World Bank's Global Economic Prospects 1999 database. These data were used to infer the rates of technological change overall and by sector in each regional group. Finally, the estimated changes in these variables were introduced as shocks to the model. The construction of the set of macroeconomic projections data (informally known as the "GTAP baseline") is documented in Walmsley, Dimaranan, and McDougall (2002).

Projection enables capturing the effects of differentials in growth rates and the broad structural changes associated with accumulation of human and physical capital and with income growth—factors that earlier research has shown can have a large impact on the estimated effects of trade liberalization (Bach and others 2000). To obtain a suitable post-Uruguay Round base, implementation of the Uruguay Round was also simulated over this same period. This includes increased market access and enlargement and eventual elimination of quotas against developing country exports of textiles and clothing under the Agreement on Textiles and Clothing. Increased market access is simulated with tariff reductions to the post-Uruguay Round tariff rates compiled by Francois and Strutt (1999) based on data from the CD-ROM version of the GATT/WTO Integrated Database. Francois and Strutt assumed that no further tariff reductions will occur for the primary agricultural commodities from their original 1995 base year under the Uruguay Round Agreement on Agriculture. The tariffs were reduced gradually, using equal shocks through the Uruguay Round simulation period of 1997 to 2005.

The simulations from 1997 to 2007 also incorporate the accession of China and Taiwan, China, to the WTO using estimates of China's tariffs in 2001 obtained from China Customs, and China's final WTO commitments, obtained

from the WTO. The elimination of quotas on exports of textiles and clothing to the United States/Canada and Europe is heavily backloaded, with most of the liberalization occurring at the end of the Uruguay Round implementation period, in 2005. For China, quota elimination is simulated for the WTO accession period, from 2002 to 2007.

The regional GDP shares for 1997 and 2008 reported in table 6.1 reflect the impact of economic growth and the Uruguay Round over the projection period. The developed country region accounts for 76 percent of global GDP in 1997, with North America and Western Europe together accounting for 60 percent. In the developing country region more rapid forecast growth rates in economies like China, Taiwan (China), India, and other newly industrialized countries result in increased GDP shares for these countries. By 2008 the developed country region is projected to account for 73 percent of GDP and the developing country region for 27 percent, a slightly larger share than in 1997.

POLICY SCENARIOS

The impact of post-Uruguay Round trade liberalization is examined from the updated database for 2008, which reflects economic growth from the 1997 base year and policy changes under the Uruguay Round. This section first describes the extent of protection remaining after completion of the Uruguay Round reforms and then discusses the policy simulations that are conducted on the post-Uruguay Round database.

Post-Uruguay Round Protection

Although the Uruguay Round successfully brought the multilateral trading system under a set of global trade rules or disciplines, very limited liberalization was required in agricultural and services trade. Agriculture in many developed countries continues to be protected by tariffs and tariff rate quotas, as well as by export and production subsidies. In many developing countries bound rates have been set well above applied rates, so tariffs can still be raised, especially for agricultural products. Imports of manufactures by many developed countries are subject to tariff peaks, and exports are constrained by tariff escalation even though average tariffs on manufactures in developed countries are relatively low. Protection of textiles and clothing markets in North America and Europe will remain high even after the phase out of export quotas introduced under the Multifibre Arrangement. Barriers to services trade and investment and to government procurement in both developed and developing countries have yet to be dismantled. These factors indicate that substantial gains can be obtained from further liberalization of world trade (Anderson and others 2001).

The trade liberalization simulations are performed on the estimated post-Uruguay Round database of average trade-weighted applied tariff rates for

Table 6.2 Average Trade-Weighted Tariff Rates, Post-Uruguay Round, Agriculture and Food and Manufactures

Country or region	Agriculture and food	Manufactures and services
<i>Developed countries and regions</i>	8.7	1.2
Australia/New Zealand	2.6	4.3
Japan	24.7	0.6
North America	6.7	1.7
Western Europe	5.1	0.9
<i>Developing countries and regions</i>	11.3	6.7
China	5.5	6.0
Taiwan, China	8.8	6.6
Other newly industrialized countries	14.0	2.3
Indonesia	5.6	8.0
Philippines	14.4	5.7
Thailand	16.9	11.2
Other Southeast Asia	14.3	5.7
India	14.7	18.7
Other South Asia	13.3	18.7
Brazil	5.6	12.8
Chile	9.0	10.9
Other Latin America	9.5	10.8
Economies in transition	8.2	3.1
Middle East and North Africa	20.4	9.2
Southern African Customs Union	13.5	5.3
Zambia	3.7	7.3
Uganda	14.9	6.8
Other Sub-Saharan Africa	8.9	7.7
Rest of world	6.4	8.2

Source: Authors' simulations based on the GTAP database and model, version 5.

agriculture and food and for manufactures (table 6.2).⁸ For both developed and developing countries average tariffs are higher for agricultural and food products than for manufactures, although the difference is far more pronounced for developed countries. Average tariff rates on agricultural and food products are highest for Japan, at 25 percent, where this weighted average is sharply reduced by the small volumes of imports on highly protected products like rice (average import protection of more than 400 percent). Average farm and food tariff rates in the developing regions range from 3.7 percent in Zambia to 20.4 percent in the Middle East/North Africa region. Substantial (greater than 10 percent) agricultural tariff rates remain throughout most of the Southeast and South Asian countries, Southern Africa, and Uganda. Despite the large commitments on manufacturing tariff bindings by developing countries, average applied tariffs are still significant in the post-Uruguay Round environment, with the highest appearing in South Asia, followed by Latin America and Thai-

land. Average applied tariff rates in manufactures are higher than average rates for food and agriculture in Latin America.

Table 6.3 presents estimated world average applied tariff rates for individual commodity groups in 2008. In terms of agricultural and food commodities, the remaining average tariff rates are highest for paddy rice. Milk, wheat, feed-grains, and processed meat also have average tariffs of more than 15 percent. On the nonfood side the highest average post-Uruguay Round tariffs are on wearing apparel (global average of 9 percent) and textiles (7 percent).

Liberalization Simulations

Each of the four trade liberalization simulations reported here involves the elimination of tariffs (on agriculture and food and on manufactures), agricultural export subsidies, and domestic support for developed countries alone, developing countries alone, full global liberalization, and partial (50 percent) global liberalization.

RESULTS

Many more results are obtained in the simulations than can be reported here. For this chapter the focus is on the trade and welfare impacts in each region

Table 6.3 Average Global Tariff Rates, Post-Uruguay Round, for Agriculture and Food and Manufactures			
Agriculture and food		Manufactures and services	
Product	Average tariff	Product	Average tariff
Paddy rice	36.4	Textiles	7.0
Wheat	18.1	Wearing apparel	8.8
Feedgrains	17.0	Wood and paper products	2.1
Oilseeds	10.8	Mining	0.5
Raw sugar	8.6	Petrochemical and mineral products	3.5
Other agriculture	9.0	Metal products	3.2
Meat and livestock	1.6	Automobiles	3.8
Forestry and fishery	1.6	Electronics	2.1
Processed rice	16.4	Other manufactures	3.3
Vegetable fats and oils	8.8		
Processed sugar	8.1		
Processed meat products	17.3		
Processed dairy	19.4		
Other processed foods	6.5		
Beverages and tobacco	8.9		

Source: Authors' simulations based on the GTAP database and model, version 5.

and globally. Although the numerical results of the simulations are reported, it is not the absolute values but rather the relative magnitude of impacts across the different scenarios and between the developed and developing countries that should be emphasized.

Trade Impacts

Impacts by Commodity

The results for trade impact by commodity suggest that developed country liberalization will increase global trade by 1.6 percent (table 6.4). Exports of processed meat, rice, dairy, oilseeds, and other agriculture each rise by more than 5 percent with the improved market access to developed country markets. With the removal of developed country domestic support for wheat and feedgrains and the elimination of export subsidies on wheat, feedgrains, meat, and sugar, world exports of these commodities decline. Developed country liberalization also gives a large boost to exports of wearing apparel as US and European markets open up to exports from developing countries. Developed country liberalization boosts food and agriculture exports by 4 percent and contributes about a quarter of the total increased trade volume (as measured in 1997 US dollars).

Liberalization by developing countries, involving mainly the removal of tariffs, is estimated to raise world exports by two and a half times more than liberalization in developed countries. Trade in most food and agricultural products increases, with the largest increases in beverages and tobacco and other processed foods. Export subsidies and domestic support are very small in developing countries, so elimination of these barriers does not offset the stimulus to trade from reductions in import barriers. The trade impacts on the manufacturing sectors are generally larger than under developed country liberalization in both percentage and volume terms due to the higher post-Uruguay Round tariffs in developing countries (see table 6.3). The simulation results suggest that developing country liberalization will increase global trade by 3.8 percent.

Full multilateral liberalization contributes to a \$448 billion expansion in export volume, or a 5.4 percent increase in world trade. Liberalization of food and agricultural products contributes 16 percent to this total increase in exports, largely from increased exports of beverages and tobacco, processed meat, other processed food, and other agricultural products. The decline in exports of wheat, feedgrains, and livestock products resulting from developed country liberalization dominates the export gains in these commodities coming from developing country liberalization.

For many commodities the trade impacts of partial (50 percent) multilateral liberalization are close to half the trade impacts of full liberalization. However, for some highly protected commodities such as rice, sugar, and meat, the very small initial import shares in many of the most protected economies

Table 6.4 Changes in Export Share and Volume by Product as a Result of Trade Liberalization, Post-Uruguay Round

Product	Developed countries only liberalize		Developing countries only liberalize		Full multilateral liberalization		Partial (50 percent) multilateral liberalization	
	Share (percent)	Volume (1997 US\$ billions)	Share (percent)	Volume (1997 US\$ billions)	Share (percent)	Volume (1997 US\$ billions)	Share (percent)	Volume (1997 US\$ billions)
Agriculture and food	3.9	26.8	6.6	45.4	10.5	72.1	4.1	28.3
Wheat	-6.4	-1.6	4.5	1.2	-2.7	-0.7	-2.9	-0.8
Feedgrains	-3.7	-0.8	3.3	0.7	-1.0	-0.2	-1.6	-0.3
Oilseeds	6.1	1.4	2.5	0.6	8.6	2.0	4.7	1.1
Other agriculture	6.3	7.9	5.3	6.7	11.9	14.9	5.4	6.8
Meat and livestock	-4.1	-1.7	0.2	0.1	-3.6	-1.5	-1.6	-0.7
Forestry and fishery	0.2	0.1	1.9	0.6	2.2	0.7	1.1	0.3
Rice	14.8	1.8	6.9	0.8	21.6	2.6	6.9	0.8
Vegetable fats and oils	1.0	0.4	8.6	3.7	9.7	4.2	4.4	1.9
Sugar	-3.9	-0.7	5.9	1.1	1.8	0.3	0.4	0.1
Processed meat	15.7	10.3	6.1	4.0	21.7	14.1	7.5	4.9

Processed dairy	8.2	3.1	5.4	2.1	12.2	4.6	2.1	0.8
Other processed food	2.0	3.2	6.3	10.2	8.4	13.7	3.8	6.2
Beverages and tobacco	4.6	3.7	17.1	13.8	22.4	18.0	9.2	7.4
Manufactures and services	1.4	103.5	3.6	270.8	5.0	376.8	2.3	172.4
Textiles	2.7	6.5	7.7	18.4	10.8	25.8	4.8	11.4
Wearing apparel	11.5	21.1	11.5	21.2	23.8	43.6	10.3	19.0
Wood and paper products	0.7	2.1	2.6	7.9	3.3	10.1	1.6	4.8
Mining	0.1	0.7	0.6	4.0	0.7	4.8	0.4	2.3
Petrochemical and mineral products	1.4	14.8	3.9	42.4	5.2	57.6	2.5	27.2
Metal products	1.0	5.5	5.2	28.6	6.2	34.1	2.9	15.9
Automobiles	2.2	13.1	7.9	46.9	10.2	60.2	4.3	25.6
Electronics	0.6	5.4	2.4	21.2	3.0	26.5	1.4	12.8
Other manufactures	1.6	27.4	4.3	72.3	5.9	100.1	2.8	47.0
House utilities	0.3	0.4	-0.1	-0.1	0.2	0.2	0.1	0.1
Trade and transportation	1.0	6.6	2.0	13.4	3.1	20.0	1.4	9.0
Construction	0.3	0.1	0.1	0.0	0.3	0.1	0.1	0.1
Business and finance	0.1	0.3	0.0	-0.1	0.0	0.1	0.0	0.0
Government service	0.2	0.2	-0.4	-0.5	-0.3	-0.3	-0.1	-0.1
Total	1.6	130.0	3.8	315.5	5.4	448.3	2.4	200.4

Source: Authors' simulations based on the GTAP database and model, version 5.

mean that the initial 50 percent liberalization has a relatively small impact on the world market. In the case of wheat and feedgrains, 50 percent liberalization results in a slightly larger drop in exports than complete liberalization does. This is due to the higher impact on developed country exports of a 50 percent cut in domestic support in these countries from initial, subsidy-augmented levels.

Trade Impacts by Region

Most of the expansion in exports occurs in the liberalizing region (table 6.5). Ninety-two percent of the expansion in exports arising from developed country liberalization is accounted for by rising exports from developed countries. This reflects the fact that the cost of producing for export is falling in the liberalizing region, and the industrial countries account for such a large share of world import demand. Japanese exports rise by 3.5 percent and North American exports by 2.5 percent, but the absolute value of the increase in exports is highest for Western Europe, at \$57 billion. Exports of some developing countries, such as India and the Middle East/North Africa region, experience a slight decline under this scenario, despite the direct stimulus to their bilateral trade with developed countries. Under developing country liberalization 73 percent of the expansion in exports occurs in the developing countries and 27 percent in the developed countries. Exports expand in all regions. The largest increases occur in India (22 percent) and Brazil (19 percent).

In the full liberalization scenario developed countries account for 46 percent of the estimated increase in global export volume and developing countries for 54 percent. Expansion in developed country exports under full liberalization is 75 percent higher than when only developed countries liberalize. This is consistent with the relatively larger impact of developing country liberalization on world trade. Partial liberalization results in close to half the changes in exports under full liberalization. Exceptions are Uganda, where export changes are 70 percent of those under full liberalization, and Thailand, India, and other South Asia, where the changes are about 40 percent of those under full liberalization. The relatively smaller expansion of exports from the rice exporters Thailand and South Asia reflects the remaining high tariff protection.

The opening of developed country markets—particularly for nonagricultural goods—gives a large boost to the net rate of return on capital, as the price of imported capital goods falls and the rental rate on capital rises. As a consequence, there is a substantial inflow of capital. This inflow is mirrored in the deterioration of the developing country trade balance, as developing country imports increase more than their exports. Developing countries account for 21 percent of the total increase in imports (table 6.6). Import volume grows at about 3 percent each in China, India, and Brazil. Liberalization by developing countries increases their imports from other developing countries, such that developing countries account for 91 percent of the increase in total imports.

Developing countries account for 70 percent of the total increase in imports under full liberalization—considerably more than their share of the increase in exports (54 percent). All the developing countries and regions expand their imports more than they expand their exports. Conversely, North America and Western Europe expand their exports more than their imports.

For most countries partial liberalization results in close to half the increase in imports as under full liberalization. Exceptions are Australia/New Zealand, Western Europe, Brazil, India, other South Asia, other Sub-Saharan Africa, and the Southern African Customs Union, for which the increase in imports is just 40 percent of that under full liberalization, and Uganda, for which the increase is just 31 percent of that under full liberalization.

World Price Effects

The average world price effects, by commodity, are reported relative to the numeraire in the model, which is the global average return to primary factors of production. The results suggest that developed country liberalization will raise average world prices of food and agricultural products by 3.9 percent (table 6.7). Average world prices of commodities that are subsidized in developed countries—wheat, feedgrains, dairy, meat, oilseeds, and sugar—rise the most. Most manufactured goods and services experience a slight decline in average world prices, with the exception of textiles and wearing apparel, which rise slightly as the US and European markets open up to developing country exports.

Although developing country liberalization results in a slight rise in average world prices of wheat and feedgrains, the overall world price for all agricultural and food products register a slight decline. Increased trade in manufactured products resulting from developing country liberalization results in declining average world prices.

The impact of developed country liberalization dominates the world price impacts under full multilateral liberalization. Average world prices of all agricultural and food commodities rise by 3.8 percent. Under partial liberalization average world price changes are about half the world price changes under full liberalization.

Welfare Effects: Changes in Utility and Equivalent Variation

The welfare impact of trade liberalization under the four scenarios is presented in table 6.8 as the percentage change in utility for the regional household⁹ and the change in equivalent variation (a money metric measure of changes in welfare used in the GTAP model). Equivalent variation is then separated into two parts in table 6.9: the welfare effects deriving from efficiency gains and those deriving from changes in the terms of trade (Huff and Hertel 2000).

Table 6.5 Changes in Export Share and Volume by Region as a Result of Trade Liberalization, Post-Uruguay Round

Country or Region	Developed countries only liberalize		Developing countries only liberalize		Full multilateral liberalization		Partial multilateral liberalization	
	Share (percent)	Volume (1997 US\$ billions)	Share (percent)	Volume (1997 US\$ billions)	Share (percent)	Volume (1997 US\$ billions)	Share (percent)	Volume (1997 US\$ billions)
<i>Developed countries</i>								
Australia/New Zealand	2.1	2.8	1.4	1.7	3.4	4.4	1.8	2.3
Japan	3.5	20.3	4.1	23.8	7.7	44.4	3.5	19.8
North America	2.5	44.1	1.7	30.3	4.2	74.5	2.0	35.1
Western Europe	1.8	56.9	1.1	34.2	2.9	91.7	1.3	40.4
All developed countries	2.2	124.1	1.6	90.0	3.8	215.2	1.7	97.7
Share of global total (percent)		92.1		27.5		46.3		47.0
<i>Developing countries</i>								
China	0.6	2.7	8.1	35.8	8.8	39.1	4.0	17.5
Taiwan, China	0.6	1.1	9.7	90.0	10.3	18.5	4.7	8.4
Other newly industrialized countries	0.3	1.6	3.5	35.8	3.8	20.1	1.8	9.5

Indonesia	1.0	0.8	5.8	17.4	6.8	5.8	2.9	2.5
Philippines	1.0	0.6	9.0	18.3	10.1	6.1	4.6	2.7
Thailand	0.5	0.4	8.8	4.9	9.3	8.8	3.7	3.5
Other Southeast Asia	0.6	1.0	6.2	5.4	6.9	10.9	3.1	4.9
India	-0.3	-0.3	21.8	8.3	21.6	19.1	8.8	7.8
Other South Asia	0.1	0.1	16.4	9.8	16.9	7.1	6.6	2.8
Brazil	0.1	0.1	19.3	19.3	19.3	19.3	8.1	8.1
Chile	0.2	0.1	6.0	6.9	6.3	1.9	2.8	0.9
Other Latin America	0.6	1.0	13.8	19.3	14.3	26.6	6.2	11.6
Economies in transition	-0.1	-0.4	4.6	1.8	4.5	17.3	2.1	8.2
Middle East and North Africa	-0.2	-0.7	8.6	25.5	8.4	33.6	3.8	15.1
Southern African Customs Unions	0.1	0.0	6.7	17.7	6.7	3.2	3.0	1.4
Zambia	0.0	0.0	2.3	34.5	2.3	0.0	1.0	0.0
Uganda	0.3	0.0	1.8	3.2	2.2	0.0	1.5	0.0
Other Sub-Saharan Africa	-0.1	-0.1	4.0	0.0	3.9	3.6	1.8	1.7
Rest of world	5.4	2.9	11.6	0.0	16.2	8.8	6.5	3.5
All developing countries	0.4	10.9	8.0	237.8	8.4	249.6	3.7	110.1
Share of global total (percent)		8.1		72.7		53.7		53.0
Global total	1.6	134.8	3.8	327.1	5.4	464.8	2.4	207.8

Source: Authors' simulations based on the GTAP database and model, version 5.

Table 6.6 Changes in Import Share and Volume by Region as a Result of Trade Liberalization, Post-Uruguay Round

Country or region	Developed countries only liberalize		Developing countries only liberalize		Full multilateral liberalization		Partial (50 percent) multilateral liberalization	
	Share (percent)	Volume (1997 US\$ billions)	Share (percent)	Volume (1997 US\$ billions)	Share (percent)	Volume (1997 US\$ billions)	Share (percent)	Volume (1997 US\$ billions)
<i>Developed countries</i>								
Australia/New Zealand	8.6	10.6	0.8	0.9	9.4	11.6	3.8	4.7
Japan	4.9	25.4	2.0	10.3	6.9	35.5	3.1	15.9
North America	2.5	42.5	0.0	0.1	2.6	43.6	1.2	20.3
Western Europe	0.9	28.5	0.5	16.7	1.5	46.4	0.6	19.1
All developed countries	1.9	107.1	0.5	28.0	2.5	137.2	1.1	60.0
Share of global total (percent)		79.5		8.6		29.5		28.9
<i>Developing countries</i>								
China	2.9	12.8	10.3	45.6	13.3	58.7	6.2	27.6
Taiwan, China	1.5	2.4	11.7	19.2	13.3	21.8	6.1	10.0
Other newly industrialized countries	0.7	3.9	5.1	27.8	5.9	31.8	2.8	15.3

Indonesia	1.4	0.9	8.6	5.7	10.1	6.7	4.6	3.1
Philippines	0.7	0.4	9.1	6.0	10.0	6.5	4.6	3.0
Thailand	1.0	0.9	13.3	12.3	14.4	13.3	6.2	5.7
Other Southeast Asia	0.9	1.2	9.0	12.8	10.0	14.3	4.5	6.4
India	2.8	2.3	24.9	20.6	28.2	23.3	11.9	9.8
Other South Asia	0.8	0.3	22.2	9.3	23.4	9.8	9.9	4.1
Brazil	3.1	3.1	24.3	23.9	27.5	27.0	11.3	11.1
Chile	-0.1	0.0	10.7	3.1	10.5	3.1	5.0	1.5
Other Latin America	0.8	1.5	17.2	31.4	18.0	32.9	7.9	14.4
Economies in transition	0.7	2.9	3.9	16.5	4.6	19.0	2.1	8.6
Middle East and North Africa	-0.7	-3.1	9.9	42.3	9.0	38.3	4.0	17.2
Southern African Customs Union	2.0	1.0	6.5	3.3	8.2	4.2	3.5	1.8
Zambia	-0.4	0.0	8.2	0.1	7.6	0.1	3.5	0.0
Uganda	-0.3	0.0	2.9	0.0	2.6	0.0	0.8	0.0
Other Sub-Saharan Africa	-0.3	-0.2	5.1	4.4	4.7	4.1	1.9	1.7
Rest of world	-1.8	-2.7	9.8	14.8	8.4	12.6	4.1	6.2
All developing countries	0.9	27.7	9.7	299.1	10.6	327.3	4.8	147.7
Share of global total (percent)		20.6		91.4		70.4		71.1
Global total	1.6	134.8	3.8	327.1	5.4	464.8	2.4	207.8

Source: Authors' simulations based on the GTAP database and model, version 5.

Table 6.7 Percentage Change in World Prices by Product as a Result of Trade Liberalization, Post-Uruguay Round

Product or service	Developed countries only liberalize	Developing countries only liberalize	Full multilateral liberalization	Partial (50 percent) multilateral liberalization
Agriculture and food	3.9	-0.1	3.8	1.6
Wheat	23.0	1.6	25.2	12.6
Feedgrains	19.7	3.1	24.0	11.8
Oilseeds	6.9	0.8	7.5	3.3
Other agriculture	-2.3	-0.1	-2.5	-2.3
Meat and livestock	8.3	0.3	8.4	3.4
Forestry and fishery	0.5	0.1	0.6	0.4
Rice	5.0	0.5	5.5	2.3
Vegetable fats and oils	2.7	-1.4	1.2	0.7
Sugar	6.7	-0.6	5.9	2.8
Processed meat	6.5	0.2	6.7	2.8
Processed dairy	11.9	0.7	13.1	5.8
Other processed food	2.1	-0.8	1.3	0.7
Beverages and tobacco	-0.4	-0.2	-0.6	-0.2
Manufactures and services	0.0	-0.5	-0.4	-0.1
Textiles	0.5	-1.2	-0.7	-0.3
Wearing apparel	1.4	-2.5	-1.2	-0.4
Wood and paper products	-0.2	-0.2	-0.3	0.0
Mining	-0.1	-0.3	-0.3	0.0
Petrochemical and mineral products	-0.2	-0.4	-0.6	-0.1
Metal products	0.0	-0.5	-0.4	-0.1
Automobiles	-0.3	-0.6	-0.8	-0.2
Electronics	0.2	-0.9	-0.7	-0.2
Other manufactures	0.0	-0.5	-0.4	-0.1
House utilities	-0.2	-0.1	-0.3	0.0
Trade and transportation	0.1	-0.1	0.0	0.1
Construction	-0.2	-0.3	-0.4	-0.1
Business and finance	-0.1	0.0	0.0	0.1
Government service	0.0	-0.3	-0.2	0.0
Total	0.3	-0.5	-0.1	0.1

Source: Authors' simulations based on the GTAP database and model, version 5.

Effects by Group and Country

In general, liberalization by the other country group results in greater welfare gains than liberalization by a country's own group—a finding that contrasts strongly with the observation by Martin and Winters (1996, chapter 1) that studies of the Uruguay Round have generally found larger gains for the countries that liberalized their own trade regimes. This discrepancy is likely due in part to the lower levels of protection in the wake of the Uruguay Round (smaller efficiency gains) and to the smaller trade elasticities used in this study.

For the developing country group welfare gains are three times greater for developed country liberalization than for developing country liberalization. The developing economies that benefit relatively more from developed country liberalization are China, Taiwan (China), Thailand, India, economies in transition, and the Southern African Customs Union. This result is due largely to the improvement in these countries' terms of trade (see table 6.9), particularly for their exports of manufactured products (table 6.10), resulting from developed country liberalization. Similarly, North America and Western Europe benefit more from developing country liberalization as a result of net positive terms of trade effects. Australia, on the other hand, gains more from developed country liberalization since the larger reductions in trade barriers made by the other developed countries result in net positive terms of trade effects for Australia. The welfare impacts of trade liberalization through changes in regional utility are small, generally less than 1 percent in absolute value. This is a common finding in studies such as this one, and such estimated gains will continue to diminish as tariffs fall.¹⁰

Full liberalization generates an annual global welfare gain of \$58 billion (again, in 1997 US dollars), substantially below the \$165 billion reported by Anderson and others (2001) using the GTAP model with higher substitution elasticities between domestic and imported goods and without taking into account tariff preferences. Three-fourths of the total gains accrue to the developed country region, which also happens to account for about that percentage of global GDP. In this sense, the gains from full liberalization may be viewed as "evenly distributed." However, national gains vary widely. While all the developed countries gain from full liberalization, Australia/New Zealand has the largest percentage gain at 1.13 percent—far greater than the 0.06 percent gain to North America. In absolute terms the largest gains accrue to Western Europe, which is also the largest economic region in the study groupings. The developing countries that gain the most from full liberalization are Zambia (0.98 percent), Brazil (0.82 percent), other newly industrialized countries (0.81 percent), and other Southeast Asia (0.46 percent). The Middle East/North Africa region and the rest of world lose in all liberalization scenarios due to large terms of trade losses. The developing countries whose terms of trade losses outweigh the allocative efficiency gains from full liberalization are the Philippines, other Sub-Saharan Africa, and Uganda.

As is well known from the economics welfare literature, the initial cuts in tariffs generate the largest gains. This is borne out in the simulations, where partial (50 percent) liberalization generates nearly 70 percent of the global welfare gains from full liberalization. This is even more pronounced if the focus is solely on the developing country group: 50 percent liberalization yields 84 percent of the gains of full liberalization. For some countries and groups, such as Indonesia, India, and other South Asia, the welfare gains from partial liberalization are even greater than those from full liberalization because of more modest terms of trade losses under partial liberalization.

Table 6.8 Welfare Impacts: Percentage Changes in Utility and Equivalent Variation as a Result of Trade Liberalization, Post-Uruguay Round (1997 US\$ millions)

Country or region	Developed countries only liberalize		Developing countries only liberalize		Full multilateral liberalization		Partial (50 percent) multilateral liberalization	
	Utility	Welfare	Utility	Welfare	Utility	Welfare	Utility	Welfare
<i>Developed countries</i>								
Australia/New Zealand	0.91	4,890	0.21	1,113	1.13	6,103	0.41	2,211
Japan	0.16	6,311	0.16	6,317	0.32	12,242	0.17	6,743
North America	0.01	550	0.05	4,432	0.06	5,778	0.03	3,120
Western Europe	0.03	2,853	0.16	14,172	0.20	18,202	0.16	14,684
All developed countries		14,605		26,034		42,325		26,759
Share of global total (percent)		53		86		73		67
<i>Developing countries</i>								
China	0.53	6,991	-0.16	-2,122	0.32	4,185	0.23	3,026
Taiwan, China	0.34	1,382	0.04	173	0.37	1,511	0.28	1,160
Other newly industrialized countries	0.26	1,959	0.57	4,270	0.81	6,007	0.43	3,219
Indonesia	0.05	108	0.09	198	0.10	235	0.12	287

Philippines	0.01	8	-0.79	-628	-0.79	-626	-0.29	-228
Thailand	0.48	804	0.19	309	0.66	1,107	0.58	964
Other Southeast Asia	0.36	564	0.37	585	0.73	1,153	0.49	766
India	0.38	2,229	-0.07	-389	0.28	1,656	0.28	1,658
Other South Asia	0.15	227	0.33	506	0.46	705	0.46	714
Brazil	0.34	2,721	0.51	4,067	0.82	6,607	0.42	3,403
Chile	0.01	5	0.21	181	0.21	177	0.15	127
Other Latin America	0.24	1,676	0.34	2,331	0.57	3,935	0.30	2,096
Economies in transition	0.11	1,170	-0.18	-1,856	-0.05	-512	-0.04	-365
Middle East and North Africa	-0.38	-4,142	-0.21	-2,249	-0.59	-6,490	-0.22	-2,429
Southern African Customs Union	0.30	490	-0.11	-180	0.17	282	0.08	125
Zambia	-0.05	-2	1.06	47	0.98	43	0.46	20
Uganda	-0.12	-10	0.13	11	-0.01	-1	-0.20	-17
Other Sub-Saharan Africa	-0.16	-370	0.01	25	-0.16	-388	-0.13	-304
Rest of world	-0.98	-3,089	-0.39	-1,207	-1.22	-3,824	-0.34	-1,060
All developing countries		12,721		4,070		15,761		13,162
Share of global total (percent)		47		14		27		33
Global total		27,326		30,104		58,086		39,921

Source: Authors' simulations based on the GTAP database and model, version 5.

Note: Utility refers to the gains on the part of the representative regional household in the GTAP model. This includes current private and government consumption as well as future consumption (savings).

Table 6.9 Allocative Efficiency and Terms of Trade Effects, by Region, as a Result of Trade Liberalization, Post-Uruguay Round (1997 US\$ millions)

Country or region	Developed countries only liberalize		Developing countries only liberalize		Full multilateral liberalization		Partial (50 percent) multilateral liberalization	
	Allocative efficiency	Terms of trade	Allocative efficiency	Terms of trade	Allocative efficiency	Terms of trade	Allocative efficiency	Terms of trade
<i>Developed countries</i>								
Australia/New Zealand	437	4,435	81	987	497	5,551	349	1,828
Japan	5,887	565	960	5,242	6,777	5,586	3,760	3,085
North America	3,388	-3,508	-30	3,352	3,480	599	2,694	-282
Western Europe	18,685	-15,927	-119	13,327	19,154	-2,031	14,081	184
All developed countries	28,397	-14,435	892	22,908	29,908	9,705	20,884	4,815
<i>Developing countries</i>								
China	-43	6,889	2,174	-4,691	1,777	1,871	1,606	1,191
Taiwan, China	154	1,318	1,115	-1,178	1,199	165	926	176

Other newly industrialized countries	60	1,793	1,577	2,438	1,617	4,051	1,019	2,052
Indonesia	86	163	575	-561	625	-438	399	-125
Philippines	22	-37	332	-786	336	-818	237	-396
Thailand	106	700	1,368	-1,110	1,446	-398	1,024	-116
Other Southeast Asia	147	504	1,243	-890	1,351	-337	903	-211
India	336	1,964	2,938	-3,619	3,020	-1,592	2,092	-563
Other South Asia	64	159	1,469	-946	1,505	-796	997	-288
Brazil	842	1,871	5,088	-1,076	5,737	798	3,165	193
Chile	-13	16	214	-63	200	-56	143	-37
Other Latin America	263	1,412	3,301	-1,054	3,497	333	2,129	-96
Economies in transition	-924	2,019	816	-2,346	177	-394	346	-556
Middle East and North Africa	-1,100	-3,034	4,070	-5,063	3,303	-8,492	2,333	-4,196
Southern African Customs Union	29	439	389	-495	428	-87	263	-110
Zambia	0	-1	12	16	11	13	7	4
Uganda	0	-10	3	4	3	-8	2	-22
Other Sub-Saharan Africa	-111	-253	448	-628	353	-939	232	-642
Rest of world	-706	-1,764	2,442	-1,173	1,944	-2,886	1,292	-1,143
All developing countries	-788	14,148	29,574	-23,221	28,529	-10,010	19,115	-4,885
Total	27,609	-286	30,467	-314	58,439	-305	39,998	-69

Source: Authors' simulations based on the GTAP database and model, version 5.

Table 6.10 Allocative Efficiency and Terms of Trade Effects, by Commodity, as a Result of Trade Liberalization, Post-Uruguay Round (1997 US\$ millions)

Country or region	Developed countries only liberalize		Developing countries only liberalize		Full multilateral liberalization		Partial (50 percent) multilateral liberalization	
	Allocative efficiency	Terms of trade	Allocative efficiency	Terms of trade	Allocative efficiency	Terms of trade	Allocative efficiency	Terms of trade
Paddy rice	641	-31	13	-1	670	-2	311	267
Wheat	2,758	-1,440	-372	30	2,954	-43	2,418	-6,914
Feedgrains	2,543	-449	-144	68	2,959	-21	2,435	-8,227
Oilseeds	1,558	-241	209	7	1,729	48	1,504	1,618
Raw sugar	-19	5	1	-1	-15	4	-17	13
Other agriculture	704	-112	1,025	-2	1,511	-5	979	13,677
Meat and livestock	2,886	-655	83	54	3,193	207	2,573	-5,201
Forestry and fishery	-9	6	61	11	52	-1	40	189
Processed rice	272	-91	214	3	513	6	340	24
Fats and oils	57	142	477	-53	506	5	368	-2,285
Processed sugar	631	-287	45	-1	787	36	560	-8,341
Processed meat products	3,809	-72	653	26	4,749	236	3,060	-10,209

Milk	3,112	-326	-110	45	3,650	-22	2,042	-27,160
Other processed foods	746	188	1,348	-43	2,053	-25	1,266	-9,991
Beverages and tobacco	243	-1	2,084	-2	2,216	13	1,440	1,794
All agriculture and food	19,932	-3,365	5,585	141	27,526	437	19,320	-60,746
Textiles	1,094	57	1,816	-88	2,633	-23	1,724	-58
Wearing apparel	2,512	176	2,522	-170	4,673	-310	2,998	-8,024
Wood and paper products	2	390	549	-7	523	-107	386	2,013
Mining	-75	-49	161	23	91	-138	104	-4,788
Petrochemical and mineral	1,735	152	4,230	-18	5,771	-157	3,753	9,206
Metals	-77	-15	1,687	-41	1,523	-45	1,185	1,349
Automobiles	1,656	29	5,760	-35	7,141	-87	4,589	3,957
Electronics	144	499	1,816	-86	1,910	-392	1,182	-2,558
Other manufactures	621	403	6,567	-15	6,695	38	4,346	17,030
House utilities	27	42	34	5	84	7	206	2,031
Trade and transportation	-74	950	302	-112	288	268	274	25,085
Construction	-84	36	-86	-1	-178	5	-42	1,063
Business and finance	274	330	-394	89	-87	176	74	13,528
Government service	-78	80	-81	0	-154	24	-101	844
All manufacturing and services	7,677	3,079	24,882	-456	30,912	-742	20,678	60,678
Total	27,609	-286	30,467	-314	58,439	-305	39,998	-69

Source: Authors' simulations based on the GTAP database and model, version 5.

Effects by Commodity Group

Developed country liberalization generates large positive allocative efficiency effects for agriculture and food commodities, especially for wheat, feedgrains, meat and livestock, and milk. Terms of trade effects for food and agriculture are negative because the prices of these export commodities fall. Developing country liberalization, on the other hand, generates relatively greater allocative efficiency gains from liberalization of the manufacturing sector, where tariffs are still quite high and export volume greatly exceeds that of agriculture.

Within the food and agriculture sectors the allocative efficiency effects are largest for beverages and tobacco, other processed food, and other agriculture. Forty-eight percent of the global welfare gains from full liberalization are generated by the food and agricultural sectors—reflecting the much higher distortions in these sectors in developed countries. Once again, the allocative efficiency effects of partial liberalization are typically more than half the effects of full liberalization. The terms of trade effects of partial liberalization are quite different, however. This reflects the importance of changing import shares as tariffs are cut.

Effects by Instrument and Region

Following the approach of Harrison, Horridge, and Pearson (1999), this decomposition by instrument and benefiting region uses numerical integration techniques to partition the individual effects of exogenous shocks on endogenous variables. Developed country liberalization of tariffs on agriculture and food and especially on manufactures benefits developing countries, but the removal of export subsidies and domestic support results in welfare losses for developing countries (table 6.11). In total, 53 percent of the welfare gains from developed country liberalization accrue to developed countries.

Developing country liberalization generates even more substantial benefits for developed countries, which gain \$26 billion annually, or 86 percent of the total welfare gains from developing country liberalization. Most of these welfare gains (79 percent) are generated by the tariff cuts on manufactures in developing countries, while 23 percent come from cuts in tariffs on agriculture and food products (table 6.12).

Of the total global gains from full multilateral liberalization of \$58 billion, 73 percent (\$42 billion) goes to developed countries and 27 percent (\$16 billion) goes to developing countries. Those shares are nearly equal to their respective shares in global GDP. Developed countries gain mostly from removal of domestic support and from the removal of tariffs on agriculture and food. Developing countries derive most of their gains from liberalization of trade in manufactures in both markets. Not surprisingly, they lose from the higher food prices following developed countries' removal of export subsidies and domes-

Table 6.11 Welfare Impacts of Full Liberalization by Developed Countries, 2007 (1997 US\$ millions)

Benefiting region	Tariffs				Total
	Agriculture and food	Manufactures and services	Export subsidies	Domestic support	
Developed countries	6,988	-12,104	6,141	13,579	14,605
Share of total (percent)	25.6	-44.3	22.5	49.7	53.4
Developing countries	5,925	17,720	-5,548	-5,375	12,721
Share of total (percent)	21.7	64.8	-20.3	-19.7	46.6
Total	12,913	5,616	593	8,204	27,326
Share of total (percent)	47.3	20.6	2.2	30.0	100.0

Source: Authors' simulations based on the GTAP database and model, version 5.

tic support. This negative impact is most pronounced in the Middle East and North Africa and the rest of the world, where there are some significant interactions with their own domestic policies.

It is also interesting to examine the extent to which the welfare gains owing to liberalization by a region exceed or fall short of their share of the global gains. Developed country liberalization is estimated to contribute 47 percent of the global gains from full liberalization, whereas they enjoy 73 percent of the global benefits from full liberalization (see table 6.13). This is simply a reflection of their relatively more open economies. In contrast, the developing countries, with higher initial distortions, contribute 53 percent of the global gains

Table 6.12 Welfare Impacts of Full Liberalization by Developing Countries, 2007 (1997 US\$ millions)

Benefiting region	Tariffs				Total
	Agriculture and food	Manufactures and services	Export subsidies	Domestic support	
Developed countries	6,172	19,761	-281	382	26,034
Share of total (percent)	20.5	65.6	-0.9	1.3	86.5
Developing countries	719	4,126	-145	-630	4,070
Share of total (percent)	2.4	13.7	-0.5	-2.1	13.5
Total	6,891	23,887	-426	-248	30,104
Share of total (percent)	22.9	79.3	-1.4	-0.8	100.0

Source: Authors' simulations based on the GTAP database and model, version 5.

Table 6.13 Welfare Impacts of Full Global Liberalization, 2007
(1997 US\$ millions and share of total)

Scenario and benefiting region	Tariffs				Total
	Agriculture and food	Manufactures and services	Export subsidies	Domestic support	
Millions of 1997 US dollars					
Developed countries liberalize					
Developed countries	6,912	-12,169	6,435	13,898	15,076
Developing countries	5,930	16,970	-5,439	-5,269	12,192
Total welfare impact	12,841	4,802	996	8,629	27,268
Developing countries liberalize					
Developed countries	7,051	19,753	-98	543	27,249
Developing countries	642	3,574	-47	-599	3,569
Total welfare impact	7,693	23,327	-145	-56	30,818
Full multilateral liberalization					
Developed countries	13,963	7,585	6,337	14,441	42,325
Developing countries	6,571	20,544	-5,486	-5,868	15,761
Total welfare impact	20,534	28,129	850	8,573	58,086
Share of total (percent)					
Developed countries liberalize					
Developed countries	11.9	-20.9	11.1	23.9	26.0
Developing countries	10.2	29.2	-9.4	-9.1	21.0
Total welfare impact	22.1	8.3	1.7	14.9	46.9
Developing countries liberalize					
Developed countries	12.1	34.0	-0.2	0.9	46.9
Developing countries	1.1	6.2	-0.1	-1.0	6.1
Total welfare impact	13.2	40.2	-0.3	-0.1	53.1
Full multilateral liberalization					
Developed countries	24.0	13.1	10.9	24.9	72.9
Developing countries	11.3	35.4	-9.4	-10.1	27.1
Total welfare impact	35.4	48.4	1.5	14.8	100.0

Source: Authors' simulations based on the GTAP database and model, version 5.

from full liberalization, whereas they receive only 27 percent of the ensuing global gains. Developing countries receive a somewhat greater share of the global gains from partial liberalization, at 33 percent (table 6.14).

CONCLUSIONS

This chapter has brought the best available data and analysis to bear for estimating the size and distribution of gains from multilateral trade liberalization in a post-Uruguay Round era. The dynamic GTAP model was used to project

Table 6.14 Welfare Impacts of Partial Liberalization, 2007
(1997 US\$ millions and share of total)

Scenario and benefiting region	Tariffs				Total
	Agriculture and food	Manufactures and services	Export subsidies	Domestic support	
Millions of 1997 US dollars					
Developed countries liberalize					
Developed countries	5,239	−4,860	3,782	10,566	14,728
Developing countries	2,622	8,316	−2,849	−2,774	5,315
Total welfare impact	7,861	3,456	933	7,792	20,043
Developing countries liberalize					
Developed countries	2,722	9,167	−96	237	12,030
Developing countries	2,022	6,109	−13	−271	7,847
Total welfare impact	4,744	15,276	−109	−34	19,878
Full multilateral liberalization					
Developed countries	7,961	4,307	3,687	10,803	26,759
Developing countries	4,644	14,425	−2,862	−3,045	13,162
Total welfare impact	12,606	18,732	824	7,758	39,921
Share of total (percent)					
Developed countries liberalize					
Developed countries	13.1	−12.2	9.5	26.5	36.9
Developing countries	6.6	20.8	−7.1	−6.9	13.3
Total welfare impact	19.7	8.7	2.3	19.5	50.2
Developing countries liberalize					
Developed countries	6.8	23.0	−0.2	0.6	30.1
Developing countries	5.1	15.3	0.0	−0.7	19.7
Total welfare impact	11.9	38.3	−0.3	−0.1	49.8
Full multilateral liberalization					
Developed countries	19.9	10.8	9.2	27.1	67.0
Developing countries	11.6	36.1	−7.2	−7.6	33.0
Total welfare impact	31.6	46.9	2.1	19.4	100.0

Source: Authors' simulations based on the GTAP database and model, version 5.

the global economy forward to 2007, based on exogenous projections of endowment growth, technological change, and trade policy changes. The trade policy changes include both Uruguay Round commitments and the WTO accessions of China and Taiwan, China. The trade liberalization analysis is comparative static in nature, using the 2007 database as a starting point, and considering four liberalization scenarios.

Developed countries reap a larger share of gains (73 percent) from full liberalization than their own liberalization contributes (47 percent) to the global gains. This is a reflection of the relatively smaller trade barriers in developed

countries (especially outside of agriculture). These gains are roughly in proportion to developed countries' share in global economic activity. However, the sources of these gains are very different between developed and developing countries. Developed countries benefit most from agricultural tariff liberalization and the removal of domestic farm support, whereas developing countries benefit most from the liberalization of manufactures trade. This is consistent with earlier findings by Hertel and Martin (2000), who argue that developing countries stand to benefit from continuing to push for tariff cuts in manufacturing—despite the fact that the developed countries have largely liberalized this sector.

Developing countries garner just 27 percent of the global gains from full liberalization, while their liberalization contributes 47 percent to the global gains. This disparity stems from the higher trade barriers in developing countries than in developed countries.

Tariff liberalization accounts for 84 percent of the global gains, of which 35 percentage points are associated with agriculture and food tariffs and 48 percentage points with manufactures. Elimination of domestic support for agriculture accounts for most of the remaining 16 percent of the global gains, although removal of agricultural export subsidies contributes a modest amount.

Thus, overall, about half of the global gains from merchandise trade liberalization following completion of the Uruguay Round are associated with food and agriculture—a sector that accounts for just 10 percent of global GDP. This highlights the critical importance of making progress on the agricultural negotiations in the Doha Development Round.

NOTES

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1. The dynamic model is a modular extension of the comparative static model, which incorporates international capital mobility (using adaptive expectations) and tracks the accumulation of wealth and capital stocks. As such, it is particularly useful in making global projections. However, the tools necessary to facilitate the extensive decomposition analysis that is essential to this chapter are not yet fully developed in the dynamic model. Hence, the virtue of using the model in its comparative static mode.
2. www.gtap.org.
3. For purposes of running the dynamic GTAP mode, the standard database is supplemented with foreign income data from the IMF *Balance of Payments Statistics Yearbook* to permit tracking of international capital mobility and foreign wealth.
4. The trade and protection data are provided by contributors to the GTAP database at the level of the GTAP sectoral classification, not at the tariff line.
5. A preliminary comparison of the impact of full trade liberalization using the most-favored nation applied rates and the preferential rates data sets indicates that use of most-favored nation rates overstates global gains from tariff liberalization by 5 percent and developing country gains in particular by about 30 percent.

6. The proper allocation and treatment of domestic support to specific commodities remains a topic of some debate (Gehlhar and Nelson 2000; Frandsen, Jensen, and Yu 2000). For the authors' most recent treatment, see Dimaranan, Hertel, and Keeney (2002), which includes further modifications.
7. The amber box component of the aggregate measurement of support differs from the producer support measures used in this database in that the aggregate measure includes some of the support provided by tariff support of administered domestic prices. The aggregate measurement of support is based on the difference between domestic administered domestic price and a fixed external reference price, rather than the current world price relevant to economic distortions.
8. The trade-weighted average tariffs for food and agriculture are low compared with other sources because they were calculated from applied rather than bound rates and because tariffs for processed food products are included in the calculation. Also, the base tariff data are already in the highly aggregated GTAP sectoral classification and not at the tariff-line level.
9. The gain in utility refers to the gains on the part of the representative regional household in the GTAP model. This includes current private and government consumption as well as future consumption (savings).
10. It should be borne in mind that the analysis does not consider barriers to trade in services, investment, and the movement of people. These offer the potential for much larger gains, since services are such a large share of economic activity (see table 6.1). Potential gains from greater exploitation of scale economies have also been ignored.

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CHAPTER SEVEN

Agricultural Trade Reform in the WTO: Special Treatment for Developing Countries

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MAIN FINDINGS

Trade Liberalization and Developing Countries

- Genuine trade liberalizing reform of highly protected agriculture in developed countries is important for improving economic and social conditions in developing countries.
- Many developing countries themselves have significant barriers to trade of their own.
- The preoccupation of countries, be they developed or developing, with increasing their exports while maintaining barriers to imports is costly for their economies.
- Multilateral trade liberalization remains the best outcome for most countries for advancing their economies overall, particularly for long-term economic growth.
- The example that developed countries set in agricultural trade liberalization and reform is important if developing countries are to embrace trade liberalization. Changing the forms of support but not the levels is unlikely to be convincing evidence of a genuine commitment to reform by developed countries.

Importance of Special and Differential Treatment

- Many developing countries are concerned about the potential costs to some of their people from substantial and immediate trade liberalization.
- Adjustment difficulties would differ markedly among developing countries, depending on the growth, structure, and diversity of their economies, labor mobility, and the availability of capital. So there is a case for differing treatment.
- Special and differential treatment as permitted under the current WTO agreements provides an opportunity for developing countries to spread adjustment costs over a longer period while taking advantage of the wider benefits to their economies from more open markets.
- Slower liberalization provides time for developing countries to implement the types of domestic programs and policy reforms that will improve the overall efficiency, competitiveness, and flexibility of their economies.
- If the appropriate domestic policies are not implemented, sectors that can currently only compete by virtue of protection will fall further behind, while unprotected industries that are supposed to benefit from trade reform will be constrained.
- The longer that domestic programs and liberalizing reforms are delayed, the longer it will take for developing countries to realize the benefits from reform.

Market Access

- Impacts of trade liberalization differ between countries. If protection was low before the reforms, the liberalization would raise commodity prices and farmers would benefit. If protection was high before the reforms, adjustment pressures may arise.
- Some of the proposals advanced for new and additional special and differential treatment in the present World Trade Organization (WTO) agricultural negotiations could lead to increased protection in developing countries. This would result in costs to both developing and developed economies, and would further depress and destabilize world prices.
- If special safeguards for developing countries were adopted to obtain agreement in WTO negotiations, it would be important to structure them in ways that limit potential damage to world markets and trade. Otherwise, special safeguards could further depress world prices and trigger additional protection in other countries.
- If additional trade preferences were extended to selected developing countries, the outcome would be inherently discriminatory and inefficient. It may provide short-term gains to the chosen countries but at a cost to other suppliers, many of which would be developing countries.
- If developing countries were to increase their tariffs progressively with degrees of processing (relative to those applied in developed countries),

they might increase their production and export of processed agricultural products but at an additional cost to domestic consumers and lower aggregate incomes both domestically and globally.

Domestic Support

- Most developing countries have relatively low levels of domestic support for their agriculture. Such support is mainly in categories that are exempt from limitations on the grounds of being considered to be minimally distorting. Current special and differential treatment exempts additional forms of support, such as input subsidies to low income or resource poor farmers, from reduction commitments.
- There is substantial room under present WTO rules and special and differential provisions for additional domestic support to be applied in developing countries where that support is regarded as necessary by members.
- A large share of domestic support by developing countries has been in infrastructure, research, and training, which is important for these countries' agricultural and general economic development.

Food Security, Adjustment, and Domestic Policies

- Food security can usually be advanced more through open trade coupled with targeted arrangements, such as social security and infrastructure development, than through import barriers or subsidies.
- Trade reform will be more effective in advancing economic conditions if underpinned by markets and institutions that function well. If other sectors can readily grow, adjustment pressures for people leaving agriculture will be eased where protection is reduced.
- Trade liberalization is only one part of the necessary reforms to advance economic development.
- The issue of special and differential treatment should be evaluated in relation to the timing, scope, and resources available to developing countries to reduce the costs of adjusting to more open markets.

INTRODUCTION

Currently, negotiations are under way in the WTO on a new agreement on agriculture. These negotiations have become part of a wider trade round since it was agreed in Doha in late 2001 that such a round should occur. The Doha Ministerial Declaration emphasizes the importance of international trade in promoting economic growth and alleviating poverty. It undertakes to make positive efforts to ensure that developing countries "secure a share in the growth of world trade commensurate with the needs of their economic development" (WTO 2001a).

Most of the distortions to international agricultural trade and markets have arisen from protection by developed countries (Tyers and Anderson 1992). Such distortions emanate from a combination of barriers to imports, market distorting domestic subsidies, and export subsidies. They hurt the economies of many developing countries through restricting their access to markets and by subjecting their farmers to competition from subsidized products. However, many trade distorting protection policies are also being pursued by developing countries, slowing both their own development and that of their trading partners, including other developing countries.

Developing countries constitute the majority of WTO membership. Consequently, the positions they take in the present negotiations are likely to be critical if real trade liberalizing reform is to be achieved. While governments of many of these countries also intervene substantially in their agricultural sectors, it is generally considered that these countries experience differing conditions from developed countries and that these conditions warrant special treatment. Agricultural adjustment costs and food security loom large in developing countries' concerns about trade liberalization.

The differing treatment for developing than for developed countries that is incorporated in WTO agreements is termed special and differential (S&D) treatment—see Michalopoulos (2000) for the evolution of S&D treatment in the context of changing views on how trade policies can help development.

S&D treatment arises in two main areas under the Agreement on Agriculture. One is through allowing developing countries to reduce their barriers against imports by less than the agreed cuts for developed countries. The other is through allowing developing countries to reduce their market distorting forms of domestic support by less than developed countries. The lesser and slower reductions provide a longer time frame for implementing trade reform in developing countries. Least developed countries (LDCs) are exempt from reduction commitments altogether.

Following the adoption of the Doha Ministerial Declaration, several developing countries, and also some nongovernment organizations on their behalf, are advancing proposals for additional and/or revised special treatment in the present WTO negotiations on agriculture. These generally call for an extension of the special treatment that is already provided, while some advocate the incorporation of a separate “development box” in the Agreement on Agriculture. Some of these proposals call for trade liberalization by developed countries while reserving the right of developing countries to provide substantial protection—and, in some cases, even to increase it.

At the same time, there is considerable confusion about the nature of S&D treatment as it is currently applied. The objectives in this report are to:

- Clarify what the S&D provisions in the present WTO Agreement on Agriculture are.
- Examine the reasons for special treatment and to provide an assessment of

some of the proposals for S&D arrangements that have been advanced for the current WTO negotiations.

- Analyze the effects that different levels of market access reform would have on economic conditions in developing and developed countries.
- Appraise the broad economic effects of S&D arrangements for domestic support.¹
- Draw conclusions on policies to address food security problems that are advanced as a prime reason for extending S&D treatment of developing countries.

OVERVIEW OF PRESENT WTO MARKET ACCESS AND DOMESTIC SUPPORT ARRANGEMENTS

General Agreement

Under the present WTO Agreement on Agriculture, it was agreed that WTO member countries, other than LDCs, should reduce both their barriers to market access and their market distorting forms of domestic support to agriculture. The agreement was implemented first by developed countries, while the implementation period for developing countries concluded in 2004.

Market Access

For market access, it was decided that all barriers to trade should be subject to a process of tariffication. Forms of economic barriers against imports other than tariffs, such as import quotas and variable import levies, were converted to their tariff equivalents. These tariffs were then bound—that is, the members undertook not to increase their applied tariffs above those levels, except by negotiations, with compensation for affected trading partners (Young 1994). It was then agreed that these tariffs along with those that were already bound were to be reduced over an agreed period of time.

An additional element of the agreed changes was that developing countries that did not have bound tariffs for particular commodities in September 1986 were allowed to nominate “ceiling bindings” for those commodities. These ceiling bindings then became their bound tariffs, from which the agreed cuts would apply. Such ceiling bindings could be higher than the applied tariffs at the time (Young 1994).

To ensure that access by exporters to import markets was not reduced, importing countries undertook to maintain at least current access levels and to provide minimum access opportunities up to agreed proportions of base (1986–88) consumption levels. These provisions were put into effect through a system of tariff rate quotas under which tariffs charged on quantities below specified levels were lower than tariffs on quantities that might enter above those levels.

Domestic Support

For domestic support, it was agreed that WTO members should reduce their amounts of market distorting domestic support for agriculture as a whole. This distorting support is represented by an aggregate measurement of support (AMS).

The AMS comprises support to producers through administered internal commodity prices that are above constant benchmark world market levels and forms of subsidies that are not exempted. These nonexempt subsidies are considered to be market distorting, being related to production, prices, or input use.

A wide range of subsidies and other forms of government support have been exempted from inclusion in the AMS on the grounds of them being production limiting (termed blue box exemptions), or being considered to be minimally market distorting (termed green box exemptions). In addition, members are allowed exemptions where support is considered to be market distorting but below agreed *de minimis* proportions of the value of production. These exemptions are available for product, specific and non-product-specific support.

The forms of domestic support that qualify for blue box, green box and *de minimis* exemptions under the present agreement can be provided by both developed and developing countries. However, the developing countries have not been using production-limiting blue box arrangements, probably because they are generally concerned to ensure supplies of food for their people and also because of the high budget costs with such arrangements.

The green box support that is exempted on the grounds of it being considered to be minimally distorting includes provision of many government services and infrastructure, domestic stockholding for food security purposes, domestic food aid, a range of subsidies for regional and environmental assistance, decoupled direct income support, income insurance subsidies, disaster relief, and investment aids.

SPECIAL PROVISIONS FOR DEVELOPING COUNTRIES

The special needs of developing countries are addressed in the present WTO Agreement on Agriculture through the following provisions (WTO 1993, 1995).

Market Access

- Developing country tariff reductions are two-thirds of those for developed countries, with average reductions of 24 percent and minimum cuts for any particular item being 10 percent. The comparable cuts for developed countries are 36 percent and 15 percent, respectively. The cuts for developing countries are over 10 years compared with 6 years for developed countries.

- The implementation period for minimum access commitments for developing countries is 10 years compared with 6 years for developed countries.
- A special provision is made for developing countries enabling them not to tariffy imports for a primary product that is the predominant staple in the traditional diet, subject to the following conditions: that imports comprised less than 3 percent of base (1986–88) consumption, no export subsidies had been provided since the base period, and effective production restraining measures had been in place. Under such conditions, minimum access opportunities should be provided for 1 percent of base period (1986–88) consumption in the first year of the implementation period, rising to 2 percent by the fifth year. The minimum access commitment would then rise in equal annual instalments to reach 4 percent in the 10th and final year of the implementation period.

Domestic Support

- AMS levels for developing countries are to be reduced by 13.33 percent over 10 years, whereas the cuts are 20 percent over 6 years for developed countries.
- Investment subsidies generally available to agriculture in developing countries and agricultural input subsidies generally available to low income or resource poor producers in developing countries are exempt from limits or cuts, as is support to encourage diversification from growing illicit narcotic crops (Article 6.2 of the Agreement).
- The thresholds for *de minimis* exemptions for distorting support measures that are used are 10 percent each for product-specific and non-product-

Box 7.1 Least Developed Countries That Are Members of the WTO and Exempt from Reduction Commitments

Angola	Guinea Bissau	Rwanda
Bangladesh	Haiti	Senegal
Benin	Lesotho	Sierra Leone
Burkina Faso	Madagascar	Solomon Islands
Burundi	Malawi	Tanzania
Central African Republic	Maldives	Togo
Chad	Mali	Uganda
Congo, Dem. Rep.	Mauritania	Zambia
Djibouti	Mozambique	
Gambia	Myanmar	
Guinea	Niger	

specific support, totaling a maximum of 20 percent of the value of agricultural production. The corresponding exemptions for developed countries are 5 percent each for commodity-specific and non-commodity-specific support, giving a total potential amount of 10 percent.

- LDCs designated by the United Nations are exempted from reduction commitments under the agreement. At present there are 49 countries on the United Nations list, of which 30 are WTO members (box 7.1).

These provisions mean that developing countries, which undertook to implement a program of trade liberalization and domestic reforms along with developed countries when they adopted the WTO Agreement on Agriculture, will be able to adopt those reforms more slowly and with smaller cuts than developed countries.

APPROACHES TO CHANGE

Opportunities for Achieving Benefits from S&D

The provision of S&D treatment in WTO agreements is now well established and accepted by the membership, with developing countries committed to lesser cuts to tariffs and domestic support than developed countries and with the least developed countries not required to make commitments.

With economic gains from trade generally arising from reducing trade barriers and market distorting support, what then should be the ongoing role for S&D treatment?

A first step is to identify the main underlying problems that developing countries face. Clearly, developed countries' protective barriers against imports harm developing countries' economies. But the problems are much wider than that. Internal economic structures and institutions in developing countries often impede the efficient functioning of markets. In practical terms this means that farmers in these countries may not have the same scope as those in developed countries to recognize market opportunities, either domestically or internationally, and to act on them.

For countries to take advantage of trade liberalization to advance their economic well-being markets need to be working well so that resources can flow readily from less productive to more productive activities.

Stiglitz (1999) points out a range of problems in developing countries that result in poorly functioning markets, including government regulations, rigidities in labor markets, and lack of access to capital. He noted that such poorly functioning markets could result in inadequate job creation to employ people who lose their livelihood in the restructuring that follows trade liberalization: "Moving workers from a low productivity sector to unemployment does not

increase output.” The effect on overall economic welfare for the country would depend on how large the distortions were in the low productivity sector and elsewhere in the economy and how many people were involved.

The underlying causes of these shortcomings need to be addressed if the potential benefits from trade liberalization are to be realized. It is here that S&D treatment can play a role. By not requiring developing countries to liberalize as rapidly as developed countries, they are given some breathing space to address the inadequacies in their internal economies and policies that limit the benefits that they can obtain from more open markets. However, such delays come at the cost of not obtaining the benefits as quickly.

Of course the extent of these problems varies widely between developing countries, but there are particular areas where reforms can have high payoffs in making markets operate more effectively. Such areas include reforms to land titling institutions to make property rights more secure, reforms to judicial institutions to enforce contracts, reforms to corporate governance, and reforms in the provision of infrastructure and in ensuring its availability to vulnerable groups (World Bank 2002). In addition, improvements in education and training are clearly important in providing the expertise to develop a wider range of economic activities and for assisting in the process of adjustment.

Where market-based reforms are instituted along with institutional and legal reforms, the situation of farmers can be improved. An example where market-oriented policy reforms have helped farmers is the deregulation of agriculture in Indonesia since 1998. Montgomery and others (2002) demonstrate that farmers in Indonesia now receive a higher percentage of the final market price of their products and that real prices for their products are higher than previously. This has resulted from the dismantling of local monopolies, monopsonies and quotas, and the elimination of many distorting taxes and levies. For Vietnam, Che, Kompas, and Vousden (2001) find that the country’s rapid change from being a large importer of rice to being the world’s second-largest exporter occurred largely as a result of more competitive markets brought about by trade liberalization, as well as earlier domestic market reform.

S&D provisions that are well designed should help provide the time, scope, and opportunity to prepare developing countries for the ongoing process of adjustment. If the opportunities that they present are not taken, those countries will fall farther behind in achieving the benefits from trade liberalization. If, instead of seeking to make both internal and external reforms to obtain the benefits from more efficient resource use and trade, countries backslide toward greater protectionism and take the route of increasing their barriers to trade, it will be to their own cost. This will be demonstrated later in this study by a modeling analysis of trade liberalization for agriculture.

Stiglitz (1999) observes that developing countries have been adept at learning from developed countries how to use additional highly market distorting protection measures such as antidumping and countervailing measures. He warns of the danger that if support for liberalization in the developing world

falters, even greater inequalities between rich and poor countries are likely to emerge, with even more people in poverty.

Unfortunately, many of the proposals that have been made by some developing countries to the present WTO negotiations on agriculture could, if adopted, result in such backsliding (see box 7.2 for a list of some such proposals for market access and domestic support).

Box 7.2 Selected Proposals Advanced by Some Developing Countries and Nongovernment Organizations

Market access

Access to developed country markets

- Developed countries should provide quota-free and tariff-free access to products from low income resource poor farmers in developing countries.
- There should be mandatory filling of tariff quotas by developed countries.
- Tariff rate quotas (TRQs) by developed countries should eventually be abolished.
- In the interim, there should be a substantial expansion of TRQs administered by developed countries.
- Low income developing countries should be given special preferential access to developed country TRQs.

Food security crops in developing countries

- Basic food security crops should be exempt from tariff reductions or other commitments.
- There should be a right to renegotiate (upward) the low tariff bindings that apply to food security crops where those bindings are currently low.

Tariff bindings

- Developing countries should be able to adjust their tariff bindings by relating them to the trade distorting policies of developed countries.
- Developing countries with domestic support below *de minimis* ceilings should be allowed to maintain “appropriate” levels of tariff bindings to protect rural populations.
- Developing countries should be allowed to reevaluate and adjust their tariff levels, allowing them to raise their tariff bindings to protect food security when cheap imports threaten domestic producers.
- All tariff reductions made by developing country members should be made from the basis of their bound, rather than applied, rates.

Special safeguards, antidumping, and like measures

- Special safeguards providing automatic increases in tariffs, with a provision to impose quantitative restrictions under specified circumstances in the event of a rapid increase in imports or decline in prices, should be allowed.

(continued)

Box 7.2 (Continued)

- There should be greater flexibility to reevaluate and adjust tariff schedules, with a view to overcoming the negative effects of cheap subsidized agricultural imports.

Minimum access

- Developing countries should be exempt from any obligation to provide any minimum market access.

Domestic support

AMS levels

- Developing countries should be allowed to offset negative product-specific support against positive non-product-specific support.

De minimis

- *De minimis* support ceilings for commodity and non-commodity-specific support in developing countries should be doubled to 20 percent each.

Expanding Article 6.2 S&D exemptions

- Subsidized credit and other capacity building measures should be permitted as exemptions when provided to low income or resource poor farmers.
- Measures should be taken to increase domestic production of staple crops for domestic consumption.
- Spending on transport costs from surplus to deficit parts of a developing country should be permitted as exemptions for food security crops.

Expanding access to green box exempt measures

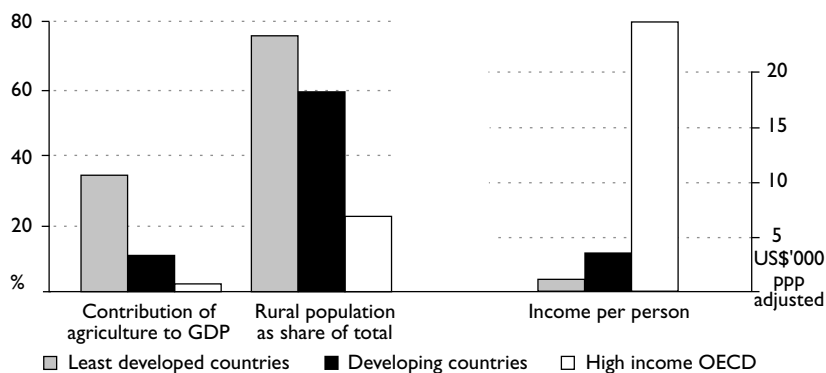
- Greater flexibility should be granted to developing country members to increase their levels of domestic support within the framework of green box (Annex II) measures.

Some Important Developing Country Considerations for S&D Treatment for Agriculture

Differences among Developing Countries

While the most obvious difference between developed and developing countries is the large disparity in average incomes, other general differences may be recognized. Many more people rely on agriculture for a living in most developing countries than in developed countries, and agriculture contributes a larger share of overall economic activity (figure 7.1). Also, most developing countries have less developed social security systems than developed countries. Many have institutional frameworks that are not well adapted to modern

Figure 7.1 Key Indicators: Differences Between Country Groups



market-based economies and inadequate infrastructure that can increase the costs and reduce the overall net benefits from more open markets. An example is where inadequate port facilities prevent imports even when tariffs or other economic barriers are lowered.

It is also critical to recognize that large differences apply among developing countries in incomes, the contribution of agriculture to the economy, the balance between large and small farms, and particularly in the rate of growth and variety of other sectors in their economies. All of these factors can influence the degree of adjustments of people and resources that may arise from trade liberalization and the ease with which the adjustments can be accommodated. Differences in the economic structure of countries are also important—for example, agricultural trade liberalization affects net exporters of agricultural products differently from net food importing countries.

S&D Treatment and Trade Liberalization

Generally, trade liberalization that reduces agricultural protection around the world results in higher world market prices (Tyers and Anderson 1992). This should reduce adjustment pressures on farmers where their returns reflect world prices. In countries and industries where agricultural protection and support have been low, this provides additional opportunities for agricultural development.

However, in countries where agricultural industries have been protected from import competition and where commitments are made to reduce barriers to trade, the protected products can encounter increased competition from imports. Such competition can adversely affect the incomes of farmers in the previously more protected parts of the sector, forcing them to adjust their operations and, at the extreme, to leave farming.

These adjustment pressures are not limited to developing countries. However, the implications of farm adjustment for people in developing countries may be more adverse because of inadequate social security systems and, in some circumstances, fewer employment opportunities elsewhere. Consequently, there can be reasons to allow greater flexibility for governments in developing countries to assist vulnerable groups of farmers than in developed countries—an argument made, for example, by Oxfam Community Aid Abroad (2002).

Apart from enabling easier adjustment by farmers, there are several other reasons why differential treatment for developing countries might be seen as justified:

- Lesser cuts in tariffs for developing countries over longer periods can reduce the rate of rural–urban migration, which can reduce the strain on often underdeveloped urban amenities in developing countries.
- Tariffs on trade are one of the few administratively convenient ways of collecting revenue for governments in many developing countries.
- Input subsidies have come to be relied on by low income, resource poor farmers in some developing countries, and their withdrawal would cause hardship for this already disadvantaged group.
- Food insecurity is a problem in many developing countries and special measures may enable developing countries to address it.

Yet, there is a danger that emphasizing these factors can discourage the very changes that are necessary to advance overall economic adjustment and development. Counterarguments to the above points include:

- Reducing agricultural tariffs can increase the rate at which people leave farming. If higher incomes can be earned in nonagricultural activities, overall benefits will arise. Not all labor released from farming need necessarily be absorbed in industrial jobs in urban centers that have inadequate infrastructure; for example, the rural nonfarm sector has been expanding in many countries (Lanjouw and Lanjouw 2001).
- Although tariffs on trade may be important for raising revenue in developing countries, low tariffs on a wide range of traded products would be less costly in economic terms than high tariffs concentrated on agricultural products and a few other items.
- Input subsidies are a highly inefficient form of support. Typically, the costs to providers exceed the benefits to recipients.
- Food insecurity can be addressed in ways that are more effective than through domestic agricultural protection (see “Options for Addressing Food Insecurity,” page 177).

Locking resources and employment into traditional structures of farming can slow the process of adjustment to more highly productive activities both within and outside agriculture and reduce longer term economic growth.

However, some developing countries have far less dynamic economies than others. For example, some countries in Sub-Saharan Africa have very narrow industry bases, with markets that are not operating efficiently. These countries face substantial challenges in developing a combination of institutional, legal, and educational reforms to provide an economic environment that is conducive to more ready transfers of labor and other resources to alternative activities when protection is withdrawn from particular activities. People and resources that may be displaced from agricultural activities in such countries if protection is withdrawn might be expected to adjust less readily than in developing countries that have more dynamic economies where markets function more efficiently. Where countries are classified in the least developed countries group, their special conditions are addressed in the present WTO Agreement on Agriculture through that group being exempt from commitments.

Food Security

In contrast to developed countries, where the purchasing power of most individuals, the existence of extensive and efficient food distribution and storage systems, and the strength of social security arrangements can ensure food security, there are real problems of food insecurity in parts of many developing countries. The definition of food security from the 1996 World Food Summit is “when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life” (FAO 1996). Food insecurity occurs when these conditions are violated.

Food insecurity stems from a lack of affordability caused by poverty and from a lack of food availability. In turn, lack of availability can result from a number of factors, prominent among which are climate and weather, disruption to supplies from war and civil strife, and inadequate transport and storage infrastructure to service isolated areas. A clear distinction should be made between food security and self sufficiency. Trade can make an important contribution to ensuring food supplies. Trying to achieve food security by highly supporting domestic production in the name of self-sufficiency can be costly and self-defeating in economies where comparative advantage lies in other industries.

Expectations of Developed Country Liberalization and Demands for S&D Treatment

While domestic political factors can and do impede liberalization and attainment of the associated economic benefits for societies as a whole, international cooperation, such as through WTO negotiations, can provide a means of reducing those negative factors through coordinated action. Countries’ concerns about competition from others’ subsidized products could be alleviated if support were reduced or eliminated in other countries as well. Also, world prices

would rise, reducing adjustment costs to farmers. These factors would ease the path to reform.

Obtaining freer access to developed country markets is clearly trade liberalizing and in the interest of global economic development and growth. However, the expectations of many developing countries for trade liberalization by developed countries under the current WTO Agreement on Agriculture have so far not been met. For example, in a proposal to the current agricultural negotiations on S&D treatment and a development box, a group of eleven developing countries observed that subsidies in OECD countries increased between the beginning of the WTO Agreement on Agriculture and 1998. They also observed that import barriers in developed countries had risen, and that developing countries that had not traditionally provided subsidies had not been allowed to do so (WTO 2000a). That same group proceeded to recommend a list of measures for developing countries that would enable them to increase support and protection, largely unconstrained.

The WTO Agreement on Agriculture includes provisions that enable developed countries to meet commitments to reduce market-distorting support simply by changing the forms rather than the levels of support. Also, commitments to reduce tariffs were from bound rates that were calculated by most countries in ways that inflated base levels, a process that some people have called “dirty tariffication” (Ingco 1995). A combination of countries being able to shuffle support from market distorting measures to “production-limiting” or “minimally distorting” measures that were exempted from cuts or limitations, along with substantial unused “water in the tariff” (that is, bound tariff rates exceeding the actual level of tariff protection), has enabled major developed countries to maintain high levels of support.

The changes in forms of support in developed countries have generally been to measures that are less distorting than formerly. However, the rules agreed for the exemptions on grounds of them being production limiting or minimally market distorting are being applied in ways that maintain definite market distorting elements. In fact, there has been a major reorientation of support by both the European Union and the United States to these production limiting and supposedly minimally distorting arrangements.

Such has been the scale of the support provided by the developed countries and so liberally are the WTO rules being applied that it is entirely understandable that some developing countries are questioning the commitment of major developed countries to the reform process. They can see that agricultural support in the OECD countries, in particular the European Union, the United States, and Japan, in the late 1990s had risen once more to levels similar to the extreme levels that prevailed in the mid-1980s (OECD 2001).

Furthermore, there have been policy changes recently in developed countries that are cementing high levels of support. This has been particularly the case with the 2002 US farm bill that provides for substantial increases in US

support beyond levels that prevailed before there was a major upsurge from 1998. It is expected that the United States will claim that much of the support is “decoupled”—not linked to production, prices, or inputs. Such decoupled payments are exempted from limits or cuts in the WTO Agreement on Agriculture, on the grounds of them being minimally distorting—that is, they are not expected to significantly influence production, consumption, or prices.

The decoupled, and therefore supposedly minimally market distorting, status of many of the payments in the new farm bill is questionable because the bill provides for growers to update the area and yield bases on which the payments are made. Such updating creates expectations that farmers can obtain greater government payments if they plant more now and over the next few years, enabling them to increase bases when they are next updated (Roberts and Jotzo 2001).

ISSUES IN THE CURRENT NEGOTIATIONS

There is a wide range of interests and objectives that have been expressed by developing countries in the WTO negotiations on agriculture, especially since the Doha declaration. While some focus on liberalization and market access to developed countries, others pursue expanded S&D provisions in a variety of areas (see Kaukab 2002). In this section, three distinct issues in the negotiations are analyzed: special safeguards for developing countries, trade preferences, and tariff escalation.

Special Safeguards for Developing Countries

India (WTO 2001b) and a group of developing countries (WTO 2000b) have proposed that all developing countries should be able to apply special safeguards against imports when they threaten to disrupt domestic industries. In the current agreement, special safeguards have been allowed where countries have converted nontariff barriers to tariff-only protection, and where they have designated items in their schedule of commitments for these safeguards to be applied (WTO 1995). Of the present WTO membership of 144 countries, 39 countries can provide special safeguards for some or many agricultural products. Of these 39 countries, 25 are developing countries (WTO 2002).

Characteristics of Special Safeguards

Special safeguards involve the temporary triggering of increases in tariffs under specified conditions when there is a surge in the volume of imports of the relevant product or when prices fall to below specified levels. In the present agreement, there are schedules relating the extent of the additional tariff, to the degree to which import volumes exceed those in a previous period or the extent to which import prices fall below levels in a base period.

Special safeguards have much in common with variable import levies that increase automatically when import prices fall. However, the special safeguards are a truncated form of such levies, with the degree of truncation depending on the rules for triggering them and the scale of temporary tariff increases that can be applied.

Variable import levies are an automatically countercyclical mechanism that was widely used by the European Union until the end of the Uruguay Round when they were outlawed. They are extremely disruptive to trade and to agricultural adjustment internationally as they render domestic production and consumption virtually unresponsive to world price signals. When world prices fall, for example, indicating high export supplies relative to import demand, variable levies increase by as much as the prices fall. This means that the low world prices do not provide signals for producers in the country applying the levies to produce less and their consumers to consume more, thereby preventing them from contributing to alleviation of the low prices. The mechanism throws an additional burden of adjustment onto exporting countries.

Special safeguards have many of the same effects as variable import levies, although within the limits and according to the schedules of tariff increases permitted.

Arguments might be made for the application of special safeguards in developing countries on the grounds that farmers in those countries do not have access to the same risk management tools to ensure against sharp short-term price reductions as those in developed countries. As market institutions are often underdeveloped, most farmers are not able to sell forward or hedge to secure price levels. They are therefore fully exposed when internal prices fall in response to a temporary influx of imports and sharp price reductions (Foster and Valdez 2002). The possibility of low border prices and the lack of instruments to ameliorate downward price risk are often factors in political pressure against trade reform by import-competing farm groups.

Also many farmers in developing countries have few financial reserves to cushion them against sharp reductions in prices, so poor farmers can face deprivation and food insecurity when such falls occur. As well as some farmers in these countries being exposed in these ways at the time when prices fall, sharp temporary price reductions can impair the ability of farmers to produce subsequently. As their resources become so depleted when they face periods of low prices, they are restricted in their ability to produce in the next year or season, thereby reducing production capacity and, it is argued, food security in the next period. It is also claimed in India's proposal (WTO 2001b) that it is time consuming for governments to avail themselves of general safeguards via the WTO Agreement on Safeguards, and by the time such safeguards may be invoked, much damage can be done to the livelihoods of affected farmers.

These arguments are primarily internal to the countries that face periodic low prices for imported commodities. They do not take account of the food security of groups other than farmers in the importing countries. Also, they do

not take account of the wider international ramifications of their use by developing countries that together may constitute a very large group of producing and trading nations that account for large proportions of world trade in agricultural products. There can also be problems with the present safeguard arrangements triggering increases in tariffs when imports rise sharply in percentage terms, even though the absolute volumes of such imports can be small.

Special safeguards play a “pot holing” role of “filling in” internal market prices when there are sharp increases in imports or sharp reductions in world prices. As such they result in higher average prices for food to both domestic producers and domestic consumers in importing countries over time. They protect domestic producers, but at a cost in terms of higher food prices to domestic consumers. They are another form of import protection.

Their automaticity is part of the appeal of special safeguards as protective measures. This is in contrast to antidumping cases that can be difficult to prove and sustain in the WTO, especially for developing countries with few administrative resources.

Effects of Special Safeguards

It is important to consider that, by their nature, special safeguards would usually be triggered when world supplies are large and *world market prices* are depressed. If developing countries that contribute a large part of world import demand implement increased tariffs when world market prices are low, there will be various effects.

The higher tariffs will mean that production in the countries imposing the safeguards will be higher than otherwise, and import demand by the countries will fall. This in turn further depresses world prices, exacerbating negative impacts on producers in the countries that do not apply safeguard measures. Some of those would be developing country exporters. Furthermore, the price insulation of producers in the countries imposing the safeguards over time will result in higher long-term average prices in those countries, increasing their production and reducing their consumption. This has a longer term depressing effect on world prices. The result will be world market prices that are periodically even more depressed than if the safeguards were not applied and lower average world prices over time. The lower average world price would result in costs to exporting countries but lower import prices for agricultural importers.

Another effect of the safeguards is their *potential to trigger additional protection* in other countries. Some major, wealthy developed countries that already have high agricultural support would almost certainly respond to the lower and more variable world prices by increasing both their level of support and its ability to offset periodic reductions in world prices. Even exporting countries that have so far provided little support to agriculture would face political pressures for agricultural assistance when faced with lower and more variable agricultural prices. Such reactions would, in turn, further depress and

destabilize world prices and trade. There is a danger that preparedness to accept the rights or abilities of large particular groups to additional protection can escalate protection generally—the antithesis of the desired outcome from WTO agricultural negotiations.

Special safeguards are a form of highly market distorting protection, when provided by either developed or developing countries. If it were necessary to provide them generally to developing countries to facilitate an agreement being reached in the WTO, both developed and developing countries need to be clear that it will be at a cost to most of their economies, and that cost could become larger than they might initially think. Some of the means that might be pursued to limit the harmful effects of special safeguards on world trade, market price levels, and variability are indicated in box 7.3.

Countries that have applied import tariffs for particular agricultural commodities that are well below their WTO bound rates can already raise import tariffs within their bound limits whenever they wish. Under such conditions, the addition of special safeguards could be largely redundant.

Box 7.3 Measures for Limiting the Harmful Effects of Special Safeguards on Trade

If special safeguards were extended to many more countries, the problem of safeguards being triggered simultaneously by many countries when world supplies are large and market prices are depressed could be limited if:

- Quantity and/or price trigger points were set so that it would require very large increases in import quantities or reductions in import prices before the safeguards could be implemented.
- The schedule for permitted increases in tariffs for various degrees by which imports increase or prices fall were set in a way that offset only a relatively small proportion of import price reductions.
- The number of countries and commodities to which special safeguards were applied could be limited.

Some specific suggestions on how special safeguards could be designed to limit market disruption have been made. For example, Konandreas 2000 (quoted in Foster and Valdés 2002) suggests that:

- Special safeguards could be allowed only for countries and commodities for which bound tariffs were less than some threshold—alternatively, the upper limit for tariff increases under special safeguards could be inversely related to the bound tariff.
- The option to apply special safeguards could be limited to countries with domestic support levels below some threshold.

Trade Preferences

But what if, instead of these economic costs of protection being directly borne by the developing countries, they could be borne by someone else? This happens when others provide special treatment to particular countries through preferential access to their markets.

Trade preferences are inherently inefficient relative to nondiscriminatory access. They allocate market access according to political criteria rather than through efficient market forces. They run contrary to one of the two founding principles of the modern multilateral trading system: reduction of barriers to trade and “the elimination of discriminatory treatment in international commerce” (preamble to GATT 1947; WTO 1995).

In the present WTO negotiations on agriculture, the European Union has proposed that “developed countries and the wealthiest developing countries [should] provide significant trade preferences to developing countries, in particular the least developed” (WTO 2000c). This is consistent with the Everything but Arms initiative by the European Union to extend full free access to its own market for all products from the least developed countries, except rice, sugar, and bananas. For the latter “sensitive” items, full implementation of tariff cuts would be delayed until 2009, and it seems likely that there will be further attempts to delay implementation as that time approaches. A recent quantitative study shows that nearly all of the benefits to the least developed countries would arise from greater access for sugar and rice (UNCTAD and the Commonwealth Secretariat 2001).

Preferential access has a strong superficial appeal to exporting countries. For those who receive it, access to markets is enhanced. That access is usually to countries where protection is high, and prices received under it are often well above those obtainable on world markets. However, it often increases production in high cost areas that become dependent on its continuation. It can focus resources on lobbying for its continuation rather than on adjusting to more efficient activities. It can stifle innovation in other sectors and result in economies having a very narrow focus. It diverts export opportunities away from more efficient producers, many of which will be other developing countries, and reduces global incomes (Topp 2001).

Tariff Escalation

In addition to adjustment pressures on farmers, food insecurity, and restricted access to markets in developed countries, developing countries have expressed concerns about the composition of trade in agricultural commodities. They observe that, on a world scale, trade in agricultural products is increasingly in higher valued processed and transformed products. At the same time many are concerned that their own exports remain primarily in unprocessed basic agricultural raw material products (WTO 2000b). There is a long established downward trend in the terms of trade for basic agricultural products, and the

declining real prices are directly reflected in the living conditions of large numbers of people in developing countries (Tyers and Anderson 1992; WTO 2000b; Oxfam International 2002).

A number of factors contribute to developing countries not obtaining a larger share of trade in processed agricultural products. Large agricultural processing industries have become established in developed countries, such as in Western Europe and North America along with the ready availability of large regional concentrations of agricultural raw material supplies from the farming industries that are well established in those regions. Many of those farming industries are heavily supported and protected, providing a continuing base for reliable supplies for processing. Also, the industrial and research bases in developed countries are well suited to establishing and maintaining processing industries. Generally, health and safety standards are high, which along with other technical advantages in these countries enable consumers to have confidence that the processed products will be safe.

However, not all factors favor the location of agricultural processing in developed countries. In many instances, characteristics of developing countries can favor agricultural processing industries. For example, many developing countries have a comparative advantage in labor-intensive activities. As agricultural processing activities can be labor intensive, developing countries can have a comparative advantage in some processing activities provided they have access to a large and reliable supply of raw materials, either domestically or through trade.

As well as many developed countries having established large agricultural processing industries, they have structured their trading arrangements in ways that perpetuate imports of raw agricultural products rather than processed products. In the European Union, for example, most agricultural imports are under preferential access arrangements where the imported items are either raw materials or are only at the first stage of processing, such as with raw sugar or meat in carcass form. Tariff escalation, under which tariffs rise as products become more highly processed, is also a factor contributing to the establishment and growth of processing of agricultural products in developed countries (WTO 2000b).

Tariff escalation is an issue not only in the development of processing of agricultural products in developed countries but also in developing countries. Many countries seek to expand processing of agricultural products both to increase export opportunities in an area of expanding global trade and to foster employment in rural areas. Support of processing through tariff protection at the expense of consumers can be a politically more attractive, less transparent means of pursuing such goals than providing it at the expense of taxpayers through the budget. Escalating degrees of protection as products progress through the processing chain entrenches protection at a cost to domestic consumers, and to the domestic and global economies.

Tariff escalation might be reduced overall internationally if larger cuts can be negotiated for high tariffs than for low tariffs. If, on the other hand, devel-

oping countries were able to increase tariffs under S&D arrangements, the degree of tariff escalation could rise relative to that in developed countries.

MARKET ACCESS REFORM

The present S&D provisions for market access enable developing countries to reduce their barriers to trade by less than developed countries do. This approach is consistent with the objective of reducing barriers to trade in both developed and developing countries, but taking into account special considerations for developing countries. However, some of the proposals that have been advanced could be used to avoid reductions in protection or to increase protection in developing countries.

While benefits from agricultural protection could flow to farmers and other rural landholders, others within the economy are also affected. Consumers pay through higher prices, while agricultural protection also imposes costs on other activities that compete with agriculture for resources. Internationally, if many countries increase import barriers, world demand falls and most countries will be affected.

Five Scenarios Analyzed

To illustrate the effects on aggregate incomes of developing and developed countries from differing levels of agricultural protection arising from the application of differing S&D arrangements, five hypothetical policy scenarios have been formulated. It is emphasized that these scenarios bear no relationship to any proposals for the negotiations. They are purely illustrative.

The effects in each scenario are quantitatively analyzed using the Australian Bureau of Agricultural and Resource Economic's global general equilibrium model, GTEM—global trade and environment model (for details of the model, see www.abareconomics.com/research/models/GTEM/GTEM.htm). The purpose is to assess and illustrate which of the policy scenarios will allow groups of countries to secure economic benefits, in terms of higher aggregate community incomes, from market access reform. Five scenarios are considered.

- *Scenario 1: tariff cuts all around*—Developing countries reduce applied tariffs by 20 percent on agricultural imports while the developed countries undertake a deeper cut of 30 percent. This scenario is consistent with the approach within the WTO Agreement on Agriculture under which the developing countries undertook to reduce their tariffs by two-thirds of the reductions of the developed countries.
- *Scenario 2: tariff cuts in developed countries only*—Only developed countries undertake market access reform, entailing a 30 percent cut in tariffs. This is consistent with a proposal for special and differential treatment, under

which developing countries are exempt from any obligation to increase market access while access to developed countries' markets is liberalized.

- *Scenario 3: tariff cuts in developed countries, more barriers in developing countries*—Developing countries raise their tariffs by 20 percent, while developed countries cut theirs by 30 percent. This represents a situation in which developing countries can adjust their tariffs upward for reasons that have been stated in some proposals for the revision of S&D treatment.
- *Scenario 4: no tariff cuts in developed countries, more barriers in developing countries*—This scenario corresponds to a situation where reforms to agricultural trade are derailed. Developed countries make no reforms, and developing countries increase tariffs by 20 percent.
- *Scenario 5: more barriers all around*—This represents a worst case scenario where WTO disciplines break down and both developed and developing countries increase protection. It is assumed that both developed and developing countries increase their applied tariffs by 20 percent.

These scenarios represent progressively less liberalization and increasing protection. Whereas the first scenario could be seen as representing the outcome of a successful trade-liberalizing round, the fifth scenario represents a systemic failure of the WTO, with increased protection everywhere.

Impacts on Groups of Countries

Impacts on incomes and trade are estimated for three groups of countries:

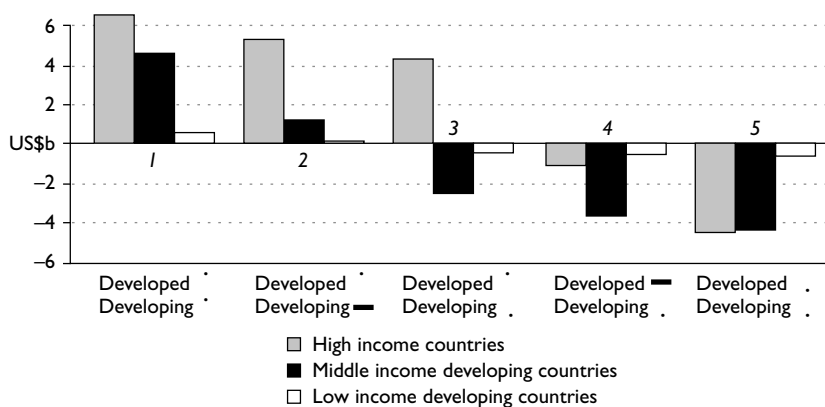
- *Developed countries*—North America, Europe excluding the former Soviet Union, Japan, other high income Asian countries, Australia, and New Zealand.
- *Medium income developing countries*—Latin America, former Soviet Union, northern and southern Africa, the Middle East including Turkey, China, and most of southeast Asia.
- *Low income developing countries*—India, Pakistan, Sri Lanka, Bangladesh, Vietnam, and Sub-Saharan Africa excluding southern Africa.

The findings based on these broad definitions may not hold for every individual country in each group. Reasons for this include differing factor endowments, differing degrees to which individual countries currently obtain preferential access to others' markets, differences between agricultural exporting and importing countries, differing uses of technology, and a number of other factors affecting individual countries.

Effects on Incomes

When every country implements trade liberalizing reforms in agriculture as in scenario 1, all of the three categories of countries considered—developed

Figure 7.2 Change in GNP Relative to the Reference Case at 2010



countries, medium income developing countries, and low income developing countries—gain (figure 7.2). The developing countries that reduce their barriers to trade in agriculture by 20 percent are projected to gain in total by about US\$5 billion a year by 2010, with most of the gains being by medium income developing countries. Such benefits are over two-thirds of the US\$7 billion a year gain by the high income countries that undertake a deeper cut in tariffs. A reason for the larger gains from liberalization by developed countries, and also for higher gains by middle income developing countries than low income developing countries, is their comparatively higher base levels of income.

Moving from scenario 1 to scenario 2 where the further opening of markets is limited to developed countries, it can be seen that all three groups still gain. However, the gains are smaller. The benefits to developed countries arise from improved allocation of resources away from highly supported agricultural activities, while developing countries benefit from both greater access to developed country markets and improved terms of trade. This result underscores the validity of developing countries' calls for greater access to developed country markets.

However, gains from greater access to developed country markets could be wiped out if developing countries increase protection of their own agricultural markets. In scenario 3 where developed countries continue to liberalize but developing countries actually increase protection, developing countries lose—despite having greater access to developed country markets. That is because, with their own increase in agricultural protection, resources are moved away from less supported activities toward the now more highly supported and less cost efficient agriculture. An important additional reason why developing countries as a group lose is because the benefits from agricultural trade between developing countries are also reduced. This is shown more fully in the next section.

Box 7.4 Country Categories in This Modeling Application

High income countries

Australia, Canada, high income Asian countries (Republic of Korea, Chinese Taipei, Singapore, Hong Kong), Japan, New Zealand, United States, Western Europe (EU-15, EFTA and Central European Associates)

Middle income developing countries

Argentina, Brazil, China, former Soviet Union, Indonesia, Malaysia, Middle East and Turkey, north Africa (Morocco, rest of north Africa: Algeria, Egypt, Libya, Tunisia), Philippines, rest of Latin America, South African Customs Union (Botswana, Lesotho, Namibia, South Africa, Swaziland), Thailand

Low income developing countries

India, rest of Africa (Sub-Saharan and southern Africa: Malawi, Mozambique, Zambia, Zimbabwe, Angola, Tanzania, Mauritius, Uganda, Benin, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Côte d'Ivoire, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Madagascar, Mali, Mauritania, Mayotte, Niger, Nigeria, Rwanda, São Tomé and Príncipe, Senegal, Seychelles, Sierra Leone, Somalia, Sudan, Togo, Zaire), rest of Asia (Sri Lanka, Bangladesh, rest of South Asia), Vietnam

Rest of world

Afghanistan, Albania, Andorra, Bermuda, Bosnia and Herzegovina, Brunei, Cambodia, Croatia, Cyprus, Democratic People's Republic of Korea, Gibraltar, Greenland, Guadeloupe, Pacific Islands, People's Democratic Republic of Lao, Macau, Macedonia, Malta, Marshall Islands, Monaco, Mongolia, Myanmar, Papua New Guinea, San Marino, Yugoslavia

Note: Original country listing is taken from Dimaranan and McDougall (2001). The cutoff point for countries in the low income category in terms of income (GDP) is approximately US\$500 per person in the aggregate regions of the model. However, some countries with per person incomes above this threshold are included in the low income category, and some low income countries in the middle income category. This is because they are aggregated within broader groups in the database. The low income developing countries category includes a number of least developed countries that have no reduction commitments under the WTO. Nevertheless, in the modeling scenarios they are assumed to change their tariffs along with other developing countries.

If negotiations fail, and developed countries do not liberalize while developing countries increase agricultural protection (scenario 4), all groups of countries would lose. Because trade is restricted, none of the groups considered would be able to exploit their comparative advantage as well as previously, thereby devoting a larger proportion of their resources to high cost protected agricultural items.

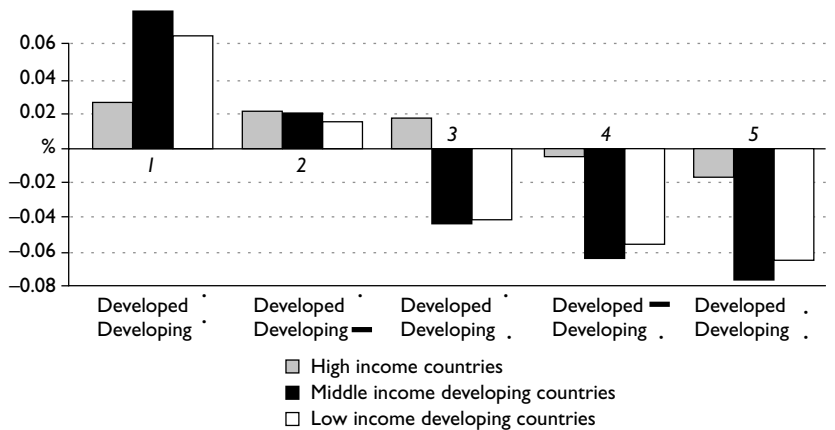
Finally, under scenario 5, where increased protection takes hold in both developed and developing countries, significant economic costs would be experienced all around as all three groups of countries direct more resources into protected agricultural industries at the expense of otherwise more profitable pursuits.

The dollar gains or losses in gross national product to low income developing countries as a result of trade liberalization or additional protection are small in comparison to those for middle income developing countries and developed countries. This is substantially because of the much larger base levels of income in the latter two groups. To gain a greater appreciation of the relative effects of changes in protection for these groups, the simulation results are shown in percentage terms in figure 7.3.

It can be seen that with trade liberalization in scenario 1, the greatest percentage gains arise for the middle income developing countries, while marked gains also arise for low income developing countries. For scenario 2, similar gains would apply for all three groups. Such gains reflect the characteristics of their economies, including the orientation toward agriculture and the demand for their products.

With the failure of developing countries to liberalize, and with them increasing agricultural protection in scenarios 3 to 5, both middle and low income developing countries would lose substantially in percentage terms. In scenario 4, where developed countries fail to liberalize, and developing countries increase agricultural protection, the percentage losses to the developing countries are greater than those for developed countries, as protection hurts their own economies. The effect is deepened in scenario 5 where developed countries also increase agricultural protection.

Figure 7.3 Percentage Change in GNP Relative to the Reference Case at 2010



Trade Flows

Developing Country Exports

Substantial trade flows in agricultural products have been established over the years in both directions between developing and developed countries. What is perhaps less well known is the extent to which trade in agricultural products has developed between developing countries. More than 40 percent of total agricultural exports by developing countries is now to other developing countries.

Agricultural exports to other developing countries, relative to exports to developed countries, have increased for all major geographic groupings of developing countries (figure 7.4). Because of this, changes in protection in developed and developing countries will not only affect trade in agricultural products between these groups but also within the groups. This is apparent from the results of the analysis of the five scenarios reported in figure 7.5.

If, for example, all countries were to liberalize their agricultural trade (scenario 1, figure 5), there would be a marked increase in the volume of agricultural exports from developing countries to developed countries. And there would also be appreciable increases in developing country exports to other developing countries.

If developed countries liberalise, but developing countries do not (scenario 2), appreciable gains in exports from developing countries to developed countries are projected. However, such gains would not be as large as if both groups liberalized (scenario 1), partly because income growth in developed countries would be smaller. However, developing country exports to other developing countries would fall slightly because of the lack of trade liberalizing reform in developing countries and the diversion of more exports to developed countries. These effects on developing country exports are intensified in scenario 3 where developing countries increase agricultural protection. In this case, devel-

Figure 7.4 Trade Between Developing Countries as a Share of Their Agricultural Exports

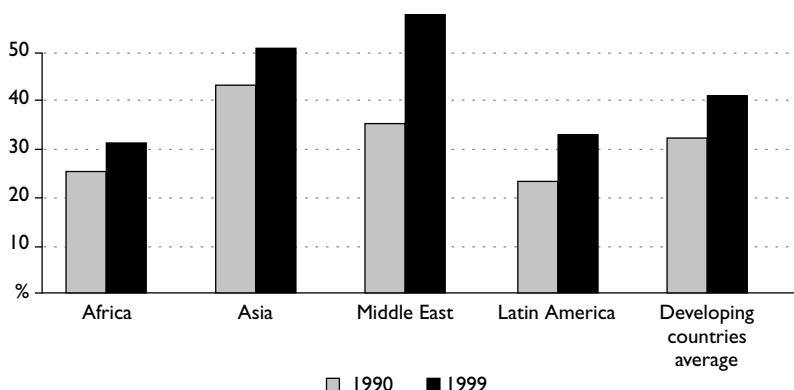
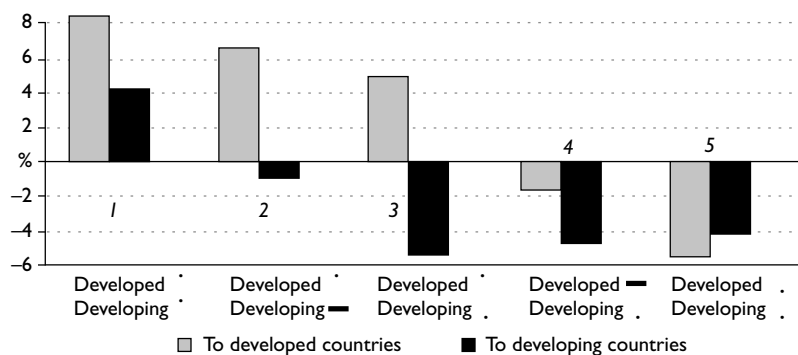


Figure 7.5 Change in Agricultural Exports from Developing Countries Relative to the Reference Case at 2010



oping countries would lose important export opportunities in other developing countries.

If there were no liberalizing reform in developed countries and developing countries increased agricultural protection (scenario 4), exports from developing countries to all groups, both developed and developing, would decline. From this it is evident that a strategy by developing countries to increase agricultural protection on the grounds of special and differential treatment, if developed countries do not reform their agricultural policies, would be harmful to the trade of developing countries. And as shown from figure 7.2, not only would the trade of developing countries suffer, but their aggregate incomes would also fall. If the developed countries were to join the developing countries in increasing protection, as in scenario 5, exports by developing countries to all markets would fall significantly.

What If Developing Countries Take the Liberalization Initiative?

One of the major concerns of developing countries in the present WTO agricultural negotiations is that they have observed very little real liberalization by developed countries. For example, the highly protectionist 2002 US farm bill can be seen as evidence of a lack of commitment of a major developed country to trade and other agricultural policy reform. A natural reaction of other countries, including developing countries could be “if they don’t liberalize, then why should we?” Given the commitment in the WTO to S&D treatment for developing countries, some developing countries could even argue that the lack of reform by developed countries should justify an increase in protection by developing countries.

Most of the proposals for special and differential treatment for developing countries have been to enable those countries to reduce protection by less than

developed countries, or even to increase it. It is important to assess whether such an approach would really provide economic benefits to developing countries, particularly when faced with persistent protection in developed countries. Basic trade theory would suggest otherwise, with economic benefits going to countries that liberalize more.

To assess the effects of trade liberalization by developing countries while developed countries do not reduce barriers to agricultural trade, a further scenario (scenario 6) has been simulated. Under this scenario, developing countries reduce all their agricultural import barriers by 20 percent while developed countries do not liberalize. It should be noted that under present S&D arrangements, such a scenario would not be possible as the philosophy behind the arrangements is that developing countries should not have to implement as many commitments as developed countries.

In figures 7.6 and 7.7, a simulation for this scenario is compared with that for scenario 4, under which there is also no further reform in developed countries, but developing countries increase barriers to trade. Incomes in developing countries would increase when they liberalize, despite there being no trade liberalization by developed countries (scenario 6).

The benefits to developing countries from their agricultural trade liberalization would arise largely from improved resource allocation and increased trade between developing countries. The gains to developed countries arise largely from greater market access to developing countries and greater demand in those countries as a result of higher incomes that flow from the liberalization.

Broad Conclusion on Reform to Market Access

The effects on income from both trade liberalization and trade restrictions are clear from the above analyses—more open trade generates income while trade restrictions reduce income. Furthermore, increasing protection for whatever reason, be it because others maintain high protection because it is considered desirable for social reasons or because it is considered to be politically desirable

Figure 7.6 Change in GNP Relative to the Reference Case at 2010

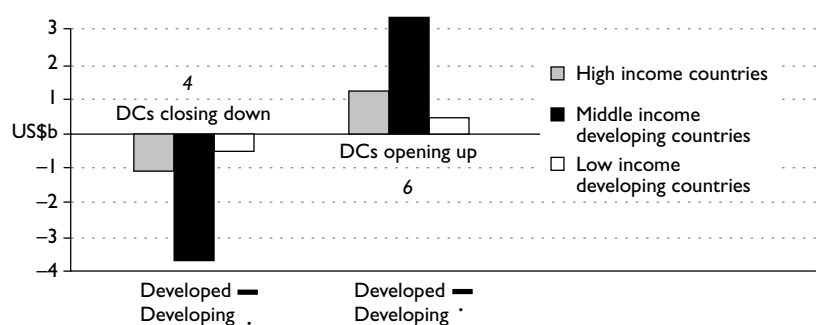
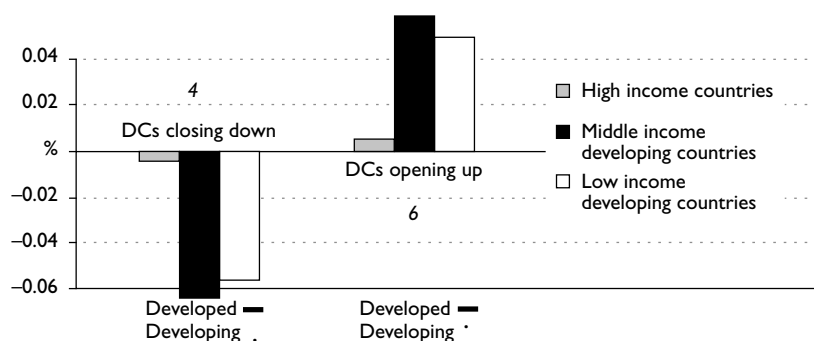


Figure 7.7 Percentage Change in GNP Relative to the Reference Case at 2010



to “advance development,” is likely to reduce incomes in the countries resorting to protection. Such protective policies, whether applied by developed or developing countries, spill over and adversely affect other countries. In contrast, trade liberalizing policies, by either or both developed or developing countries, increase incomes and trade.

The analysis shows that if trade reform is slow or stalled in some countries, the best response for most of the remaining countries in terms of policies that generate the highest incomes, is not to increase protection in a retaliatory fashion, but to take a leadership role and reduce distorting protection.

One Size Does Not Fit All

The kinds of benefits from liberalization that are indicated by the forgoing modeling results depend on assumptions that when resources are displaced from one sector, they move readily into others. Indeed, a prime driver of economic growth from trade liberalization is the improved efficiency of resource use through displacement of resources that were inefficiently used in protected industries, to more efficient uses in other activities. Whether such ready movement does in fact occur depends on whether there is sufficient growth in the economy and alternative activities available to absorb resources displaced through trade liberalization.

This important qualification applies to a marked degree for some developing countries, particularly a number in Sub-Saharan Africa. In some countries in southeast Asia, by contrast, economic growth has been relatively rapid, economic structures have been flexible, and demand for labor and other resources has been sufficient to enable relatively rapid and substantial adjustment between activities.

The large differences in economic activity and growth rates, and in structural economic reforms between different developing countries highlight the inadequacy of a one size fits all approach to S&D treatment in agricultural trade reforms. However, it does not alter the conclusion that the economies of

many developing countries would benefit from trade liberalization and that if S&D provisions that enable countries to maintain or increase protection were applied, they would result in lower incomes in most countries. Stiglitz (1999, p. 7) concludes that:

trade liberalization is essential for successful development, and progress in trade liberalization depends on a new round that is truly balanced and inclusive . . . if the new round is seen as unbalanced and support for liberalization in the developing countries falters, then we are likely to see the emergence of even greater inequalities between the rich and the poor countries, and even more people in poverty.

DOMESTIC SUPPORT

In providing assistance to agriculture, governments face choices in which mechanisms to use. They can limit imports through tariffs or other restrictions to market access, or they can pursue domestic support arrangements that involve subsidies to farmers or some forms of internal price support. In the WTO Agreement on Agriculture, S&D arrangements apply for both market access and domestic support as shown in the “Overview of Present WTO Market Access and Domestic Support Arrangements,” page 150.

To place domestic support under S&D arrangements into perspective, ABARE carried out an analysis of domestic support as notified to the WTO by the 41 developing countries that have reported such support.

An analysis of domestic support and S&D arrangements as they relate to domestic support has been published in a separate ABARE study (Roberts, Jotzo, and Perry 2002). The main findings from that analysis were:

- Levels of domestic support in developing countries have been low, with all but eight of the countries notifying support below 10 percent of their agricultural value added.
- For most countries, the total level of domestic support used has been well below even the *de minimis* threshold (10 percent of the value of production for each of commodity-specific and non-commodity-specific support). This even includes support that is already exempted under the green box, which is by far the most widely used form of support by all of the countries considered.
- Levels of domestic support vary markedly between developing countries. More than a third of the countries reported levels of less than 3 percent of value added in agriculture. In contrast, Trinidad and Tobago, Venezuela, Namibia, South Africa, and Zambia reported levels more than three times the developing country median. The Republic of Korea, which has many economic characteristics more in line with developed countries than developing countries but which still claims developing country status for WTO

agricultural arrangements, notified domestic support equivalent to 31 percent of agricultural value added over the period 1995–99.

- More than half (56 percent) of domestic support has been green box support in categories that are not restricted. Expenditure on infrastructure, research, training, and extension has been prominent, accounting for 53 percent of total green box support. These categories of expenditure are necessary for the development of efficient agricultural sectors, both to establish the capacity to produce agricultural products and to sustain the growth of competitive industries.
- Specific S&D exemptions for investment subsidies and input subsidies to low income, resource poor farmers have been only a small part (5 percent) of total domestic support. Some forms of that support such as input subsidies are blunt, inefficient instruments to deal with complicated domestic problems.
- Most developing countries are not constrained under current WTO rules and have substantial scope to address adjustment concerns and development needs, both within current *de minimis* exemption levels and under exempt categories in the green box and present S&D arrangements.

OPTIONS FOR ADDRESSING FOOD INSECURITY

There is a common thread through many proposals by developing countries that staple food crops should be exempted from limits on, or reductions in, support under WTO arrangements. Some advocate increasing support for staples. It appears that the prime motivation is to provide food security in developing countries where farm populations are large. However, it is unclear whether protection for otherwise uncompetitive staple or other crops actually increases food security for communities as a whole. Such protection may increase domestic production and supplies to farm families, but it increases prices or taxes and comes at a cost to others in the society. David (1999) shows how policies to expand rice and corn production have harmed the food security of the nonfarming poor in the Philippines.

At the consumer level, food security is to a large degree an issue of affordability, and food insecurity is mainly associated with poverty (Thompson 1999). Protecting producers from cheaper imports can thus harm food security for the poor. Diaz-Bonilla, Thomas, and Robinson (2002) point out that “increasing protection for food crops acts as a regressive tax, with a larger incidence on poor consumers, and benefits accrue mostly to larger farmers.”

Price support to farmers producing staple crops can only address the problem of food insecurity for society overall if those farmers constitute the dominant food insecure group. In addition, if this group were large, effective price support would need to be very high if the transfers were to be sufficient to make much difference, imposing high costs on nonfarm groups. Where most

production is and remains by subsistence farmers, price support will have little effect on those farmers.

Policy Instruments

Governments can use many policy approaches to address food insecurity, with differing effects on different groups. In table 7.1, effects on food security for these groups are related to factors influencing food security, namely income effects, price effects for food purchases, access to domestically produced supplies, and access to imports.

Import restrictions, including tariffs and direct restriction of market access, raise internal prices and increase domestic farmers’ production and incomes. The higher incomes improve farmers’ food security, but the higher prices would at least partly offset the improvement. Others in society would be less food secure as they would face higher food prices and reduced effective incomes. Although they would have greater access to domestically produced

Table 7.1 Impacts of Selected Policy Approaches on Food Security

Policy	Land owners or farmers			
	Economic access		Physical access	
	Income effect	Price effect for food purchases	Access to domestic supplies	Access to imports
Import restrictions	better	worse	better	worse
Domestic subsidies	better	none	better	none
Targeted social security	better for poor	none	none	none
Rural infrastructure	better	better	better	better

Policy	Others in society				Society overall
	Economic access		Physical access		
	Income effect	Price effect for food purchases	Access to domestic supplies	Access to imports	
					Overall food security
Import restrictions	worse	worse	better	worse	worse
Domestic subsidies	worse	none	better	none	uncertain
Targeted social security	better for poor	none	none	none	better
Rural infrastructure	worse	better	better	better	better

food, imports would fall by more and overall consumption levels would be reduced. Food security for society is likely to be reduced although some farmers would be more secure.

The impacts of *domestic subsidies* depend on the form of the subsidies. They increase farmers' incomes, thus improving farmers' food security. The effects on incomes of groups other than farmers would be negative because of the cost of supporting farmers. Overall, the effects on food security would depend on the extent of the subsidies and the incidence of food insecurity in farming and nonfarming communities.

Targeted social security increases incomes of both poor farmers and other poor people, enhancing their access to food from domestic or foreign sources. Overall physical access to food for society would remain largely unchanged. However, distribution chains in poor regions could improve as a result of higher incomes for poor people. Social security systems come at a cost to better off and more food secure groups, but would improve food security overall if they are well targeted.

Provision of *rural infrastructure* would enhance the food security of farmers by increasing their incomes and their access to food supplies. Others in the society who have to pay for the infrastructure would encounter lower incomes. However, that income effect could be reduced, or even offset, if the infrastructure reduced the transport and handling costs. Overall, food security should be increased.

This broad brush approach suggests that targeted social security and the provision of rural infrastructure would be more effective in addressing food insecurity than domestic subsidies to farmers, and especially increased tariffs. However, the effects depend on the relative size of agriculture in the economy and relative numbers of farmers and in nonfarmer groups that are vulnerable to food insecurity.

CONCLUDING COMMENT

S&D treatment for developing countries addresses the greater problems that those countries face with adjustment following agricultural reform and with food security, than developed countries face. Furthermore, they have fewer resources to address those challenges than developed countries. Their societies should therefore be subject to less stringent adjustment pressures from trade liberalizing reforms through the WTO than developed countries.

Even so, S&D treatment should not be considered as a crutch with which to maintain market distorting protection. A good form of S&D treatment provides a means of progressing toward more open and less distorted markets globally—not of impeding progress toward such an outcome.

The economies of developing countries collectively, and of most of them individually, will gain from trade liberalizing reforms, irrespective of whether

developed countries also gain. However, it is clear that developing countries will benefit more if developed countries also open their markets more and reduce market distorting support. Substantial trade liberalizing reform by developed countries is an absolute prerequisite for success in the present WTO agricultural negotiations.

It is therefore critical that major developed countries show real commitment to trade liberalization and reducing levels of agricultural support, rather than just changing the forms of their support. Such commitment is essential if developing countries are to agree to open their markets and to reduce their own support.

NOTES

This report was prepared in 2002 and is copyrighted by the Commonwealth of Australia and reprinted by permission of the Australian Bureau of Agricultural and Resource Economics (ABARE), a professionally independent government economic research agency. The authors acknowledge advice provided by Bruce Bowen, Elizabeth Ward, and Vernon Topp. They also acknowledge the input by Richard Perry on domestic support aspects in this study. Thanks also to Simon Murray for literature review work.

1. A more comprehensive analysis of S&D arrangements for domestic support has recently been published by ABARE (Roberts, Jotzo, and Perry 2002) and is available on ABARE's website (www.abareconomics.com).

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CHAPTER EIGHT

The Medium-Term Impacts of Trade Liberalization in OECD Countries on the Food Security of Nonmember Economies

**Wyatt Thompson, Garry Smith,
and Armelle Elasri**

INTRODUCTION

Developing countries that are not members of the Organisation for Economic Co-operation and Development (OECD) are expected to play a major role in the multilateral trade negotiations under the Doha development agenda. The successful conclusion of these negotiations will depend on the full and successful participation by nonmember economies (NMEs).¹ Addressing the concerns and ambitions of these countries, which comprise the largest group within the World Trade Organization (WTO), will be crucial in this respect.

Originally published as *The Medium-term Impacts of Trade Liberalization in OECD Countries on the Food Security of Non-member Economies*, Joint Working Party on Agriculture and Trade, COM/AGR/TD/WP(2001)74/FINAL, © OECD 2002. Reprinted with permission. This paper builds on an earlier paper that looked at the effects of OECD trade policies on food security in nonmember economies (OECD 2000c). That scoping paper addressed definitions and macro indicators of food security and the difficulty of treating nonmember economies as a homogenous group. The principal authors of this paper are Wyatt Thompson, Garry Smith, and Armelle Elasri. Other staff in the Directorate for Food, Agriculture, and Fisheries also contributed.

One of the key concerns raised to varying degrees by NMEs in relation to trade liberalization is food security. A particular focus of the discussion on food security is whether these countries will be negatively affected by further trade reform.

According to the FAO “food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. Achieving food security means ensuring that sufficient food is available, that supplies are relatively stable and that those in need of food can obtain it.”² For the purpose of the current study, the above definition suggests that food security can be measured in three dimensions: *availability* and *stability* of food supplies, whether from domestic production or imports, and *access* to these food supplies by all people at all times to meet their food needs. World food production is not the root cause of the problem of food security as the increase in production has been outstripping population growth, leading to a long-term trend of a decline in basic food prices in real terms (Mitchell, Ingco, and Duncan 1997). Part of the problem is that a large share of the growth in production has been taking place in developed countries with the benefit of substantial subsidies, while the food security problems are essentially located in the low income countries (USDA/ERS 1999).

Food insecurity also has a transitory and chronic dimension with the former characterized by periodic food supply shortfalls and the latter due to a sustained lack of food. Chronic food insecurity, a daily problem for parts of the population of some countries, is a longer term phenomenon of inadequate access to food on a continuous basis primarily as a result of poverty and insufficient purchasing power. There are many factors that can give rise to food insecurity. These range from natural resource endowments and climate, to economic, social, demographic, cultural, and political instability resulting from wars and civil unrest. Although the causes of chronic or continuous food insecurity may differ among the low income countries, they often have a number of features, present to varying degrees, such as high population growth, rapid urbanization, and a large unskilled and poorly educated rural population with little connection to markets. The rural population is often engaged in subsistence farming with low agricultural productivity and restricted access to inputs, technology, and imported foodstuffs to supplement the domestic food supply due to limited foreign exchange availability and poor distribution infrastructure. Even where the aggregate availability of food is sufficient, pockets of food insecurity can still exist in the population due to lack of access. Access to food is a function of effectively operating markets, distribution networks, an adequate system of infrastructure, government policies, overall stability, law and order, and most importantly sufficient income (and its distribution) to purchase food (ABARE 2000). In other cases, a lack of food availability can be the source of food insecurity when the combined quantities of food produced and imported commercially are insufficient to feed the population. While lack

of food availability is the primary cause of food insecurity in this case, it can also be viewed as an access problem at the national level due essentially to lack of foreign exchange to purchase, for instance, food imports (OECD 1998).

A comparison of NMEs with significant food security problems reveals that they lie somewhere in the spectrum between these two situations, often with different agricultural potentials and demographic characteristics as well as being at different stages of economic development. While other countries can provide assistance in the form of food aid and development assistance, it is ultimately the responsibility of individual national governments to provide for the food security of their populations over time. This requires them to take actions that respond to the forces, outlined above (in particular raising agricultural productivity), that influence the prospects for national food security (IISD 2001). In addition, to enhance the ability of food insecure people/households to have greater access to the available food supplies it is also necessary to increase their incomes so they can afford to buy it. This is normally a function of economic growth and development. It is in this respect that trade can make a difference, although the potential contribution of trade will not be the same for all countries.

Trade reforms, in addition to their effect on the terms of trade, can lead to higher economic growth in the liberalizing countries and better allocation of national resources by allowing countries to make the most of their comparative advantage (FAO 1999). Thus, countries can benefit directly, from their own policy reform, or indirectly through trade, from liberalization taking place in other countries. However, these changes can take time to be realized and depend upon circumstances within each country; in particular, the country's ability to respond to the new opportunities that more open markets create and to reduce less-favored activities. The extent to which trade-induced growth affects food security will depend on the distribution of the benefits and, in particular, whether distribution of benefits raises (or lowers) the effective income of the population so that more (or fewer) people have access to and can purchase sufficient food. The amelioration of food security will depend on the initial openness of each country to trade and the existence of necessary support structures to facilitate change and ultimately improve availability and access to food.

Two broad approaches have been followed by countries to achieve adequate and stable levels of food supplies: food self-sufficiency and food self-reliance. A strategy of food self-sufficiency is based on the provision of sufficient domestic production to meet consumption requirements, but does not necessarily imply that all households in the country have access to all the food they require. In addition, due to the heavy reliance on domestic supplies, food security may be particularly sensitive to variance in domestic production, such as weather- or pest-related shocks to crop yields. A strategy of food self-reliance by contrast allows for domestic food production to be supplemented by imports with the benefits and risks that international trade implies (FAO

1996). This latter strategy has enabled an improvement in food security and efficiency gains to be achieved even in countries where agriculture remains a major contributor to GDP, by shifting resources into the production of non-food export goods and importing a part of their food requirements. A strategy of food self-reliance has become the norm as the liberalization of global trade has proceeded and widened to span a broader array of goods and services.

This study concentrates on the role that a more open trading system can play in the food security of NMEs. Within this trade reform dimension, the study is narrowly focused on the links between OECD countries' domestic and trade policies and the national food security of individual NMEs and NME country groupings. More specifically, it attempts to shed light on the question of how further liberalization of OECD trade policies would affect the national food security of these NMEs in terms of the aggregate availability, stability, and access to food supplies over a medium-term time horizon. In concentrating on only this facet of the broader food security problem, other possible causes are intentionally being set aside. For example, factors such as culture or conflict, which may play an important part in the food security problems of particular countries, are not addressed in this report and, indeed, may not be expected to respond to changes in trade policies.

Despite the demonstrable welfare gains that accrue from trade liberalization, there exists widespread concern that not all countries will benefit equally. Many less developed countries with a high dependence on agriculture believe that they will be at a competitive disadvantage to developed countries in a more open trading system. Furthermore, some countries have cited the loss or dilution of existing preferential access to developed country markets as an additional source of adjustment difficulties. If these factors do indeed affect export earnings or if price levels of basic foodstuffs are higher and more volatile following trade liberalization, then the achievement of the food security objectives of some poorer countries may be negatively affected by further agricultural and trade policy reform by OECD countries. While these concerns are understandable and were given some recognition in the Uruguay Round Agreement on Agriculture (URAA),³ there are also likely to be substantial benefits to be achieved by NMEs from a more open and fairer trading system. Developed country agricultural policies and subsidies are the source of the largest distortions in world commodity markets and may be an additional source of instability in world markets. Although this protectionism is most costly to the economies of these developed countries themselves, it also imposes substantial costs on NMEs as a group. In these circumstances, whether, and to what extent, there are losers from trade reform will likely depend on how comprehensive the reforms being negotiated are and the circumstances of each NME or country grouping, in particular on whether a given NME is a food exporter or a food importer. Consequently, the likely outcome from a food security perspective becomes largely an empirical question for evaluation.

Modeling Frameworks

The analysis is based on two modeling frameworks. These are used to trace the impact on the food security of NMEs in moving from the liberalization of a single sector (agriculture) to a more comprehensive, economy-wide, trade reform in OECD countries and also to estimate indicators of the three dimensions characterizing the food security situation at the macro or aggregate level. Each model has its relative strengths and weaknesses for this type of analysis and when used in parallel should contribute to a more complete evaluation. The Aglink model of OECD agriculture, with its partial equilibrium structure and detailed member country policy specification, is useful for examining how changes to OECD agricultural trade policies alone will impact the indicators of the food security situation of NMEs. For this purpose, detailed specifications of agricultural markets for temperate-zone products in 115 individual NMEs, based on simulations of the FAO's World Food Model (WFM), were developed and used to replace the aggregate Rest of the World crop component of the Aglink model in a fully interactive system. Changes in OECD policies could then be traced through world markets to their effects on the NMEs.

The study also employs a second approach based on a global general equilibrium model, the Global Trade Analysis Project (GTAP), to complement the partial equilibrium analysis. The global general equilibrium model includes an economy-wide representation of all countries and regions. In addition to covering agricultural products, this model can extend the analysis of trade liberalization to agricultural processing, nonagricultural products and services, and the interactions between these sectors through intermediate input markets, to competition for limited resources and their contribution to household income.

The relative contributions of the two modeling frameworks in terms of scope and output are summarized in box 8.1.

Indicators of Food Security

Due to its different facets or dimensions, no single indicator is available to measure food security at the national level. In circumstances where sufficient food is available in per capita terms and supplies are relatively stable, the effects of a policy change in the OECD area on food security in NMEs is best measured by the consequent world price impacts and related change in food consumption. Food consumption is expressed as calories per person and can be measured as both the change in dietary energy use per person and against some standard of minimum calories to satisfy the dietary energy requirements for a normal and healthy life (that is, deficit or surplus). However, it is unrealistic to think that information can be found or predicted on actual individual food consumption. Consequently, a set of indicators is employed that will provide an overall view of how the food security situation of an individual (large) country or group of "similarly endowed" NMEs (that is, similar in food secu-

Box 8.1 Contributions of the Two Modeling Frameworks

The partial equilibrium (Aglink) and general equilibrium (GTAP) models applied in this study each bring to the analysis a different perspective on the problem and can produce a certain set of food security measures. Some represent characteristics common to these two types of models, but more generally the differences reflect different priorities during model development. However, one important difference is in regard to the treatment of world trade of an individual commodity. In the case of Aglink, commodities traded are generally treated as homogeneous, so there is no distinction based on country of origin. On the other hand, GTAP relies on the assumption that goods made in different countries are imperfect substitutes, so bilateral trade is identified and there is no single world price. A broad review of these and other models is provided in Tongeren, van Meijl and Surry (2001), but a brief comparison of certain aspects of the analytical framework and the contributions of these two models in terms of the factors addressed, relevant output, and scenarios conducted are listed here:

Aglink partial equilibrium model	GTAP general equilibrium model
<i>Analytical framework</i>	
Details of selected policy	Standardized policy representation
Details of selected markets	All sectors and resources
<i>Output relevant to food security</i>	
Quantities produced, consumed, traded, and stocked for selected commodities	Quantities produced, consumed, and traded in all sectors, with bilateral trade identified
Prices of selected commodities	Prices in all sectors, including factor markets
Market evolution and adjustment	Export earning, income, and other broader results
<i>Scenarios conducted</i>	
OECD export subsidy scenarios (reduction or elimination)	URAA extension relating to export subsidies, market access, and domestic support, agriculture only
OECD market access expansion	OECD members only or all countries OECD members only or all countries, with trade measures of other sectors included

These two model approaches share many similarities, but vary mostly in scope. The partial equilibrium model, Aglink, utilized in the following section, focuses on detailed representation of OECD policies in certain agricultural commodity markets. Such details include automatic policy responses based on trigger levels (for example, floor prices), interaction of domestic policy and border measures (for example, export subsidies used to maintain internal market price support), and limits on policies that may be binding (for *continued*)

Box 8.1 (Continued)

example, URAA commitments). The general equilibrium model, GTAP, provides more standardized representations of policies and markets in order to expand coverage to include all sectors of an economy and their interactions. By representing policies as wedges between agents' and market prices and by applying a uniform structure with varying parameters (to all 57 sectors in 66 countries), the equilibrium spans all stages of the circular flow of each economy (from resources to intermediate goods to final production, from income to consumption and market-clearing prices).

While some of the output of these two models will overlap as regards selected commodity markets, they are designed to answer different questions. Aglink has been developed to represent the interaction of OECD agricultural policies and world markets for the commodities affected by these policies. Although this model is not capable of addressing the effects of price changes on many NMEs, it can be extended in country representation in order to capture key measures without compromising its representation of the specificity of OECD policies and market evolution. GTAP addresses broader questions about the effects of policies in a more stylized manner and is not restricted to agriculture. Thus, agriculture is modeled within the context of the broader economy, which may be important for NMEs in the sense that agriculture as a sector accounts for a greater share of income or consumes a larger share of resources in terms of land, labor, and capital.

rity and trade characteristics) is likely to be affected by further OECD trade liberalization. The indicators selected are those which throw light on the three dimensions of food security: *availability*, *stability*, and *access* to food and which are considered to be robust and capable of being calculated from modeling exercises.

The set of indicators proposed include those that are considered as proxies to actual individual data. Average consumption per capita provides one useful measure of the *availability*, *stability*, and *accessibility* dimensions of food security in each country or country grouping. Although average annual consumption is considered to be the most useful aggregate measure of the *availability* dimension, it does not address the issue of volatility of food supplies, within a year or across years, in the face of a sudden change in a key aspect of a NME's situation such as with crop yields, exchange rates, import prices, or export earnings. The coverage of this aspect requires the use of some supplementary measures that focus on the *stability* of food supplies. These measures would include production, imports, and stocks in total or expressed as ratios to use or as a variability index. These physical quantity measures also have their short-

comings, however, in that they do not directly incorporate features that are more relevant as current market indicators of *access* to food, such as changes in market or import prices relative to export earnings.

One of the strengths of the general equilibrium model is that it can measure changes in income or GDP per person arising from agricultural or more comprehensive trade reforms involving sectors in addition to agriculture. This can throw light on the scope for a policy of food self-reliance. In other words, the extent to which particular NMEs can improve their food security situation by shifting resources into nonagricultural production for export and importing a proportion of their staple food requirements with the income generated from export earnings.

The food stability measures used in this study have their limitations. These indicators do not attempt to measure the effects of market liberalization on the variance of world prices or production, if any. Moreover, while the stocks-to-consumption ratio is probably a reasonable indicator of the supply buffer provided by stocks, self-sufficiency in production is an ambiguous indicator. If variability in weather makes domestic production an important source of volatility, then a higher self-sufficiency ratio would be associated with greater volatility in domestic prices and consumption. In other words, self-sufficiency may reflect the degree to which a country's domestic market is insulated from world market or exchange rate variations, but has the opposite implications when considering the degree to which a negative shock to domestic production affects food security. In any case, the indicators used in this study do not recognize that other possible mechanisms may exist to limit or prevent transmission of volatility—be it from world markets or domestic production—to consumption. For example, no account is taken of the possibility that purchasing options or other financial instruments could be used to offset market price volatility as an alternative to holding physical stocks.

As regards the issue of volatility, there are reasons to expect either greater or lower volatility in a country's domestic market following greater liberalization *a priori*, but little evidence exists thus far. It can be argued that terminating a regime with mandated prices in domestic markets would increase volatility in domestic prices and consumption, but this overlooks potential limits to such regimes if faced with shortfalls in domestic production—as well as the implicit tax on consumers and the related inefficiencies which accompany such policies. In international markets, fewer policy barriers can be expected *a priori* to reduce volatility as more price transmission implies more supply and demand response across countries. Moreover, a reduction of government intervention, often based on considerations other than world prices, may reduce the uncertainty of world markets. On the other hand, any reduction in government intervention may be accompanied by lower stocks, which might result in higher world price volatility to the extent that these stocks vary inversely with world prices. In any case, the empirical evidence since implementation of the URAA began does not support either hypothesis of variations in world prices follow-

ing liberalization. Yet authors of such analysis often note the difficulties of separating the effects of the URAA from other factors in world markets. (Discussions of policy reform and market volatility, in terms of both expectations and data, are available in FAO 1999; Konandreas and Sharma 2000; Konandreas, Sharma, and Greenfield 1998.)

The present study does not investigate this topic as the instruments available are not readily capable of simulating volatility in international and NME markets following greater liberalization by these countries and/or OECD countries. Preliminary work by the OECD analyzing the interaction between border measures and market volatility is available elsewhere (OECD 1999). This work used Aglink to examine the consequences of shocks emanating from shortfalls either in a NME's own crop production or in OECD crop production, repeating the experiment under two regimes: once with border protection in place and a second time without border measures. This work highlights the potential for shocks within a country to be absorbed by the international market if trade is liberalized. However, this preliminary work also hints at the complexity of addressing this problem on a global scale. It implies that at least the main sources of volatility in different countries' markets must be identified in terms of the degree of volatility and, perhaps, their correlation with other sources in order for such analysis to be extended to estimate the effects of policy changes on world markets.

Limits of the Framework

There are certain limits to the framework described above which must be recognized. These apply to the time period of the analysis, the theoretical underpinnings of the economic models utilized for the empirical analyses, the incomplete treatment of food aid, and the fact that the results cannot be extrapolated to the situation of individuals within the countries examined, etc.⁴ Perhaps most importantly, the indicators used here are aggregate in nature. Even setting aside the limits of the measures discussed above, the aggregate nature of these measures means that this analysis will only address the effects on average. Individuals within these country groups may be affected by more or by less than the averages reported here. For example, in later analysis of changing OECD agricultural trade policy, a reduction in export subsidies may have a larger than average effect on those individuals who receive the export subsidy and on those individuals who compete directly with the export subsidy. Alternatively, in cases where import barriers are reduced in OECD countries, a producer of the relevant goods in an NME might gain somewhat more than average, while a consumer of the same goods may lose somewhat more than average. Thus, while the results of this analysis will provide insight into the aggregate or average effects, the results should not be extrapolated to all individuals. These limits should be borne in mind when evaluating the results presented in the following sections of the paper.

NONMEMBER ECONOMIES CLASSIFICATION SYSTEM

Overview

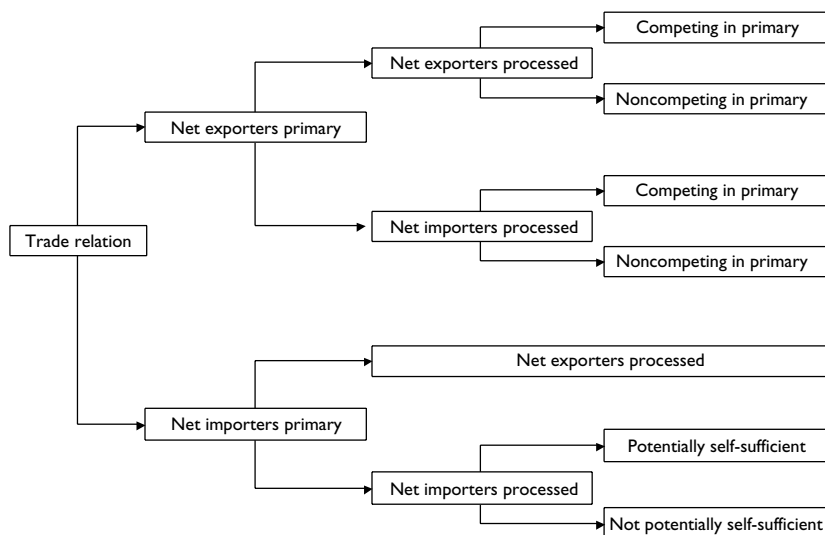
NMEs are not a homogenous group and are likely to have divergent interests with respect to trade liberalization (WTO 2000; OECD 2000d). As with all trade liberalization, there will be gainers and losers among and within these countries. The fact that economic structures, trade balances, domestic policy, and factors such as urban/rural balances vary means that there is no single coherent grouping of NMEs with respect to the impact of agricultural or economy-wide trade liberalization on food security. However, rather than treat all NMEs individually in the course of the analysis, or in the presentation of the results, it was considered necessary to make some groupings of countries. The goal was to select groupings of countries that share sufficient characteristics that each member of a group would be similarly affected by a change in OECD trade policies.

The United Nations lists of least developed countries (LDC) and net food importing developing countries (NFIDC), which have formed the basis of some earlier analyses, are not necessarily appropriate for this study. These groupings are considered to be too broad and to contain countries that show considerable diversity in their characteristics associated with food security. As noted earlier, there are a number of facets or characteristics to the problem of food security that a NME can face. As we are focusing largely on how trade policies affect these different facets, trade is considered to be one of the main criteria for partitioning individual and groups of NMEs, in addition to their food security status. In this way, each individual NME is characterized by a trade dimension and a food security dimension. Fortunately, existing work can be applied with some adaptation to the present case to inform these characterizations.

In relation to trade, each NME is classified by its net trade position following van Meijl and Tongeren (2001). That is, as a net food exporter or a net food importer (see figure 8.1). This trade partitioning is further extended into primary and processed products and this gives four trade subgroups. As a consequence, each country may be a net exporter or a net importer in one or both categories of primary and processed agricultural products. FAO data are used to provide the data and, as such, the classification is limited to UN members.

In figure 8.1 a further partitioning of the net trade position is made by adding the “competing” and “self-sufficiency” dimensions. The competing dimension is added only if a country is a net exporter of primary agricultural products. The competing dimension is useful in identifying the degree to which a change in commodity markets due to OECD policies is likely to affect a NME (see box 8.2). For example, if a NME exports goods that are typically not produced by OECD countries, then a reduction in OECD countries’ intervention in domestic and international commodity markets is unlikely to have any direct effect on the NME’s exports. On the other hand, if a NME exports

Figure 8.1 Classification Scheme of Trade Dimension



goods that are produced in abundance by OECD countries, then reducing intervention by OECD countries may have direct effects on the NME's exports.

The potential self-sufficiency dimension signals the importance of food trade for an NME relative to the size of the domestic market (see box 8.3). A country which is deemed not potentially self-sufficient according to this measure depends on trade for a greater share of its consumption and consequently its food security may depend more on changes in world markets due to policy reforms. This measure is calculated only for those countries that are net importers of both primary and processed foods. It should be noted that this measure is distinct from food security strategies discussed in the context of the introduction (and later in the conclusion section) of this paper. The measure here is used to rank countries a priori on the strength of links from world agricultural markets to domestic food markets. The discussion of strategies to achieve food security through self-sufficiency, as opposed to self-reliance, is relevant in considering the general results of this paper in a broader context.

Apart from their trade position, each country is also classified by a food security dimension based on analysis undertaken by some other researchers (Diaz-Bonilla, Thomas, Robinson, and Cattaneo 2000). This classification of countries is based on five criteria: food production per person, total exports relative to food imports, calorie consumption per person, protein consumption per person, and nonagricultural population (pp. 6–8). These five statistics are computed for each country (based on 1993–97 data from FAOSTAT 1999) and then countries are grouped by applying cluster analysis. Thus, each country within a group should have similar food security status and characteristics.

Box 8.2 Competition Index

A competition index is constructed to determine whether or not any primary product that accounts for a large share of total exports by a NME is competing with production in developed countries. In other words, the index will be high when a large share of a NME's export earnings comes from sales of a primary agricultural commodity and, in addition, these exports compete against developed countries' producers. This index combines the importance of exports of a certain primary commodity for a certain country's total export earnings with the importance of that commodity for all developed countries. This is achieved by multiplying the export share of commodity j in country i with the developed country share in world production:

$$C_i = \sum_j [X_{j,i}/X_i * Y_{j,DC}/Y_{j,wld}]$$

i = country

j = element of primary agriculture

C_i = competition index for a composite sector in country

$X_{j,i}$ = export value of product j in country i

X_i = total export value in country i

$Y_{j,DC}$ = production of product j in developed countries

$Y_{j,wld}$ = production of product j in the world

This index is calculated for primary agricultural products by using export value and production (MT) quantity data for 1997 from FAOSTAT.¹ If the commodity has a large share in the export portfolio of a certain NME, and if in addition the particular commodity has a large share in developed countries' output, then the commodity/country pair is deemed to be competing. On the other hand, if either the commodity has a small share in the export portfolio, or the commodity is insignificant for developed countries as a whole, then the commodity/country pair is considered noncompeting. In practice a cut-off value of 0.19 is used, which equals the average value of the index for all least developed countries (under the UN classification). If the index is higher than 0.19 the country is classified as competing with developed countries in primary agricultural products.

1. Index is not calculated for processed food products because production quantity indices are missing in FAOSTAT. Consequently, processed foods are not assumed to be competing or noncompeting.

For the purpose of this study, each country is classified into one of three food security categories: food insecure countries, food neutral countries, or food secure countries. Although the broad clustering results of Diaz-Bonilla and others (2000) are applied in the present study, their subclusters based on trade dimensions are not used here in favor of applying data more closely associated

Box 8.3 Potential Self-Sufficiency Index

An index is constructed to measure the possibility for a NME to provide for its food needs out of domestic production. While this ignores the possibility that a NME can achieve food self-reliance, each country's food self-sufficiency can be estimated. Obviously, this ratio is useful for identifying groups of NMEs based on the importance of their direct links to world markets for primary agricultural commodities. In other words, this measure is not constructed in the context of previous discussions of strategic approaches to food security, in that the present goal is to group countries based on the degree to which a change in world markets is likely to cause changes in a NME's domestic markets. The "potentially self-sufficiency" index for country i is calculated by adjusting domestic production for net exports:

$$S_i = 1 - (X_i - M_i) / Y_i$$

M_i = import of primary agricultural commodities in country i

X_i = export of primary agricultural commodities in country i

Y_i = production of primary agricultural commodities in country i

The formula is calculated for primary agricultural products by using export, import, and production quantity data for 1997 from FAOSTAT. If the index is smaller than 0.75 the country is classified as not-potentially self-sufficient, although this level is chosen arbitrarily.

It may be observed that the formula given above is identical to the self-sufficiency ratio, defined as the ratio of domestic consumption to domestic production, in the case where stocks are ignored.

with the base data used in later analysis. In addition to these categories relating to food security, it is possible to present individual results for some heavily populated countries such as China, India, and Indonesia. In some cases, the traditional United Nation categories of LDCs and NFIDC are reported as well for comparison purposes, even though the alternative categories presented here are considered to be more relevant for the issues addressed in this report.

The identification of all 21 groups (3 categories relating to food security status and 7 categories relating to trade characteristics) is illustrated in table 8.1. OECD countries are also included within this classification because they form part of the GTAP analyses.

Applying the System in an Empirical Framework: The Case of Aglink

When the general classification is applied to a given model framework, certain practical limitations mandate some adjustments to the general scheme. For

Table 8.1 Country Classification Based on Food Security and Trade Dimensions

Net trade position		Compete in Prim.	Self- sufficiency	Country groups based on food security and trade dimensions
Primary	Proc.			
<i>Export</i>	<i>Export</i>	<i>Comp.</i>	<i>NA</i>	Food insecure
<i>Export</i>	<i>Export</i>	<i>Noncomp.</i>	<i>NA</i>	<i>Bolivia</i>
<i>Export</i>	<i>Import</i>	<i>Comp.</i>	<i>NA</i>	Côte d'Ivoire, Madagascar, Mauritania, Nicaragua, Namibia, St. Vincent, Solomon Is, Vietnam, Zimbabwe
<i>Export</i>	<i>Import</i>	<i>Noncomp.</i>	<i>NA</i>	Afghanistan, Mongolia
<i>Import</i>	<i>Export</i>	<i>NA</i>	<i>NA</i>	Cambodia, Cameroon, Chad, Guatemala, Guinea, Guinea Bissau, Honduras, Kiribati, Laos, Mali, Nepal, Niger, Somalia, St. Lucia, Sudan, Tanzania, Uganda, Vanuatu
<i>Import</i>	<i>Import</i>	<i>NA</i>	<i>Self-suff.</i>	Ghana, Guinea, India, Kenya, Pakistan, Papua N., Philippines
				Albania, Angola, Armenia, Azerbaijan, Bangladesh, Benin, Burkina Faso, Burundi, Cent Af. Rep., Comoros, Congo D. Rep., Congo Rep., Cuba, Djibouti, Dominican, El Salvador, Ethiopia, Gambia, Georgia, Haiti, Liberia, Malawi, Mozambique, Peru, Rwanda, Senegal, Sierra Leone, Sri Lanka, St. Kitts Nev., Togo, Zambia
<i>Import</i>	<i>Import</i>	<i>NA</i>	<i>Not suff.</i>	Botswana, Eritrea, Grenada, Lesotho, Seychelles, Tajikistan, Yemen
<i>Export</i>	<i>Export</i>	<i>Comp.</i>	<i>NA</i>	Food neutral
<i>Export</i>	<i>Export</i>	<i>Noncomp.</i>	<i>NA</i>	Brazil, Chile, Moldova Rep., South Africa, Thailand
<i>Export</i>	<i>Import</i>	<i>Comp.</i>	<i>NA</i>	Belize, Costa Rica, Ecuador, Morocco, Myanmar
<i>Export</i>	<i>Import</i>	<i>Noncomp.</i>	<i>NA</i>	Paraguay, Syria
				Dominica, Panama, Suriname

<i>Import</i>	<i>Export</i>	NA	NA	Bulgaria, China, Colombia, Guyana, Indonesia, Kyrgyzstan, Latvia, Malaysia, Maldives, Swaziland, Tunisia
<i>Import</i>	<i>Import</i>	NA	<i>Self-suff.</i>	Bahamas, Barbados, Croatia, Egypt, Estonia, Fiji Islands, Gabon, Iran, Jamaica, Lebanon, Macedonia, Mauritius, Mexico, Nigeria, Russian Fed., Slovakia, Uzbekistan, Venezuela
<i>Import</i>	<i>Import</i>	NA	<i>Not suff.</i>	Algeria, Antigua Barb., Brunei Darssm, Cape Verde, Jordan, Korea Rep., Kuwait, Libya, Macau, Saudi Arabia, Trinidad Tob.
Food secure				
<i>Export</i>	<i>Export</i>	<i>Comp.</i>	NA	Argentina, Australia, Canada, Denmark, France, Ireland, Hungary, Netherlands, New Zealand, Spain, Ukraine, USA, Uruguay
<i>Export</i>	<i>Export</i>	<i>Noncomp.</i>	NA	Iceland, Norway, Turkey
<i>Export</i>	<i>Import</i>	<i>Comp.</i>	NA	Kazakhstan, Romania
<i>Export</i>	<i>Import</i>	<i>Noncomp.</i>	NA	No entries
<i>Import</i>	<i>Export</i>	NA	NA	Bel-Lux, Lithuania, Poland
<i>Import</i>	<i>Import</i>	NA	<i>Self-suff.</i>	Austria, Belarus, Czech Rep., Finland, Germany, Greece, Italy, Sweden, UK
<i>Import</i>	<i>Import</i>	NA	<i>Self-suff.</i>	Hong Kong (China), Israel, Japan, Malta, Portugal, Slovenia, Switzerland, United Arab Emirates

Sources: Food security information from Diaz-Bonilla (2000) and trade dimensions from van Meijl and Tongeren (2001).

“Comp.” = Competing in primary; “Noncomp” = noncompeting in primary; “Self-suff.” = potentially self-sufficient; “Not suff.” = not potentially self-sufficient; and “NA” = Not applicable in that this was not measured in the context of classifications by the referenced studies as the trade position data indicated that this aspect (competition position or self-sufficiency) was not relevant.

Note: The classification presented includes fish data as a food product. Thus, for example, Norway and Iceland are listed among the net exporting countries even though they may not be so categorized if fish data were excluded. In the context of later analysis, the fish sector is not counted among the agriculture sectors which are the focus of this project, both in terms of policies adjusted (e.g., in the hypothetical extension of URAA commitments) and in terms of food security indicators.

example, regional aggregates in a model might have to be mapped into a single food security/ trade group. In addition, dimensions of the trade classification may not all be relevant when interpreting results of different models. In such cases, presenting all country groups separately may not be useful where the output of the model does not provide substantially different trade and food security indicator results across certain groups. In the Aglink model no distinction is made between primary agricultural products and processed products so this element of the trade dimension is omitted. Thus, applying the framework in the case of Aglink allows the identification of 11 NME groupings and 3 large separate countries (China, India, and Indonesia). OECD members are not the focus of the present study on food security so indicators are not produced for them. (Readers interested in the implications of these scenarios for OECD markets are encouraged to examine earlier OECD studies.) Alternatively, the traditional LDC and NFIDC categories can also be identified in addition to the more appropriate groupings described earlier. These groups are illustrated in table 8.2.

A full representation of NMEs is not included in the Aglink framework. Even after the addition of a number of NMEs to the Aglink model through cooperation with the FAO, certain countries are omitted from the analysis. The list of LDCs and NFIDCs not represented in the model includes: Barbados, Comoros, Djibouti, Eritrea, Kiribati, Samoa, Saint Lucia, Sao Tome and Principe, Solomon Islands, Tuvalu, and Vanuatu.

Applying the System in an Empirical Framework: The Case of GTAP

For the GTAP analysis, the country classification is slightly different in recognition of the distinction made for trade positions between primary and processed products, but the partitioning based on competition in primary goods is not maintained. In addition, the food secure and OECD countries are handled separately from the trade dimension—a choice which is justified by the focus of the study on food insecure NMEs, thereby facilitating the application of GTAP. Moreover, although GTAP is also a global model, the number of individual NMEs represented in the model (version 5.3 prerelease) is less than the total included in the Aglink analysis. However, for each of the country aggregates of the present study a set of representative countries is identified. Table 8.3 classifies the GTAP countries and regions in this framework and provides a list of the acronyms and definitions of the different groups. Based on this classification scheme we distinguished 14 groups or countries for the trade liberalization analysis: 7 groups of food insecure and food neutral countries distinguished by their trade characteristics; India and China as separate countries; and 5 groups of food secure and OECD countries. (These last 5 groups are not the subject of the present study, so they are identified following the

Table 8.2 Aglink NME Groupings

Food security	Trade status / Country	Countries in the group
Food insecure	Net Importers, not potentially self-sufficient	Botswana, Lesotho, Tajikistan, Yemen
	Net importers, potentially self sufficient	Albania, Angola, Armenia, Azerbaijan, Bangladesh, Benin, Burkina, Faso, Burundi, Central African Rep., Congo Dem. Rep., Congo Rep., Cuba, Dominican Rep., El Salvador, Ethiopia, Gambia, Georgia, Haiti, Liberia, Malawi, Mozambique, Peru, Rwanda, Senegal, Sierra Leone, Sri Lanka, Togo, Zambia
	Net importers, primary only	Kenya, Ghana, Papua New Guinea, Philippines, Pakistan
	Net exporters noncompeting	Cambodia, Cameroon, Chad, Côte d'Ivoire, Guatemala, Guinea, Guinea Bissau, Honduras, Laos, Madagascar, Mali, Mauritania, Namibia, Nepal, Nicaragua, Niger, Somalia, Sudan, Tanzania, Uganda, Vietnam, Zimbabwe
	Net exporters competing India	Afghanistan, Bolivia, Mongolia India
Food neutral	Net importers, not potentially self-sufficient	Algeria, Cape Verde, Jordan, Kuwait, Libya, Saudi Arabia, Trinidad Tob.
	Net importers, potentially self-sufficient	Egypt, Estonia, Fiji Islands, Gabon, Iran, Jamaica, Lebanon, Mauritius, Nigeria, Russian Federation, Uzbekistan, Venezuela
	Net importers, primary only	Bulgaria, Colombia, Guyana, Kyrgyzstan, Latvia, Malaysia, Maldives, Swaziland, Tunisia
	Net exporters, noncompeting	Belize, Costa Rica, Dominica, Ecuador, Morocco, Myanmar, Panama, Suiname
	Net exporters, competing	Brazil, Chile, Moldova Rep., Paraguay, South Africa, Syria, Thailand
Food secure	China	China
	Indonesia	Indonesia
	All categories	Argentina, Belarus, Chinese Hong Kong, Israel, Kazakhstan, Lithuania, Romania, Ukraine, United Arab Em.

(continued)

Table 8.2 (Continued)

Food security	Trade status / Country	Countries in the group
UN groupings	Less developed countries	Afghanistan, Angola, Bangladesh, Benin, Bhutan, Burkina Faso, Burundi, Cambodia, Cape Verde, Central African Republic, Chad, Congo, Ethiopia, Equatorial Guinea, Gambia, Guinea, Guinea-Bissau, Haiti, Laos, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Myanmar, Nepal, Niger, Rwanda, Sierra Leone, Somalia, Sudan, Tanzania, Togo, Uganda, Yemen, Zambia
	Net food importing developing countries	Botswana, Cuba, Côte d'Ivoire, Dominican Republic, Egypt, Honduras, Jamaica, Kenya, Mauritius, Morocco, Pakistan, Peru, Senegal, Sri Lanka, Trinidad and Tobago, Tunisia, Venezuela

Note: Country classifications are adapted from Diaz-Bonilla and others (2000) and van Meijl and Tongeren (2001), as described in relation to table 8.1, but the net trade position in processed foods is not applied as Aglink data do not follow a strict primary/processed distinction.

structure of the GTAP database rather than by trade characteristics.) The naming convention is relevant to the presentation of GTAP analysis results only.

In implementing the country groups in GTAP some adjustments were necessary. First, Argentina and Uruguay were added to the group of food neutral exporters of primary and processed food products (NEUAGREXP). Second, Mexico was shifted into the North American Free Trade Agreement (NAFTA) and Korea into the rest of OECD (ROECD) because they are OECD members and the current study focuses on nonmember economies. Third, European Free Trade Association (EFTA) countries are placed in the other OECD group (ROECD). However, the Czech Republic and the Slovak Republic are in the food neutral agricultural product importer group (NEUAGRIMP) as they cannot be separated from the Central and East Europe aggregate in GTAP. Similarly, other countries may be grouped within a regional aggregate and thus cannot be identified within the appropriate group. However, these changes are only intended to make the groupings more amenable to GTAP analysis and also to maintain the focus on NMEs' food security. There should not be important effects on the results or the general conclusions; an effort is made not to shift countries into or from food insecure groups, which is the primary focus of the present study.

Table 8.3 GTAP Country Aggregates

<i>Food insecure and food neutral countries classified by trade relation</i>		
Trade relation	Food insecure	Food neutral
Positive net-export position in agriculture and processed food	India, Vietnam, Zimbabwe, Central America - INSAGREXP	Argentina, Brazil, Chile, Colombia, Morocco, Thailand, rest of SACU, Uruguay, rest of South America, rest of Andean Pact - NEUAGREXP
Positive net-export position in agriculture and negative in processed food	Tanzania, Uganda, rest of Sub-Saharan Africa - INSPRIEXP	
Negative net-export position in agriculture and positive processed food	Other Southern Africa - INSPROEXP	China, Indonesia, Malaysia - NEUPROEXP
Negative net-export position in agriculture and processed food, potentially self-sufficient	Bangladesh, Malawi, Mozambique, Peru, Philippines, Sri Lanka, Zambia, rest of World, rest of South Asia - INSAGRIMP	Venezuela, former Soviet Union, rest of CEEC, rest of Middle East, rest of North Africa - NEUAGRIMP
Negative net-export position in agriculture and processed food, not potentially self-sufficient	Botswana	
<i>Food secure countries and OECD members</i>		
Group name	Countries or groups of GTAP	
AUSNZL	Australia, New Zealand	
NAFTA	Canada, Mexico, USA	
EU	European Union Members	
ROECD	Hungary, Japan, Korea, Poland, Switzerland, Turkey, rest of EFTA	
OTH	Chinese Taipei; Hong Kong, China; Singapore	

Note: Country classifications are adapted from Diaz-Bonilla and others (2000) and van Meijl and Tongeren (2001), as described in relation to table 8.1, but the competing/non-competing aspect is not applied in the context of the analysis based on GTAP. Moreover, the food insecure and food neutral NMEs identified by Diaz-Bonilla and others are distinguished according to the trade dimension of van Meijl and Tongeren, but the food secure NMEs and OECD members are aggregated based largely on the structure of the GTAP database (e.g., without reference to trade characteristics).

Limits of the Framework

There are difficulties applying the country classification described here in the present study. Perhaps the most significant is the discrepancy in the list of commodities. The classifications are based on a wider definition of food goods that includes fishery output, whereas the analysis of this report does not always include the contribution of fish products to food supplies. In the partial equilibrium analysis, this component of food supply is held constant (in terms of calories per person) and in the general equilibrium analysis the output from fisheries is classified as an extraction rather than a food industry (although fish sector output may serve as an input into the food sectors, such as processed foods). Hence, to the extent that food or trade derived from fisheries are significant and shift a country in the classification scheme relative to its standing based on agricultural goods alone, there may be some difference between individual country results relative to the group's performance. The dependence on existing classifications was unavoidable barring a substantial revision to the referenced studies that would reclassify countries in the absence of fishery products. On the other hand, the analysis conducted in the remainder of the study does not address fishery policies in the same manner as agricultural policies, which are the focus of much of the study and, certainly, of Aglink. Finally, as the results of the next section will demonstrate, the reader will note that the effects of the scenarios explored in the present study for the different classifications of countries do not vary so much that this limitation is likely to jeopardize any of the broad conclusions regarding the implications of liberalization on aggregate food security indicators.

PARTIAL EQUILIBRIUM (AGLINK) RESULTS

Method

Aglink is a partial equilibrium model maintained by the Secretariat and co-operators in certain OECD member countries. The model rests on the assumptions that perfect competition and strong substitution across uses and supplies of any given aggregate of crop or livestock product are useful simplifications in studying certain world agricultural commodity markets. The model is described briefly in box 8.4.

To apply Aglink in the current study, the existing limited representation of nonmember economies needed to be extended. The FAO maintains a partial equilibrium model called the World Food Model (WFM). This model includes explicit representation of many NMEs' commodity markets. As such, it does provide necessary information about how production, consumption, stocks, and trade of agricultural products in NMEs respond to changes in world prices. These relationships are derived from an FAO baseline completed in March 2001 and then used to construct models of about 125 NMEs to add to

Box 8.4 A Brief Description of Aglink

Aglink is a partial equilibrium model used to generate annual commodity market projections for the medium term, to highlight the role of policies, and to analyze how different policy alternatives can affect this outcome. The equilibrium is partial: Aglink only examines a certain set of agricultural commodity markets, assuming that the results are not affected through interaction with other markets/sectors that are not represented in the model or, alternatively, that any such effects are represented in the supply or demand equations of the model. Assuming a continuation of announced policies and a certain macroeconomic environment, quantities of production, consumption, stocks and trade and market prices are projected over a medium-term horizon. The model focuses on OECD countries and on temperate-zone agricultural commodities that are affected by these countries' policies.

The commodities represented in the model are wheat, rice, coarse grains, oilseeds, oilseed meal, vegetable oil, beef, pork, poultry, milk, butter, cheese, skim milk powder (SMP), and whole milk powder (WMP). In addition, sheep meat, casein, and whey powder are included in Aglink, but are not a focus of the analysis described in this report.

In most cases, Aglink provides estimates of market prices and quantities of production, consumption, stocks, and trade. Market prices are usually measured at the producer or wholesale level. Production is often separated into area and yield in the case of crops or breeding animals and output per animal in the case of certain livestock products (for example, beef and dairy). Consumption includes food use and, where appropriate, feed use.

Policy representation in Aglink is intended to be complete as regards those schemes that most affect trade and varies according to the details of each scheme. Policy varies across countries in the model just as policies vary across countries in reality. The distinction between floor prices and market support prices is maintained, of course, as are characteristics that may make such instruments operate at levels not quite equal to the stated targets. The Secretariat and member country co-operators strive to balance often conflicting goals of containing a maximum amount of policy detail while keeping the number of model equations to a size that can be managed by a small team. The consequence is a focus on those OECD member policies deemed likely to have greatest market consequences for the set of commodities listed above.

Finally, Aglink analysis provides results to be compared to a baseline over a medium-term horizon of about six years. In the annual Outlook exercise, the model is used to project market evolution from the current year over a projection period of six or so years. Scenario results are generally represented as the percentage of change from the Outlook baseline. In other words, a scenario will alter some exogenous assumption relative to the original set of Outlook projections, such as lower subsidized export limits or higher market access, and then the model results must be compared to the Outlook results to show

(continued)

Box 8.4 (Continued)

how this alternate assumption impacts world markets over the projection period. The process allows an examination of policy effects in a forward-looking context, and the results will depend in part on the original baseline levels of endogenous and exogenous variables.¹

1. For a recent example of policy analysis generated using Aglink, please see OECD (2000a, b) or Meilke, Wensley, and Cluff (2001).

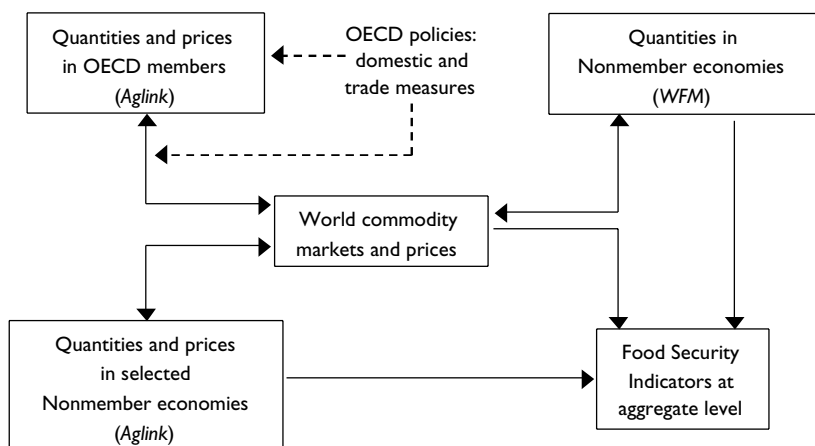
Aglink. The relationships derived from the WFM are used in place of the rather cursory treatment of most NMEs' commodity markets in the original Aglink model. An example of the complete model structure (relevant to crop product markets) is provided in figure 8.2. Co-coordinating the output of these two models is not a simple task because commodity and market definitions are not identical.⁵ The complete model provides projections of wheat, rice, coarse grains, oilseed meal, vegetable oil, beef, pork, poultry, sheep meat, milk, and butter markets in NMEs and, moreover, represents how quantities in these markets respond to changes in world prices.

The final quantities that are projected by the model are then aggregated based on their calorie equivalent. Rather than simply summing quantities or expenditures for different commodities, FAO conversion rates for commodities from quantities into calories are applied as the amount of calories per person per day is considered to be the most appropriate basis of aggregation in the context of food security. The conversion rates applied are the averages of 1998 and 1999 for each commodity in each country. These calorie equivalents of model output can be used to construct a set of indicators of food security, as listed in box 8.5.

Baseline Results

The initial solution of Aglink, before a policy change scenario is performed, is important for three reasons. First, this initial baseline provides a set of agreed medium-term projections of market evolution and can be informative of the market consequence of existing policies, even without additional policy changes. For example, the projected levels of calories consumed per person per day from Aglink commodities may be of interest as an indicator of the medium-term prospects for food availability in NMEs. Second, the results of analysis using Aglink are measured relative to the baseline in order to show the effects of any scenario change. Since all other external factors are held at the same levels in both baseline and scenario, all changes from the baseline are explained by the scenario assumptions. Third, the results of any analysis may

Figure 8.2 World Market Representation Combining Aglink and Derived WFM Relationships



Box 8.5 Indicators Produced by Aglink

Aglink, as extended by the addition of NMEs derived from the WFM, can be used to produce several indicators of food security in NMEs. None of the indicators used here is perfect, there being no unique and definitive measure of food security. Moreover, the study focuses on indicators at the aggregate level, not the individual level, where instances of food insecurity may exist regardless of the level of national indicators. Thus, the selection below is designed to capture the characteristics relevant for the issues addressed in this paper, and these are appropriate given the empirical tool applied in this section.

The indicator for food *availability* is average calorie consumption per person per day. The amount of calories provided by those commodities not represented in Aglink is added to the total calories from Aglink commodities. The amount of such other calorie consumption per person per day is assumed to be constant at the 1999 level throughout the projection. While a useful assumption is to recognize the relative contribution of those commodities not included in Aglink, this may misrepresent the trends and the policy analysis results. The former may be particularly relevant to the baseline results; the latter depends upon the extent that Aglink commodity price changes cause changes in consumption of non-Aglink crops and the extent to which OECD policies affect markets of non-Aglink commodities directly. However, some of these commodities may feature less prominently, if at all, in OECD country trade and trade policies.

(continued)

Box 8.5 (Continued)

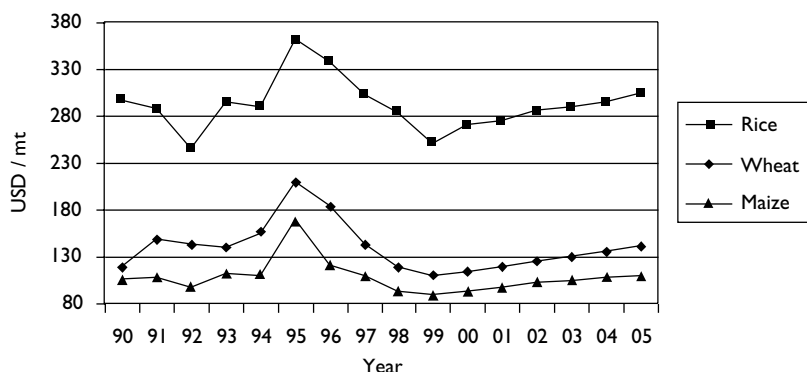
The effects of a policy change on food *accessibility* are measured by the change in world cereal price facing a country group. The cereal prices of Aglink (wheat, rice, and coarse grains) are weighted by the share of each in total calorie consumption in order to construct an index that may represent the price consumers face. However, there may be doubts about the degree to which consumer prices reflect world price changes in NMEs in light of the low degree of price transmission common in the WFM (discussed below). Thus, to the extent that a change in world prices will cause a change in consumer prices, this indicator measures food accessibility effects of a policy reform. On the other hand, the world cereal price should represent the cost for accessing cereal imports traded at world prices—in short, the costs of more commercial food imports. (While import price changes measure one aspect of purchasing power, this is supplemented in the GTAP analysis to include income changes generated from policy reform such as export earnings.)

Two indicators are produced to proxy food *stability*: self-sufficiency and stocks-to-consumption ratios. The first ratio is defined as the production of Aglink commodities in terms of calories per person per day divided by the consumption of Aglink commodities also in calories per person per day. It should be noted that this measure is related to the self-sufficiency measure used in classifying countries (as described in the previous section) with a focus on Aglink commodities. This statistic offers a measure of the degree to which consumption is insulated from shocks in trade, caused by foreign production shortfalls, or exchange rate or world price changes, for example. On the other hand, as stated in the introduction, a high degree of food self-sufficiency exacerbates the sensitivity of consumption to variance in domestic production. The second indicator of food stability is the ratio of cereal stocks to cereal consumption (both in calorie terms), where NME stocks and production depend upon prices as derived from the WFM. This is probably a better indicator of stability as shocks of any type could be addressed by drawing commodities from stocks. In other words, whereas the vulnerability of consumption to shocks in domestic production may increase with a higher self-sufficiency ratio, a higher stocks-to-consumption ratio is not ambiguous in providing food supply stability.

vary depending upon the baseline assumptions due to the existence of asymmetric responses to different market situations.⁶

The baseline used in the present study is a composite of the 2000 *OECD Agricultural Outlook* (hereinafter, the Outlook) and a set of March 2001 projections from the FAO's WFM. The motivation for using the Outlook of 2000 is that this set of projections served as the baseline for previous forward looking policy analysis work undertaken by the Secretariat as part of the program

Figure 8.3 Nominal World Grain Prices in the Aglink Baseline



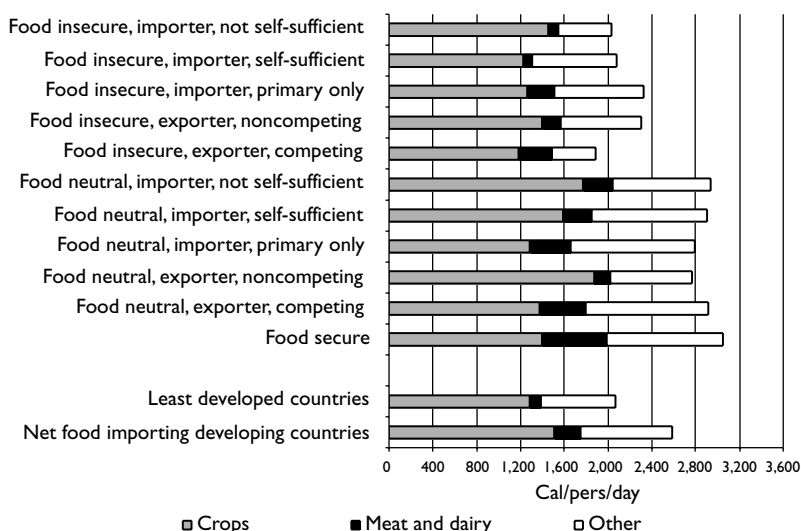
of work on trade issues, and helps to determine the choice of the policy changes to be analyzed, as described later;⁷ in order to maintain some comparison with this earlier work. The FAO's March 2001 projections were the only set available at the time of undertaking this analysis with the additional data required to derive the world price effects on individual NMEs. While staff at the FAO cooperated closely with the OECD Secretariat to generate the data, the additional data requirements were significantly greater than the normal model output. The results of these two sets of projections were merged and a new set of projections produced.⁸

The modified baseline for the current study does not differ sufficiently from the Outlook to justify a long description. Still, it may be useful to refer to figure 8.3 to see the evolution of world grain prices during the projection period.⁹

The most significant new element of this baseline compared to the original is the addition of aggregate food security indicators, such as the calorie consumption per capita per day in NMEs, calculated from the Outlook data as supplemented by the NME representation derived from the WFM. These data show the evolution of calories and the contribution of each commodity to the total calories intake per person in each NME. The averages of 2001–05 are presented in figure 8.4. Two alternate NME aggregates are reported: the aggregation used in the context of the GTAP analysis as well as the UN categories of least developed countries (LDCs) and net food importing developing countries (NFIDCs).

In relation to the UN grouping of NMEs, the projections for the NFIDCs and LDCs indicate that about two-thirds of calorie consumption is from crop products modeled in Aglink, with 30 percent of total calories coming from wheat alone in the case of NFIDCs. On the other hand, for the LDCs, the most significant commodities are rice and coarse grains, accounting for 31 percent and 20 percent, respectively, whereas only 9 percent of the average consumption in these countries is from wheat. Aglink meat and dairy products are rel-

Figure 8.4 Baseline Calorie Consumption by Source, Average 2001-05



atively unimportant for both of these groups of countries, representing less than 10 percent of total calories. Using the country grouping roughly consistent with later GTAP analysis, the results are more complex but fairly similar overall: Aglink commodities account for about two-thirds of calorie consumption, with rice or wheat typically filling a large portion of the average diet.

The medium-term baseline includes average daily calorie consumption per person of these commodities and does not project any substantial improvement over time. In fact, measures of food *availability*, food *accessibility*, and food *stability* do not appear to improve substantially under the *status quo* assumptions of the baseline—namely a continuation of current or announced policy, steady macroeconomic growth, longer term productivity trends, and normal weather. Concerning food availability, per capita calorie consumption of crops is flat for most groups as growth in total consumption is matched by population growth. The extremes are narrowly defined. In the case of food insecure net exporters of competing products, the average calorie consumption is projected to fall by 2 percent, whereas the average consumption in food secure NMEs rises by 2 percent. Overall, average calories per person from animal products are projected to increase slightly, but such goods comprise a relatively small share of total food. Of course, no projections are available for those commodities not included in the composite Aglink and WFM model, such as roots, tubers, and fish, so this amount is held constant in the baseline (that is, calories consumed per person per day from other sources does not change from 2001–05). Consequently, no strong conclusions can be drawn about food *availability* from the total calorie consumption as an indicator, but,

judged by the availability of Aglink commodities alone, there is no reason to expect any substantial change relative to the present situation under the baseline assumptions.

To the extent that the internal prices are correlated with world prices, which may not be true in cases of weak price transmission, the increase in the costs of cereals indicates a growing difficulty on the part of lower income countries to *access* necessary food from domestic or trade sources. The world rice price increases by 12 percent from 2001 to 2005, while the price of coarse grains rises 19 percent and that of wheat by 25 percent in nominal terms. To measure *access* for each set of NMEs, the world prices of wheat, rice, and coarse grains are aggregated using the share of each cereal in calorie consumption for that country group. This share index suggests that food secure countries pay 22 percent more per unit of cereal imported under a continuation of existing policies. The average import cereal price increases less than other NME aggregates, but are never lower than the rice price change of 12 percent. The cereal price average for the LDCs group rises by 12 percent and that of NFIDCs by 18 percent. Thus, the projections for world prices indicate that these countries will be negatively affected over the medium term leading to deterioration in their terms of access to food, where such food purchases are made at or under the influence of rising world prices. However, no strong conclusion about the trends of food access is possible without projections of income levels, particularly the income of the poorest NMEs.

As regards food *stability*, the baseline projections offer no clear indications. The projections, which are based on normal weather and productivity trends, contain no substantial change in the levels of stocks relative to consumption compared to recent years, but rather a gradual decline. The food insecure groups suffer only a small decrease in stocks-to-consumption ratios. Stocks decrease from a range of 9 percent to 19 percent of consumption in 2000 to 8 to 18 percent in 2005. Food neutral groups suffer larger decreases of 5 percent to 15 percent of stocks-to-consumption, but begin from higher levels of 24 percent to as high as 48 percent in 2000.¹⁰ On the other hand, the projections do not show any substantial decrease in the relative importance of domestic production and imports for NMEs; self-sufficiency ratios generally change very little, though some do rise slowly in the period. There should be some increase in domestic production relative to domestic consumption under the influence of higher prices and greater protection against external or exchange rate shocks. The only exception is for food insecure countries that are net exporters of competing products. The self-sufficiency ratio for Aglink commodities for this group of countries does decline from 118 percent in 2001 to 105 percent in 2005. Apart from this exception, the result of greater self-sufficiency indicates that world price or exchange rate shocks are slightly less likely to affect consumption at the end of the medium-term outlook to the extent that higher domestic production serves as a buffer against such instabil-

ity. However, NMEs may remain vulnerable to shocks in domestic production under the baseline assumptions as domestic production accounts for a slightly greater share of domestic consumption than at the start of the baseline.

The baseline projects small changes in these indicators of NME food security for three reasons: the significant share of food consumption not represented in Aglink, relatively low price transmission, and modest market response in NMEs to higher world prices. The commodities represented in Aglink—chosen due to their relative importance in terms of OECD agricultural policy—reflect on average about two-thirds of NME calorie consumption. Consequently, even if changing world prices do affect consumption of Aglink commodities, one-third of calorie consumption and related food production in NMEs are not directly affected.

Low price transmission and modest NME market response are manifest in the small effects of changes in world prices on quantities produced and consumed in NMEs. The response functions derived from the FAO's WFM reflect a low coefficient of the combined effects of price transmission and supply and demand elasticities.¹¹ The decomposition of average and selected response functions is represented in table 8.4. The simple average price transmission from world to domestic markets of the NMEs is 0.5 or lower, and the average supply and demand elasticities are less than 0.4, in absolute value. The product of these two parameters gives the low total effect. In the case of wheat, only half of the change in world price is transmitted to domestic agents and the elasticities are of the order of 0.4 (in absolute value), so the change in production or consumption of wheat in NMEs following a 1 percent change in the world wheat price is expected to average less than ± 0.2 percent. Hence, even for a significant rise in world prices in the baseline, the quantities consumed and produced do not respond greatly.

The baseline projections are relevant in that they may be informative and these data serve as the basis of comparison for later scenarios. The projections foresee very little change in the food security status of NMEs based on a selection of indicators intended to proxy food *availability*, food *access*, and food *stability*. These conclusions are dependent upon the general market situation reflected in the baseline projections. That is, a situation of rising world prices, due to a favorable macroeconomic environment, leads to stronger demand relative to supply growth. Higher prices tend to dampen consumption growth and stock-holding, but encourage domestic production to the extent it is responsive to world price signals. The consequences of rising world prices for the food security indicators used here are clear and do not result from any OECD country agricultural policy change other than those already in place or being implemented and, where such policies do affect food security, the link is through their world prices impacts.

The Secretariat has completed an analysis and released a report studying the effects of an elimination of export subsidies based on Aglink and the 2000 OECD Agricultural Outlook projections (OECD 2000a, b). The report focused

Table 8.4 Price Transmission and Own-Price Parameters as Derived from FAO's WFM

	Wheat market parameters				Rice market parameters			
	Price transmission to		Own-price elasticity of		Price transmission to		Own-price elasticity	
	Producer	Consumer	Production	Demand	Producer	Consumer	Production	Demand
World average	0.40	0.49	0.37	−0.39	0.37	−0.39	0.32	−0.32
Selected countries								
Bangladesh	0.20	0.20	0.20	−0.43	0.20	0.20	0.11	−0.37
Egypt	0.60	1.00	0.76	−0.19	0.71	1.00	0.26	−0.24
India	0.75	1.00	0.25	−0.23	0.53	1.00	0.25	−0.42
Indonesia	0.62	1.00	n.a.	−0.51	0.77	1.00	0.12	−0.22
Nigeria	0.29	0.29	0.40	−0.78	0.29	0.29	0.19	−0.52
Russia	0.25	0.25	0.32	−0.38	0.25	0.25	0.38	−0.23

Note: The price transmission and elasticities may or may not precisely reflect those applied in the FAO's WFM. These parameters are derived from impact multipliers constructed through cooperation of FAO staff. The parameters of this table are not direct reproductions of parameters as found in the WFM equations. n.a.—not available.

exclusively on export subsidies as defined in Article 9 of the URAA and notified to the WTO. There were no assumptions made in this study about other export competition policies, such as officially supported export credits, state-trading enterprises, food aid, or cross-subsidizing pricing schemes. On the other hand, the scenario does not completely isolate export subsidies for reduction as this is not possible: Aglink recognizes the links between border and domestic measures, so some change in domestic support occurs in this scenario to the extent that world prices rise and domestic prices fall, for example, or direct payments adjust. The results showed that, given the relatively small role of export subsidies in the 2000 OECD Agricultural Outlook projections, their elimination would not have very strong effects on most world commodity markets. The international dairy markets were the exception as export subsidies are more significant relative to the amount traded.

The scenario applied in the context of the present study is an extension or replication of the annual URAA reductions in export subsidies to 2005.¹² This reduction is implemented over a five-year period, is a decrease relative to the commitment levels at the end of the URAA implementation period (rather than from initial URAA levels), and is restricted to OECD countries. No change in NME export subsidy policy is explored. The consequences for world markets of the reduction are, not surprisingly, comparable to those reported in the original analysis, but of smaller magnitude. The effects on selected world prices are summarized in table 8.5. Referring to the 2005 results (reflecting the consequences following full implementation), the cereal prices rise by as much as 1.4 percent relative to the baseline in the case of wheat, but by only 0.2 percent in the case of rice. Livestock product price changes following a reduction in export subsidy commitments are greater, with the largest impact falling on world dairy prices. The present study does not focus on OECD and world markets, which were discussed in the earlier report in any case, so more detailed results as regards OECD countries are not shown here.

Table 8.5 Continuation of URAA Export Subsidy Reductions for OECD Countries: Effects on World Prices

	2001	2002	2003	2004	2005
<i>(percent change relative to the baseline)</i>					
World crop product prices					
Wheat	0.4	0.5	1.1	1.6	1.4
Rice	0.0	0.1	0.2	0.2	0.2
Maize	0.6	0.9	0.9	1.3	1.3
Oilseed	0.1	0.0	0.1	0.0	-0.1
World livestock product prices					
Beef	1.4	1.2	1.5	1.6	5.5
Butter	0.5	1.2	1.8	2.1	2.4
Whole milk powder	3.0	3.4	5.4	5.5	6.8

The causes for the relatively limited effects on world prices are, again, the small role played by export subsidies in the projection period. This result is in turn contingent upon certain assumptions in the baseline: announced or existing policy is continued into the projection period, implying that countries which have reduced or unilaterally suspended export subsidies are assumed to maintain low or no export subsidies. The Outlook assumptions regarding macroeconomic conditions lead to stronger demand growth relative to recent years. When coupled with supply response to low prices prevailing at the start of the Outlook, the projections suggest rising world prices. In addition, the exogenous set of exchange rates reduces the margin between internal support prices and world prices for the European Union, the largest user of export subsidies. Of course, if these assumptions or results were altered, the effects of an export subsidy reduction could be greater or smaller than those summarized here.

Having found that the URAA export subsidy extension results in small world price changes, the next question in the context of food security is how these price changes affect *availability*, *access*, and *stability* of food in NMEs. The results for the four indicators in 2005 under the scenario assumption of decreasing export subsidy commitments are presented in comparison to the Outlook baseline results in the same year in table 8.6. In fact, these results could be produced for each year of the Outlook period in order to track their evolution during the implementation period, but the changes are of small enough scale that this exercise is omitted.

Average calorie consumption per person is the indicator selected to represent overall food *availability* in each NME group. As shown in table 8.6, the average effects of export subsidy reduction on prices and consumption are extremely small. In no case does the average consumption change by more than -0.5 percent. The largest changes, of -0.3 percent, are suffered by the food insecure importers of primary goods only. Similarly, average calorie consumption in the group of food neutral NMEs that are net food importers of primary goods falls by -0.2 percent as is the case of India and food neutral net exporters of products that compete with OECD producers. To some extent, it may be the case that the combination of price transmission and own-price elasticity are slightly more significant in these countries, but the results are also attributable to the relatively large share of Aglink commodities in total consumption—about 81 percent in the case of India. However, in general, the small cereal price changes cause even smaller changes in consumption in NMEs due to low price transmission and low elasticities of domestic demand. Given that cereals are critical to food security, this implies little change in overall consumption as measured here and indicates no strong effects on food availability. The effects are more noticeable in those countries that depend on world markets for a substantial portion of both their consumption and their commercial exports, but the decrease in consumption remains relatively small.

Similarly, the effects on food *access* appear slightly negative. The average level of cereal prices does increase, by as much as 1.2 percent in cases where rice

Table 8.6 Continuation of URAA Export Subsidy Reductions for OECD Countries: Effects on Food Security Indicators in 2005

Group or country	Average consumption all commodities		Average world price of cereals		Self-sufficiency ratio Aglink commodities		Stocks-to-consumption ratio for cereals	
	Scenario (calories)	Change (percent)	Scenario (USD/t)	Change (per cent)	Scenario (ratio)	Change (absolute)	Scenario (ratio)	Change (absolute)
Groups defined by food security and trade								
<i>Food insecure</i>								
Net importers, not self-sufficient	2,032	-0.1	145	1.2	0.38	0.001	0.09	0.000
Net importers, self-sufficient	2,091	-0.1	216	0.5	0.96	0.001	0.11	0.000
Net importers, primary only	2,324	-0.3	190	0.8	0.95	0.007	0.18	0.000
Net exporters, not competing	2,239	-0.1	213	0.5	1.12	0.002	0.16	0.000
Net exporters, competing	1,872	-0.1	162	1.0	1.04	0.002	0.08	0.000
India	2,474	-0.2	226	0.6	1.07	0.006	0.21	0.000
<i>Food neutral</i>								
Net importers, not self-sufficient	2,931	-0.1	159	1.1	0.49	0.001	0.43	0.000
Net importers, self-sufficient	2,919	-0.1	157	1.0	1.39	0.003	0.23	0.000
Net importers, primary only	2,798	-0.2	194	0.7	1.15	0.006	0.26	0.000
Net exporters, not competing	2,767	-0.1	237	0.5	0.98	0.002	0.24	-0.001
Net exporters, competing	2,860	-0.2	202	0.7	1.87	0.008	0.26	0.000
China	3,088	0.0	225	0.5	1.45	0.000	0.32	0.000
Indonesia	2,924	-0.1	270	0.3	1.02	0.002	0.06	0.000
<i>Food secure</i>	3,078	-0.1	147	1.2	2.93	0.010	0.49	0.000
Less developed and net food importing								
LDC	2,072	-0.1	215	0.5	1.00	0.001	0.12	0.000
NFIDC	2,576	-0.2	168	1.0	0.90	0.006	0.20	-0.001

does not play an important role in the average diet relative to wheat and coarse grains, but overall the effects are modest. While this magnitude of cereal price increase faced by the food secure countries group may not jeopardize their access, the same percentage of increase for the group of food insecure, net importers that are not self-sufficient, and the 1.0 percent increase in cereal prices experienced by the group of food insecure net exporters of competing primary products may indicate a risk to, or deterioration of, food access among poorer countries. However, the more substantial price increases from the export subsidy scenario occur in certain animal product markets as export subsidies account for a greater share of trade in world markets for these products in the baseline. Apart from those countries that export such commodities, in which case rising livestock product prices may lead to substitution of cereals use from human consumption to animal feed, the meat and dairy products are not critical in terms of food security for most countries. Instead, the smaller crop price changes are more relevant.

The consequences of the export subsidy reduction for food *stability* appear mixed. The cereal stocks-to-consumption ratio does not change significantly. At the same time, the self-sufficiency indicator actually rises slightly for most countries or group of countries. Rising world prices due to lower export subsidies by OECD countries encourages NMEs' own production of agricultural commodities and discourages their consumption. Thus, the ratio of production over consumption increases. However, these indicators only serve as proxies of the degree to which these NMEs may be able to withstand shocks such as a sudden change in import prices and, in the case of the stocks-to-consumption ratio, domestic production shocks. Nevertheless, the overall effects on food stability are mixed, but appear to be relatively small.

The scenario explored here represents a further reduction in export subsidy commitments by OECD countries of the same order of magnitude as the URAA commitments. However, as noted before, the original report upon which this exercise is based analyzed the effects of an export subsidy elimination. To address any question about whether or not the results shown above are robust, the implications of hypothetical export subsidy elimination are briefly discussed here. The complete elimination of export subsidies (as defined under Article 9 of the URAA and notified to the WTO) results in significantly larger price changes for livestock products, such as dairy products, relative to the original scenario because of the significant share of exports that are subsidized. On the other hand, the previous export subsidy reduction scenario alone is sufficient to substantially reduce crop export subsidies from the already low levels (relative to trade) projected in the Outlook. Thus, in moving from the export subsidy reduction scenario to an export subsidy elimination scenario, the additional impact on world cereal prices is marginal—even when including both the direct effects as cereal subsidies are eliminated as well as the cross-commodity effects from livestock markets. As these are the primary food commodities for NMEs, the slightly larger world price changes result in small additional effects

on the indicators of food security. For example, average food consumption decreases by 0.6 percent for two groups but by less for other groups.

Market Access Expansion

The OECD is in the process of examining the impacts of an increase in market access (OECD 2002).¹³ By applying the method of this preliminary work here, the effects of a scenario based on URAA market access continuation can be estimated where this is interpreted as reducing in-quota, over-quota, and non-quota tariffs by 36 percent and increasing TRQs by 50 percent relative to the commitment levels at the end of the URAA implementation period (rather than the initial levels). The methods of making modeling changes to accommodate market access analysis are complex and are elaborated on in the other report.¹⁴ Again, as in the case of the export subsidy scenario, changes may also take place in the applied levels of other policy measures in the sense that Aglink recognizes the links between border and domestic policies.

This analysis does not address all aspects of market access. For instance, the analysis does not suppose any change in the allocation system of import quotas. Preferential agreements are not added to Aglink. Thus, the degree to which beneficiaries of preferential access may gain or lose in the case of a general tariff reduction and quota expansion is not estimated. However, while the work is preliminary and does not encompass all aspects of market access, the results are useful in estimating the effects on a specific set of world commodity markets. Moreover, the results of the general equilibrium analysis, to be seen later and which does not suffer some of these deficiencies, in that it models bilateral trade and the list of commodities is more complete, seem to concur with the partial equilibrium results discussed below.

Results of the market access scenario for world crop prices and those livestock products most affected are shown in comparison to the baseline in table 8.7. Taking into account the direct effects of the reduction in import barriers and the cross-commodity interactions, the final effects for crop prices at the end of the implementation period are mixed, with increases observed in rice and coarse grain prices but with slightly lower wheat and oilseed world prices. The livestock product market effects can be larger, setting aside pork, poultry, and sheep meat as few TRQs were implemented for these commodities. A repetition of the URAA market access commitments in the 2001–05 period results in higher prices for beef and dairy products.

NMEs are affected by the expansion in access to OECD markets and through world price effects. The change in world price should be equal to the change in export or import prices at which NMEs sell and buy commodities. To the extent that a NME has preferential access to certain OECD markets and the price change in world markets is different from the change in the price at which their goods are traded, the results may not precisely reflect the situation of exporting NMEs. However, the relative importance of preferential access agreements is not

Table 8.7 Continuation of URAA Market Access Improvement for OECD Countries: Effects on World Prices

	2001	2002	2003	2004	2005
(percent change relative to the baseline)					
World crop product prices					
Wheat	0.0	0.0	0.0	-0.1	-0.2
Rice	0.1	0.2	0.3	0.5	0.5
Maize	0.1	0.1	0.2	0.2	0.2
Oilseed	0.0	0.0	-0.1	-0.1	-0.2
World livestock product prices					
Beef	0.5	3.7	5.1	1.2	3.6
Butter	1.3	2.5	2.4	2.4	3.0
Whole milk powder	0.5	3.5	5.4	7.1	9.5

clear and the degree to which world prices fail to reflect the changes in export prices even where preferential access exists is also not determined. In any case, the effects on exporting NMEs may be over- or underestimated, but the results for those countries that depend on imports and do not export any of these commodities are not greatly affected by such considerations.

Table 8.8 shows the impacts of these world price changes for the selection of food security indicators. As before, average food consumption is used to measure food *availability*, the change in the weighted-average cereal price gives an indication of the effects on *accessibility* for consumers that buy at prices related to world prices and both self-sufficiency and stocks-to-use ratios are provided to give some indication of food *stability* in the face of external and more general shocks, respectively.

The change in average calorie consumption caused by the changing world prices is not very large for any of the groups of NMEs, indicating no serious change in food *availability* as a consequence of the policy reform. The largest effect is -0.1 percent for average calorie consumption per person.

Similarly, *access* to food does not appear to be substantially affected. A small change in world prices such as is represented in table 8.7 causes a small change in the average cereal price. Thus, even a country which is highly dependent on imports and whose internal prices vary directly with world prices is not substantially affected by the OECD market access expansion examined in this scenario. To the extent that this liberalization raises consumer prices, it would decrease access to food. However, the small world price effects and low transmission into NMEs markets argue against any serious negative impact on this aspect of food security.

The *stability* of food supplies is represented by the last two indicators of table 8.8. As shown, the effects of the increased OECD market access on these two indicators are very small. In fact, in the case of the self-sufficiency indica-

Table 8.8 Continuation of Market Access Improvement for OECD Countries: Effects on Food Security Indicators in 2005

Group or country	Average consumption all commodities		Average world price of cereals		Self-sufficiency ratio Aglink commodities		Stocks-to-consumption ratio for cereals	
	Scenario (calories)	Change (percent)	Scenario (USD/t)	Change (percent)	Scenario (ratio)	Change (absolute)	Scenario (ratio)	Change (absolute)
Groups defined by food security and trades								
<i>Food insecure</i>								
Net importers, not self-sufficient	2,031	0.0	152	0.0	0.38	0.000	0.09	0.000
Net importers, self-sufficient	2,088	0.0	226	0.4	0.96	0.001	0.11	0.000
Net importers, primary only	2,312	-0.1	200	0.2	0.97	0.005	0.18	0.000
Net exporters, not competing	2,234	0.0	222	0.4	1.13	0.001	0.16	0.000
Net exporters, competing	1,868	-0.1	171	0.0	1.05	0.002	0.08	0.000
India	2,494	-0.1	235	0.3	1.00	0.003	0.23	0.000
<i>Food neutral</i>								
Net importers, not self-sufficient	2,932	0.0	167	0.0	0.49	0.000	0.43	0.000
Net importers, self-sufficient	2,915	0.0	165	0.1	1.40	0.001	0.23	0.000
Net importers, primary only	2,793	-0.1	203	0.2	1.16	0.003	0.26	0.000
Net exporters, not competing	2,762	-0.1	248	0.4	0.99	0.001	0.24	0.000
Net exporters, competing	2,933	-0.1	217	0.3	1.79	0.003	0.25	0.000
China	3,060	0.0	235	0.3	1.47	0.001	0.32	0.000
Indonesia	2,917	0.0	282	0.5	1.03	0.001	0.06	0.000
<i>Food secure</i>	3,043	-0.1	155	-0.1	3.36	0.006	0.46	0.000
Less developed and net food importing								
LDC	2,068	0.0	224	0.4	1.01	0.001	0.12	0.000
NFIDC	2,566	-0.1	176	0.1	0.92	0.003	0.20	0.000

tor, the food security situation appears to improve marginally as the higher prices increase domestic production relative to slightly lower domestic consumption. Thus, the effects of this policy change scenario on stability of food supplies appear to be mixed, but relatively small in any case.

Summary of Aglink Results

The Aglink model has been extended for the purposes of the present study to account for certain aspects of food security. The most substantial change is the addition of commodity market representations for 115 NMEs as derived from FAO's WFM in cooperation with FAO staff. By incorporating the effects of world prices on NMEs' consumption, production, stocks, and trade for Aglink commodities, the expanded model can generate a set of useful indicators that describe the consequences of a liberalization scenario for the macro or national food security situation in these countries.

The empirical results of two scenarios extending the URAA reforms for export subsidies or market access show that these consequences are very small. In fact, the changes are of such small scale that the evolution of indicators over the implementation period is not reported. The small effects follow from the relatively small changes in world cereal prices, the limited degree of world market integration of many NMEs, and the fact that one-third of calories are consumed from commodities that generally are not directly affected by OECD policies. While the higher world prices do result in a slight worsening of certain indicators of food security at the aggregate level, such as *availability* and *access* to food, the effect is mixed in terms of *stability*.

These results are drawn from a partial equilibrium analysis. While there are advantages of using this approach in terms of the detail of OECD agricultural trade policy representation and for the particular indicators produced, the implications for the wider economy and vice versa, which may be important given the large role of agriculture relative to total output and resource use in the case of many NMEs, are not considered in this approach. In order to address these cross-sector effects of further reform in domestic and trade policy in an economy-wide context, the next section will report the results of a global equilibrium analysis conducted using GTAP.

GENERAL EQUILIBRIUM (GTAP) RESULTS

Method

The Global Trade Analysis Project (GTAP) is the general equilibrium model applied to capture economy-wide effects of a greater range of policy changes in order to provide a broader perspective on the links between OECD trade policies and NME food security. It is not within the scope of this paper to provide a detailed explanation of GTAP, although box 8.6 summarizes some salient features of the model.

Box 8.6 A Brief Description of GTAP

The present study uses the GTAP database (version 5.3) and GTAP model (version 5.0). The GTAP database spans 66 countries or regions and 57 sectors. The version of the database used here is prerelease 5.3, but the changes relative to the final, public database are modest.¹ To facilitate the analysis of the present study, certain sectors are aggregated and countries sharing similar food security and trade characteristics are grouped together. The model is designed to show the medium-term results of an external shock, but not any long-run or dynamic responses.

GTAP is a general equilibrium model. Thus, the final solution represents a solution across all sectors and all agents of an economy. In other words, all markets clear, consumers maximize utility across all products and producers maximize profit for all outputs made and inputs purchased. Important assumptions of the standard model include perfect competition, full utilization of resources (including labor), and full mobility of resources with the exception of land, constant returns to scale, and that certain commodities or even sectors can be usefully aggregated. GTAP is a multiregion model. Bilateral trade between countries or regions is modeled following an Armington structure.

The model starts from a given set of resources (for example, labor, land, capital), a set of technical coefficients representing production capabilities (assuming constant elasticity of substitution with constant returns to scale), a policy regime (in the form of a set of price wedges between agent and market prices), and a utility function (a nonhomothetic constant differences of elasticities expenditure function). The representative consumer always maximizes utility, whether through goods purchased directly, purchased through government, or purchased in the future (which is money saved now), subject to income and prices. Producers compete to convert resources and intermediate goods into final goods. The competition in input markets bids the prices of limited resources higher, and the assumption of perfect competition implies that no economic profit will accrue to firms. Instead, all the value of the output will be bid into the input prices, such as the prices of labor and land, and the values of the resources help determine the income received by the representative household.

Government policy is always represented as a wedge between agent and market prices. An import tariff raises the domestic market price of imports relative to the import (c.i.f.) price and an export subsidy lowers the export price (f.o.b.) relative to the domestic price. On the other hand, an area payment linked to production of a certain output reduces the land price below market price for producers of that output. The costs and revenues from any intervention accrue to the representative household; the accounting balances incorporate these policies.

The model estimates the change from the starting point—a standard equilibrium displacement model. The base year is 1997.

(continued)

Box 8.6 (Continued)

1. The prerelease 5.3 version (April 2001) of the GTAP database differs from the final database (released in August 2001), but the revisions tend to be modest. The tariff data represent a small exception with more noticeable changes, as follows:

Raw milk sector tariffs are revised, but this product is almost nontradable and the revision has insignificant effects.

A. The average tariff on wheat imports of food insecure, processed good exporting countries (INSPROEXP) is overestimated by 17.5 percent in the prerelease data. As a result, the simulations of this document overestimate the trade effects in the scenarios where these tariffs change (for example, when the NME agricultural tariffs are also changed). However, the effects on the results in this scenario as regards world markets and the country groupings own markets will not be large because these countries account for 0.2 percent of world wheat imports and wheat accounts for only 0.5 percent of their total imports. Similarly, the dairy import tariffs for this region were also too high in the prerelease data, but the region accounts for only 0.6 percent of world dairy imports, and dairy accounts for 1.5 percent of total imports into the region so the effects on the results should not be large.

B. The tariff relating to beef imports of other food secure countries (SECOTH) is revised in the publicly available data. However, both the level of protection in either case is so high that this percentage point difference does not appear to be significant in terms of simulation results.

C. The duty paid by on exports of dairy products from food neutral exporting countries (NEUEXP) change from 53 percent to 46 percent (for example, from high to still high). However, these countries' trade accounts for only 1.3 percent of world dairy exports so the change to new protection data is not expected to affect world markets very much in the scenarios where it is reduced. At the same time, dairy accounts for only 0.1 percent of these countries' exports, so the effects on the domestic economy will not be very large.

For more information, see Hertel (1997) or the GTAP home page (www.agecon.purdue.edu/GTAP/ or www.gtap.org).

The scope and the results of GTAP are different from those of Aglink. These differences confer certain advantages and disadvantages in terms of the possible set of food security indicators. The list of such measures to be used in identifying the effects of various scenarios on food security in NMEs is summarized in box 8.7.

The sector aggregation is an important element of the study. These aggregates are summarized in table 8.9. In the present study the focus on agricultural commodities is reflected in the distinction between primary and processed by the choice of sector aggregates. Sector aggregates 1–7, including cereals, are considered *primary* agricultural goods; sector aggregates 8–11 are considered *processed* agricultural goods. As regards manufacturing, these sectors are aggregated as either labor or capital intensive. The division is based on the median value of the observed (normalized) capital-to-output ratios, with factor shares calculated from the input-output data of the GTAP database.

Box 8.7 Indicators Produced by GTAP

GTAP produces several indicators of food security in NMEs, provided the sector aggregation and country groupings are carefully defined. None of the indicators used here provides a perfect measure of food security, as there is no unique and definitive measure available. Moreover, the study focuses on indicators at the aggregate level, not the individual level, where instances of food insecurity may exist regardless of the level of national indicators. Thus, the selection below is designed to capture the aspects/characteristics relevant for the issues addressed in this paper and these indicators are appropriate given the empirical tool applied in this section.

The indicator for food *availability* is average consumption per person of primary and processed foods. This proxy offers a measure of the amount of food, no matter the source of supply, that is present for consumption. The aggregation method provided by GTAP is by expenditures.

Food *accessibility* is measured by purchasing power of unskilled labor. This indicator is calculated for factor income obtained from unskilled labor. This is motivated by the consideration that relatively poor segments of the population derive their incomes mostly from relatively unskilled activities and from small landholdings. The development of unskilled factor payments relative to the development of food prices therefore gives a first indication of the food purchasing power of poor segments of the population. According to the theory embedded in the model, factor earnings will rise for those production factors that are used relatively intensively in expanding sectors. In as far as unskilled labor is used intensively in agriculture, manufacturing, and some services, and as these sectors expand following trade liberalization, this might lead to higher unskilled wages. However, the food purchasing power for those factor incomes only improves if, in addition, domestic food prices grow more slowly than factor payments. Moreover, while this indicator provides a proxy of the average purchasing power of the poorest consumers, the underlying assumption of full factor employment should be borne in mind.

Self-sufficiency can be used as an indicator to proxy food *stability*. This ratio is defined as the production of primary or processed food relative to consumption. The aggregation is, again, by value, although some commodities contribute more than others in terms of calories. Apart from differences in units and commodities included, the measure is related to the self-sufficiency ratio applied in the country classification (described in a preceding chapter). One caveat regarding food self-sufficiency as an indicator of stability should be made: greater dependence on domestic production may decrease stability if this source of food proves to be highly volatile. Again, stocks-to-consumption would be a better measure of the degree to which the market is insulated from shocks in general, but in the absence of stocks, self-sufficiency does at least give some hint as to the protection against world market or exchange rate shocks. Despite the ambiguity of this indicator, the percentage of change in self-sufficiency caused by a scenario will be reported.

Table 8.9 GTAP Sector Aggregates

	Aggregate name	Description	Original GTAP v5 commodities
<i>Primary agriculture</i>	1 Rice	Rice, paddy and processed	Paddy rice, processed rice
	2 Wheat	Wheat	Wheat
	3 Coarse grains	Coarse grains	Cereal grains nes
	4 Oilseeds	Oilseeds	Oilseeds
	5 OtherCrop	Horticulture and other crops	Vegetables, fruit, nuts, crops nes, plant-based fibers, sugarcane, sugar beet
	6 Milk	Raw milk	Raw milk
	7 OtherAnimal	Other animal products	Cattle, sheep, goats, horses, wool, silk-worm cocoons, animal products nes,
<i>Processed agriculture</i>	8 Beef	Red meat	Meat: cattle, sheep, goats, horse
	9 Pork&Poultry	Pork, poultry, and white meat	Meat products nes
	10 Dairy	Dairy products	Dairy products
	11 ProceFood	Food products nes and food processing	Food products nes, beverages and tobacco products, sugar, vegetable oils and fats
<i>Other sectors</i>	12 Extraction	Natural resources and extract	Oil, coal, gas, minerals nes, forestry and fishing
	13 LabIntManuf	Labor intensive manufacture	Wood products, paper products, publishing, metal products, motor vehicles and parts, transport equipment, textiles, wearing apparel, leather products
	14 CapIntManuf	Capital intensive manufacture	Petroleum, coal products chemical, rubber, plastic products, mineral products nes, ferrous metals, metals nes, electronic equipment, machinery and equipment nes, manufactures nes
	15 Services	Services and activities nes	Electricity, gas manufacture, distribution, water, construction, trade, transport nes, sea transport, air transport, communication financial services nes, insurance, business services nes, recreation and other services, pub admin/ defense/ health/ education, dwellings

“nes” = not elsewhere specified.

Before discussing the results of the scenarios, an introduction to the base data is appropriate for two reasons. First, the base data alone are informative. The base data show the commodities that NMEs depend on for food imports or export revenues and the incidence of border protection. Second, the results of the GTAP experiments will depend in part on the beginning data. Obviously, a decrease of any policy level by a given percentage will have greater impact if the policy lever begins at a higher level. Moreover, a policy change will tend to have a greater effect if it directly influences a flow that represents a relatively large share of a market. A brief overview of the GTAP base data is analogous to the introduction of the baseline in the Aglink section of this paper.

Base Data

The starting point of the GTAP analysis is the GTAP database version 5.3. The base year data represent the situation of markets and policies in 1997. More information about the database and how it is derived may be found elsewhere. A brief summary of certain relevant characteristics of these data follows.

For exporters, the magnitude of the effects of trade policy reform on the domestic economy depends on the ratio of exports to GDP. These data are represented in table 8.10. This ratio typically is higher for relatively small countries or groups of smaller countries as opposed to large countries. For example, exports comprise a greater share of GDP in food insecure countries as compared to the average, whereas the share of exports in total GDP tends to be smaller for aggregates including OECD countries, but there are exceptions. Because of greater variety in goods produced domestically, big countries, in general, can exploit different comparative advantages within the country, while smaller countries rely on trade to enable them to benefit from their comparative advantage. Although not shown in the table, some small NMEs depend on a limited number of export products, particularly primary commodities, and depend on a relatively small number of trading partners for a large share of their exports. Thus, many NMEs have a skewed trade pattern vis-à-vis a selected set of trade partners, which are often OECD countries. Finally, table 8.10 also reports the size of each country or country group relative to world GDP. In this respect, food insecure countries account for a total of 4.4 percent, the food neutral countries for 15.0 percent, and the food secure countries for 80.6 percent of total world GDP.

The right side of table 8.10 contains the analogous ratios for imports. For importers as well, the effects of agricultural trade policy reforms on the domestic economy are also strongly correlated with the ratio of imports to GDP, as rising traded food prices will imply that a larger share of GDP has to be devoted to imports of food. This implies that, for a given level of GDP, fewer funds are available to import machinery and other essentials. For example, the food insecure, agriculture importers group of countries are relatively open, with the ratio of primary and processed imports to GDP (1.1 percent and 1.8

Table 8.10 Trade Relative to GDP in 1997

Country or group		Exports (exclusive of taxes and subsidies)				Imports (exclusive of taxes and subsidies)				Country or group share in world GDP
Food security status	Trade position	Primary food	Processed food	Other sectors	All sectors	Primary food	Processed food	Other sectors	All sectors	
(percent)										
Food insecure (INS)	AGREXP	5.5	4.1	30.5	40.1	1.9	3.8	54.1	59.9	0.4
	PRIEXP	4.2	1.3	19.7	25.2	0.8	1.9	27.9	30.7	0.6
	PROEXP	0.3	3.9	51.3	55.5	1.1	4.2	30.8	36.1	0.1
	INDIA	0.9	0.9	9.2	11.0	0.3	0.3	11.7	12.3	1.4
	AGRIMP	0.7	1.2	17.9	19.8	1.1	1.8	23.8	26.6	1.9
Food neutral (NEU)	AGREXP	1.3	1.8	11.5	14.6	0.5	0.7	15.7	17.0	5.8
	PROEXP	0.8	2.9	44.5	48.2	1.6	1.4	43.0	46.0	1.1
	CHINA	0.7	0.9	26.1	27.6	0.6	1.0	23.6	25.2	3.0
	AGRIMP	0.6	0.6	28.4	29.6	1.2	2.4	27.3	30.9	5.2
Food secure (SEC)	AUSNZL	1.9	2.7	14.4	19.0	0.2	0.6	18.8	19.6	1.6
	NAFTA	0.5	0.4	12.2	13.2	0.3	0.4	14.3	15.0	30.9
	EU	0.6	1.8	27.4	29.7	0.9	1.6	27.2	29.7	27.5
	ROECD	0.1	0.3	15.7	16.1	0.5	0.8	14.0	15.4	18.9
	OTH	0.2	0.8	59.7	60.7	1.5	2.5	61.7	65.7	1.8
All countries		0.6	1.0	19.7	21.3	0.6	1.1	20.4	22.1	100

Source: GTAP database prerelease version 5.3 (April 2001).

percent) higher than the average (0.6 percent and 1.1 percent). On the other hand, food insecure agricultural product exporters are even more dependent on imports, but also export large amounts of their agricultural production. NMEs in this group are typically net exporters of agricultural products, while they are net importers of other products.

The self-sufficiency ratio in table 8.11 is defined as the ratio of domestic production to domestic consumption. This ratio indicates how different sectors of the various country groups are likely to be affected by trade liberalization. For example, self-sufficiency ratios of food insecure agricultural importers exceed 100 percent only in the other crops and services sectors. The wheat self-sufficiency ratio is particularly low relative to other sectors at 73 percent. This indicates that a general rise of traded commodity prices led by a rising wheat price, following more liberal policies in OECD countries, will directly increase their wheat imports bill, while they have limited potential to generate additional export revenues in other sectors. On the other hand, the self-sufficiency ratios of all but two primary and processed food sectors are at least equal to 100 percent for food neutral agricultural exporters (the exceptions being wheat at 97 percent and dairy at 96 percent).

The food-insecure countries are typically not self-sufficient in those commodities whose markets are most distorted by trade policies and domestic policies in OECD countries. Evidence is found in table 8.11: among primary products, the food insecure countries at the left-hand side of the table tend to have lower self-sufficiency ratios for rice, wheat, coarse grains, and oilseeds relative to other crops. Food insecure countries tend to export other crops (horticulture, natural rubber, etc.) and some are net exporters of oilseeds, but are likely to rely on imports for their cereals needs in particular. Processed food is another category where some food insecure countries generate export revenues, particularly in comparison to beef and dairy which are more heavily supported by OECD countries.

The share of each sector relative to total output is represented in table 8.12. Generally speaking, the share of primary agriculture in production becomes smaller in moving from left to right across this table while the share of manufacturing and services increases. In other words, primary agriculture is of greatest importance for the food insecure groups of countries (accounting for 7–20 percent of total output), important for the food neutral countries (with 5–12 percent of total output), and relatively less important for the food secure countries (2–4 percent). The processed commodity sectors follow a similar tendency, whereas the reverse is true of the other sectors, as shown at the bottom of table 8.12. Finally, other crops and processed food tend to have high shares in the composition of domestic production in the food insecure countries, just as these sectors were shown in the previous discussion to be important component of exports.

Table 8.13 and table 8.14 summarize the patterns of import protection applied in 1997. The former shows the average trade weighted tariff equiva-

Table 8.11 Production-to-Consumption Ratios in 1997

Sector	Food insecure (INS)					Food neutral (NEU)				Food secure (SEC)				
	AGR EXP	PRI EXP	PRO EXP	INDIA	AGR IMP	AGR EXP	PRO EXP	CHINA	AGR IMP	AUS NZL	NAFTA	EU	Rest OECD	Other
Rice	100	99	75	104	99	105	99	100	90	126	109	78	97	92
Wheat	58	64	48	98	73	97	3	94	73	334	169	101	49	14
CoarseGrains	74	94	95	100	94	107	84	102	76	117	111	100	38	33
Oilseeds	94	112	98	102	96	109	76	84	98	164	140	69	22	15
OtherCrops	145	134	93	103	101	110	97	100	91	125	96	83	88	67
Milk	100	100	100	100	100	100	97	100	100	100	100	100	100	99
OtherAnimal	100	101	96	99	99	100	101	100	99	135	101	98	90	85
Beef	95	89	47	100	92	102	84	89	87	197	102	97	81	33
Pork&Poultry	86	91	66	74	97	108	91	101	63	108	103	102	75	91
Dairy	64	58	9	100	82	96	59	81	73	171	98	104	89	65
ProcesFood	103	96	101	107	96	107	116	96	82	105	99	101	91	76
Extraction	88	210	714	81	98	104	145	97	202	147	86	53	58	59
LabIntManuf	68	67	68	111	94	95	109	109	82	86	95	101	103	95
CapIntManuf	61	64	57	88	78	89	89	96	89	80	96	103	107	89
Services	103	92	103	101	102	100	99	100	99	101	101	101	100	106

Source: GTAP database prerelease version 5.3 (April 2001).

Table 8.12 Shares of Total Output in 1997

Sector	Food insecure (INS)					Food neutral (NEU)				Food secure (SEC)				
	AGR EXP	PRI EXP	PRO EXP	INDIA	AGR IMP	AGR EXP	PRO EXP	CHINA	AGR IMP	AUS NZL	NAFTA	EU	Rest OECD	Other
Rice	2.6	7.2	0.2	3.6	3.6	0.7	5.9	2.7	0.4	0.1	0.0	0.0	0.7	0.4
Wheat	0.3	0.3	0.1	1.6	0.5	0.4	0.0	0.5	0.5	0.4	0.1	0.1	0.1	0.0
CoarseGrains	0.4	1.4	0.9	1.1	0.7	0.4	0.5	0.6	0.4	0.2	0.4	0.1	0.1	0.0
Oilseeds	0.3	0.5	0.2	2.1	0.5	0.6	0.3	0.4	0.1	0.0	0.2	0.1	0.0	0.0
OtherCrops	7.0	8.0	3.7	5.9	4.5	3.2	3.4	4.0	1.5	1.1	0.6	0.7	1.0	0.5
Milk	0.7	0.4	0.0	2.7	1.0	0.9	0.0	0.1	0.7	0.6	0.2	0.4	0.2	0.0
OtherAnimal	1.6	2.5	1.5	2.2	2.2	1.4	2.0	3.5	1.6	1.4	0.8	0.8	0.4	0.8
<i>All primary</i>	12.9	20.3	6.6	19.2	13.0	7.6	12.1	11.8	5.2	3.8	2.3	2.2	2.5	1.7
Beef	0.9	0.2	0.2	0.0	0.6	1.2	0.2	0.1	0.7	1.1	0.5	0.5	0.3	0.0
Pork&Poultry	0.7	0.5	0.4	0.0	1.1	0.8	0.3	0.6	0.3	0.4	0.5	0.7	0.2	0.5
Dairy	0.6	0.2	0.0	0.2	0.6	0.9	0.1	0.0	0.6	1.1	0.5	0.8	0.4	0.1
ProcesFood	7.6	6.8	6.7	3.5	7.1	6.6	5.7	3.9	4.2	3.1	3.1	3.5	3.7	1.9
<i>All processed</i>	9.8	7.7	7.3	3.7	9.4	9.5	6.3	4.6	5.8	5.7	4.6	5.5	4.6	2.5
Extraction	3.2	11.2	21.6	3.0	3.7	2.5	7.5	4.3	9.7	4.1	1.6	0.7	0.9	2.0
LabIntManuf	15.0	6.2	9.4	10.9	11.4	14.2	9.9	16.6	10.3	9.4	12.3	11.2	10.7	10.0
CapIntManuf	14.3	8.2	9.7	21.7	14.3	18.7	20.8	31.2	18.0	10.6	15.6	18.0	20.6	27.7
Services	44.9	46.3	45.3	41.4	48.2	47.4	43.4	31.5	51.0	66.6	63.7	62.2	60.9	56.0
<i>All other</i>	77.4	71.9	86.0	77.0	77.6	82.8	81.6	83.6	89.0	90.7	93.2	92.1	93.1	95.7
All sectors	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Source: GTAP database prerelease version 5.3 (April 2001).

Table 8.13 Trade-Weighted Tariff Averages on Exports by Country or Country Group of Origin in 1997

Sector	Food insecure (INS)					Food neutral (NEU)				Food secure (SEC)				
	AGR EXP	PRI EXP	PRO EXP	INDIA	AGR IMP	AGR EXP	PRO EXP	CHINA	AGR IMP	AUS NZL	NAFTA	EU	Rest OECD	Other
Rice	40	98	100	19	22	50	102	67	62	188	90	21	38	66
Wheat	26	14	74	44	55	32	9	75	41	41	63	32	38	66
CoarseGrains	23	28	26	38	16	39	26	157	26	79	42	31	28	23
Oilseeds	27	50	22	17	21	23	9	46	5	62	40	23	5	17
OtherCrops	12	10	14	18	20	14	16	26	9	15	20	30	18	33
Milk	1	1	1	1	1	1	1	1	1	1	1	1	1	1
OtherAnimal	8	15	21	15	12	8	2	7	14	12	16	28	16	8
Beef	37	70	52	32	64	80	16	16	60	40	40	37	49	28
Pork&Poultry	22	39	32	47	109	50	23	42	37	38	34	57	25	55
Dairy	76	112	98	78	88	53	17	25	93	68	99	69	65	41
ProcesFood	29	29	62	28	26	24	25	25	28	25	30	33	25	33
Extraction	1	1	1	2	2	2	2	1	1	2	2	1	1	4
LabIntManuf	11	3	12	10	11	8	9	11	8	6	6	9	11	14
CapIntManuf	6	2	5	6	5	6	7	5	7	4	6	6	5	5
Services	0	-2	-3	-4	-5	0	-3	0	-3	6	-1	-1	1	0

Source: GTAP database prerelease verion 5.3 (April 2001).

lents that each country group encounters in the specific composition of destination countries for its exports, while the latter shows the trade weighted average of tariff equivalents that each country group imposes on imports entering the country. The averages are calculated from bilateral trade and protection data. Data exclude trade within the country group.

Data of table 8.13 show that food insecure and food neutral countries encounter significant barriers on their agricultural exports. In fact, dairy accounts for seven of the highest barriers faced for any country or country group and rice accounts for another four such peaks. The average tariff barrier of extraction, manufacturing, or services exports is never the highest for any country or country group. The other crops aggregate appears to be the relatively least protected, which coincides with a relatively large share in NME exports. While trade barriers are generally higher in agriculture than in other sectors, it is also worthwhile to note the nonagricultural protection patterns. Within nonagricultural trade, the food insecure countries encounter the highest trade barriers on their labor intensive manufacturing exports. With an abundance of low-skilled labor, many food insecure countries can be expected to gain from trade liberalization in those activities to the extent that the reform lowers barriers of their trading partners.

As noted, data in table 8.14 represent the trade-weighted tariffs imposed on imports into a country or country group (excluding intragroup trade). Again, the relatively higher barriers are found on agricultural commodities in most cases. Moreover, within agriculture, tariffs tend to escalate, moving from primary to processed sectors, although China and the rest of the OECD (ROECD) are exceptions. Also, these barriers apply not only on trade with OECD countries, but also to exports to other NMEs. In fact, barriers imposed by NMEs on all trade in nonagriculture sectors tend to be higher than those imposed by OECD countries. On the other hand, the OECD countries do impose barriers on low-skill manufacturing goods that are greater than their tariffs on high-skill manufacturing goods—similar to the escalation of tariffs of processed sector trade relative to primary sector trade. These characteristics are clearly at odds with one another. The comparative advantage of NMEs in manufacturing due to an abundance of low-skill labor may be offset at least in part by the relatively high barriers these goods face in their export markets.

URAA Extension by OECD Members

The first scenario conducted using GTAP is to extend the OECD member policy reforms of the URAA as regard domestic support, market access, and export subsidies applied to all agricultural sectors.

Policy representation in GTAP is standardized in the form of wedges between agent and market prices.¹⁵ Thus, in those cases where there are price wedges representing policies in OECD countries in the base data, these price wedges are reduced by the appropriate percentage of reductions directly,

Table 8.14 Trade-Weighted Tariff Averages on Imports by Country or Country Group of Destination in 1997

Sector	Food insecure (INS)					Food neutral (NEU)				Food secure (SEC)				
	AGR EXP	PRI EXP	PRO EXP	INDIA	AGR IMP	AGR EXP	PRO EXP	CHINA	AGR IMP	AUS NZL	NAFTA	EU	Rest OECD	Other
Rice	31	20	14	0	28	5	24	107	9	1	5	76	271	0
Wheat	3	12	22	0	7	15	1	108	48	0	13	61	148	5
CoarseGrains	9	24	8	0	9	13	3	88	28	1	1	39	94	1
Oilseeds	4	9	16	40	8	16	6	108	31	1	10	0	84	1
OtherCrops	12	18	10	25	15	14	26	11	32	3	14	7	36	5
Milk	36	16	14	0	14	0	1	0	1	0	0	0	1	0
OtherAnimal	10	13	4	19	10	16	7	12	43	1	2	9	26	0
Beef	14	21	12	12	16	64	14	15	49	1	8	89	45	4
Pork&Poultry	20	21	16	22	14	31	31	15	44	6	11	31	76	3
Dairy	23	16	33	27	13	32	12	19	68	8	56	88	235	8
ProcesFood	22	21	27	34	22	31	13	39	36	6	13	25	45	10
Extraction	7	2	-5	18	5	2	2	1	5	0	1	0	0	3
LabIntManuf	16	18	22	28	17	19	16	20	14	8	6	6	6	2
CapIntManuf	9	14	31	27	11	11	4	13	9	3	2	2	4	8
Services	1	3	5	0	-8	-2	-9	0	-2	1	0	0	0	0

Source: GTAP database prerelease version 5.3 (April 2001).

without making any allowance for those cases where the relevant URAA commitments are not binding. In other words, this approach represents a hypothetical reduction in the applied rates, but would overstate the effects of a continuation of URAA reductions in commitments to the extent that applied rates are below bound or commitment levels. It is not possible at this time to explicitly identify URAA limits and then reduce the applied policies only in those cases where the limit reductions are binding.¹⁶ In all scenarios conducted using GTAP, a commitment to reduce support by a given percentage is assumed to cause a reduction in the corresponding GTAP price wedge by the same percentage.

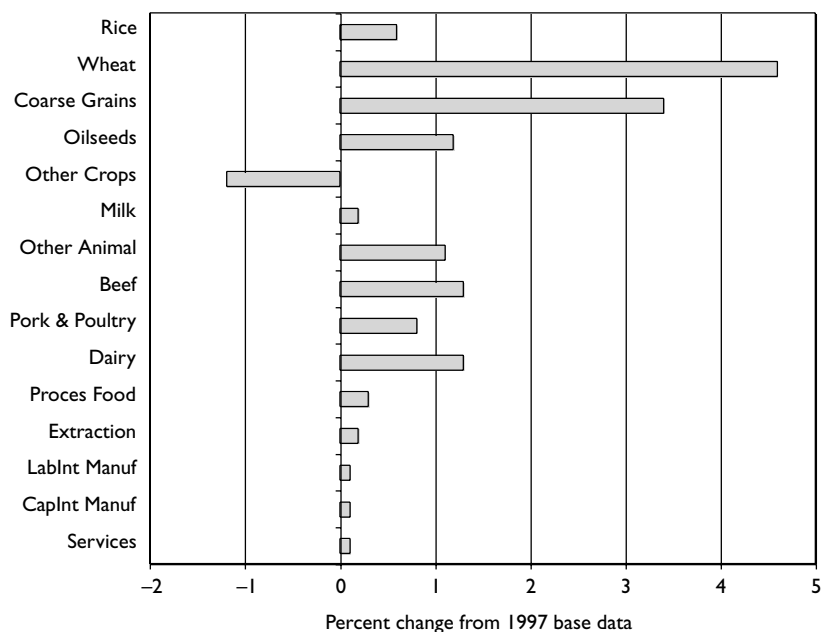
The stylized treatment of policies might be criticized in that actual links between border measures and domestic support policies are not recognized. This is in contrast to the partial equilibrium analysis previously discussed, in which the interaction between border and domestic measures could not be severed. The treatment of policies provided by GTAP allows for broader experiments, in terms of sectors and regions, than is possible in the partial equilibrium analysis discussed in the previous section.¹⁷

The GTAP results reflecting a hypothetical continuation of the URAA reductions in export subsidies, domestic support, and market access are not large in general. For example, the traded price effects summarized in figure 8.5 typically show small percentage changes from the base levels. The traded prices are defined as an average of import prices, weighted by value shares.¹⁸

The increase in the traded price of the heavily supported food- and feed grains sectors is bigger than the change in most other sectors. However, this result is in part due to the derivation of these price indices, in that the average traded prices of livestock products are greatly affected by intraregional and intra-OECD trade. In particular, the average import prices of figure 8.5 are heavily weighed by the EU data (even though modeled as an aggregate trading block in these scenarios), a large portion of which is intraregional imports for which the demand in intermediate input markets falls. If these values are excluded, the other import prices to the European Union from other sources tend to rise. Reducing support in OECD countries leads to a decline in the traded price of the other crops group, an important export product for food insecure countries. The main reason for the price drop is the reduction in input costs, particularly land rents in OECD countries, which follows the reduction of subsidies.¹⁹ Some resources shift to other crops as the reductions in domestic support lowers the bias in favor of certain crops, such as wheat, coarse grains, and oilseeds. The market implications of the liberalization of processed goods sectors by OECD countries are presented in box 8.8.

GTAP output extends beyond agriculture and beyond prices alone to include the economy-wide effects. Further liberalization of the agricultural sectors in OECD countries has only a marginal impact on welfare or real GDP. Food insecure exporters, where agriculture is a relatively large part of their GDP, and the OECD countries that liberalize their own markets gain by these measures. Abolition of all tariffs gives the highest gains of welfare and real GDP

Figure 8.5 Real Average Price Changes from URAA Extension by OECD Members



Box 8.8 Excluding OECD Policies Directed at Processed Food Sectors

The GTAP data provide evidence of tariff escalation in that tariffs on OECD imports of processed food sectors tend to be higher than tariffs on primary foods (see table 8.14). Moreover, the Aglink analysis indicates that an extension of the URAA may have relatively greater effects on certain livestock product markets. Consequently, the GTAP results may be expected to vary depending on whether or not a URAA extension is applied to processed food sectors as well as primary food sectors. Due to the roles of processed food sectors as a source of food, as a traded good that can increase export earnings, and as an important user of primary commodities, further investigation on the relative importance of processed food sectors in the context of a URAA extension is warranted. A scenario is undertaken to highlight the importance of processed food trade liberalization for NMEs. In this scenario, the URAA extension continuing the original rates of reduction is only imposed on primary agricultural products. The comparison of the results of this scenario with those discussed previously, where the URAA extension is applied equally to primary

(continued)

Box 8.8 (Continued)

and processed agricultural commodities, provides an indication of the relevance of trade liberalization in processed products for NMEs.

The results are briefly summarized in the table below. For convenience, the previous results with the URAA extension based on a continuation of the committed rates of reduction (rather than the –50 percent case) applied to all agricultural sectors, processed or primary, are shown as well. The traded price effects can be compared by noting the data represented on the left side of the table. Not surprisingly, the prices of beef, dairy products, and processed foods are higher when processed sectors are included in the URAA extension. Dairy prices actually fall relative to the base period data if OECD policies for processed dairy products are excluded from the reform.

Comparing Effects of a URAA Extension with and without Including Processed Food Sectors

Sector	Traded price effects		Country or Group	Trade position or country	Real GDP effects	
	Liberalisation of all agriculture	Liberalisation of primary only			Liberalisation of all agriculture	Liberalisation of primary only
	(percent change)				(percent change)	
Rice	0.6	0.3	Food insecure (INS)	AGREXP	0.09	0.00
Wheat	4.6	4.4		PRIEXP	0.01	–0.01
CoarseGrains	3.4	3.3		PROEXP	0.10	0.00
Oilseeds	1.2	1.1		INDIA	–0.01	0.00
OtherCrops	–1.2	–1.4	Food neutral (NEU)	AGRIMP	0.00	0.00
Milk	0.2	0.1		AGREXP	0.02	0.00
OtherAnimal	1.1	1.0		PROEXP	0.01	0.00
Beef	1.3	0.7	Food secure (SEC)	CHINA	0.00	–0.01
Pork&Poultry	0.8	0.8		AGRIMP	–0.03	–0.01
Dairy	1.3	–0.5		AUSNZL	0.00	0.00
ProcesFood	0.3	0.1		NAFTA	0.02	0.01
Extraction	0.2	0.2		EU	0.12	0.07
LabIntManuf	0.1	0.2		ROECD	0.17	0.08
CapIntManuf	0.1	0.2		OTH	0.01	0.00
Services	0.1	0.2				

Note: The results represented here are dependent upon the model structure, the scenario design, and assumptions made with respect to key parameters such as elasticities, technologies, and exchange rate mechanisms and therefore may not be comparable to the results of other analyses.

The real GDP effects are also presented in the table based on the usual country groups. The overall effects are generally not very large. However, a
(continued)

Box 8.8 (Continued)

sustained increase of even 0.1 percent may be significant. For example, the total increase in real GDP totals US\$ 20 billion per year following the policy changes applying to primary and processed products. Excluding processed products reduces this total to US\$ 11 billion. (In either case, the GDP increase of these scenarios might be compared to the US\$ 40 billion Official Development Assistance provided in 1997.) As noted before, these medium-term results assume that the many factors that drive GDP, such as resources and technology, are fixed so that the gains arise from improved allocation of existing resources under existing production technologies.

Only India and food neutral agricultural product importers (NEUAGRIMP) might prefer a URAA extension omitting processed food sectors, and in these cases the differences from the previous case are not large. This compares to the noticeable gains of a broader URAA extension for NME processed agricultural product exporters whether or not they import primary agricultural goods (AGREXP and PROEXP), the European Union (EU) and the rest of OECD aggregate (ROECD). In general, for food insecure countries, the production gains from liberalization are lower if primary sectors alone are liberalized. The partial elimination of tariff escalation in the broader liberalization scenario opens trade opportunities to food insecure countries, which are forgone if only primary commodities are liberalized. Through backward production linkages, the expansion in processing industries generates demand for primary agriculture which stimulates domestic production in food insecure countries. Finally, the OECD countries gain in terms of higher GDP by reducing their government support for processed food sectors. This is largely due to the improved resource allocation as market distortions are reduced.

for food insecure exporters, some positive impact on food neutral exporters, and a negative effect on food neutral importers.

The effects of OECD agricultural trade liberalization on NME food security may not be well represented by the changes in traded commodity markets, welfare, and GDP. Instead, the three dimensions of the food security situation examined in the present study (availability, stability, and access) must be examined using the indicators discussed earlier. The results for these indicators are given in table 8.15.

Changes in food consumption, the indicator of *availability* of food following an extension of URAA reductions on OECD agricultural support and trade measures, is generally slightly lower for NMEs. The exceptions are India and the groups of food insecure countries that are net exporters of primary agriculture products (whether or not they import processed products). On the other hand, those food insecure countries that are net exporters of processed

Table 8.15 URAA Extension by OECD Countries, Percentage Change from Base Data

		URAA extension at original levels of reduction					
Country or group		Food consumption		Food self-sufficiency		Unskilled labor	
Food security status	Trade position	Primary food	Processed food	Primary food	Processed food	factor income	purchasing power
(percent change from the base)							
Food insecure (INS)	AGREXP	0.2	0.2	0.0	4.3	0.9	0.0
	PRIEXP	0.0	0.0	-0.1	2.9	0.5	0.0
	PROEXP	-0.3	-0.1	5.1	17.2	2.8	1.3
	INDIA	0.0	0.0	0.1	1.1	0.3	-0.2
	AGRIMP	-0.1	-0.1	0.4	1.5	0.5	-0.5
Food neutral (NEU)	AGREXP	-0.1	0.0	0.8	1.3	0.6	-0.5
	PROEXP	-0.1	-0.1	0.3	1.2	0.3	-0.2
	CHINA	-0.1	-0.1	0.4	0.6	0.2	-0.5
	AGRIMP	-0.1	-0.1	0.8	1.5	0.3	-0.5

food products but import primary agricultural products experience the largest percentage decrease in average food consumption (-0.3 percent). Average consumption of food decreases in all food neutral groups or countries. Overall, the relatively small changes in consumption reflect the small changes in traded prices and the absence of further reform on the part of NMEs themselves.

The *stability* of food is loosely indicated by the self-sufficiency ratio. (The results given are percentage changes in the ratio values, not the absolute change in the ratio values.) As a rule, production increases relative to consumption—an obvious response of NME commodity markets to higher traded prices. This result indicates that stability of NME food security may be enhanced when considering shocks that originate from outside the country. On the other hand, the greater dependence on internal production will not help insulate these countries' food supplies from sudden changes in internal production.

GTAP output includes traded food prices, which can be taken as an indicator of food *access*. This measure can be focused more narrowly on those consumers whose food access may be most jeopardized by rising traded prices by comparing the food prices to changes in unskilled labor income. The factor income from this resource (low-skill labor wages) is also presented in table 8.15, both in absolute terms and relative to the food price. The URAA extension at previous rates of reduction does increase unskilled laborers' wages in NMEs, particularly in those that export processed products. However, when the higher food price is taken into account, we see that the increase in income

is often more than offset by the higher food costs. The net effect of the OECD agricultural policy reform is likely to be slightly lower food purchasing power among poor consumers in many NMEs.²⁰ Food insecure countries that export processed goods and import primary goods experience the largest decrease in purchasing power even as their factor income rises the most. In this case, primary agricultural prices are driven higher by both higher traded prices and higher intermediate demand (in order to produce more processed goods) in the domestic market.

Other Trade Liberalization Scenarios: Multicountry and/or Multisector

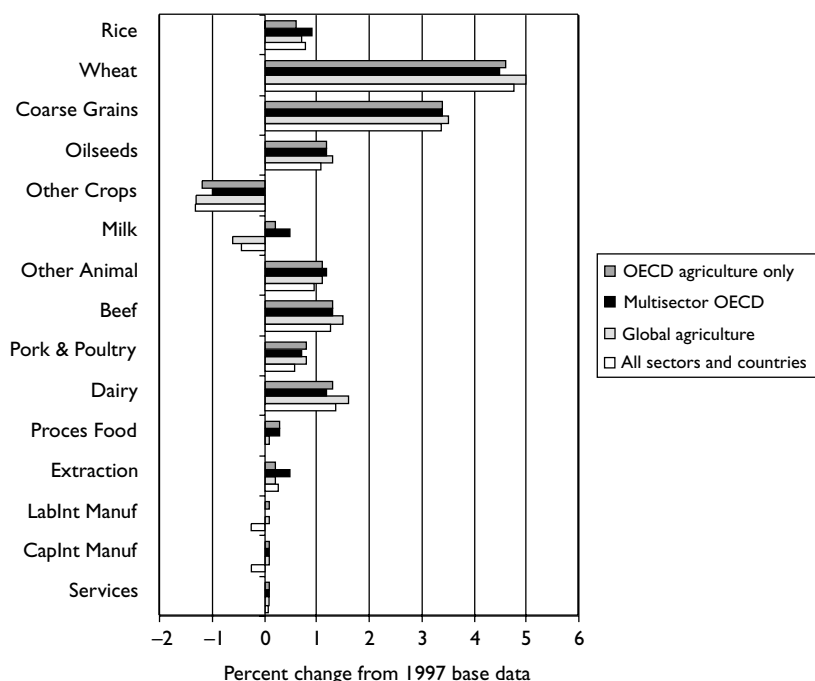
GTAP, as a general equilibrium model, allows the analysis to extend beyond agriculture to include other sectors. The model has been constructed with the same style of policy representation for all segments of all economies, allowing a broader set of market liberalization scenarios than the partial equilibrium model, Aglink, can provide. Scenarios of market liberalization that go beyond OECD members or cover more than agricultural commodities are reported on in the following section.

Three additional scenarios are provided for comparison to the URAA extension by OECD members for agricultural sectors: multisector OECD reform; global URAA extension for agricultural sectors (with NMEs participating); and the combined multisector, global policy reform (all countries and all sectors).

In the case where reforms extend beyond agriculture, the same percentage reductions are imposed on all sectors as on agriculture—but the reductions only extend to export subsidies and market access. Domestic support measures applied to agriculture are reduced in this scenario, but domestic support provided to other sectors is *not* changed. At this time, a broad or economy-wide reduction in domestic support is not possible due to data limitations.

The price changes under different liberalization scenarios are shown in figure 8.6. The top line reproduces the results of the initial scenario (that is, URAA extension by OECD members for agricultural sectors only), the second line is associated with an extension of the trade policy reforms to other sectors by OECD members (“multisector OECD”), the third corresponds to an expansion of the agriculture-only scenario to NMEs (“global agriculture”), and the fourth line represents the results when reforms are extended to trade policies of other sectors and NMEs participate (“all sectors and countries”). These scenarios highlight several important points: the relative magnitude of OECD and NME governments’ intervention in agriculture and nonagriculture sectors (excluding domestic support) relative to the total value of these sectors; the relative magnitude of OECD and NME support for agriculture; and the impact of agriculture reform on prices as compared to a wider liberalization. Each of these points leads to certain results relevant to food security, as measured by the indicators produced by GTAP.

Figure 8.6 Real Average Import Price Changes from Alternative Liberalization Scenarios



The international market effects when the URAA continuation includes NMEs (moving from the OECD agriculture only to the global reforms) are not large. The price changes are slightly greater when NMEs also liberalize, but the additional change is marginal compared to the effects of a URAA extension affecting OECD agricultural policy. OECD countries tend to be among the largest traders in most world markets and are responsible for the bulk of intervention/distortions in these agricultural markets. Thus, the effects of lower OECD trade and domestic policies are the more important element of a global reform of agricultural policies in terms of the international market effects. Conversely, the NMEs are responsible for a smaller share of trade and do not provide as much support, so the policy reforms of these countries are unlikely to have significant international market effects. On the other hand, these changes may be significant for the NMEs own domestic markets.

The price changes in the nonagricultural sectors are most sensitive to the sector coverage of the liberalization. The original scenario results led to price increases of 0.1–0.2 percent in nonagriculture sectors. The results of the global, agriculture-only reforms do not differ much. NME agricultural policies have no significant indirect effects on these nonagricultural sectors. On the other

hand, if OECD members' intervention in trade relating to these sectors is reduced in addition to their commitments in agriculture, then the prices rise by 0.5 percent in the case of extraction industries and very slightly if at all in the case of manufacturing. In the event of global and multisector reforms, the prices of manufactured goods fall (−0.2 percent). However, these changes are smaller than the percentage of changes in agricultural commodity prices for the same change in government intervention, indicating the smaller initial role of government intervention in nonagricultural sectors as compared to the role in agricultural sectors.

The different scenarios do have significantly different results, even though figure 8.6 may leave the reader with the impression that they do not. The traded price effects, particularly for agricultural commodities, do not vary by large amounts from one scenario to another. However, it is important to recognize that a sustained increase in the output prices of a sector can be important, particularly for any country that depends on world markets for a substantial share of income. Thus, traded price changes may have significant effects on NMEs in particular. For example, referring to table 8.10, the group of food insecure NMEs that export agricultural products (AGREXP) depends on trade for a large share of its income: primary food sector exports account for 6 percent, processed food sector exports for 4 percent, and the total of exports for all sectors is 40 percent of GDP. Clearly, a sustained general increase in traded prices of those goods exported by this group will raise aggregate income. Apart from the traded price effects, the reductions in these countries own trade measures will have an effect by lowering the costs of imports and lowering the receipts of exporters. These changes may have direct effects on food security, for example, by offsetting some part of the rise in traded prices, perhaps even resulting in lower domestic food prices, as well as indirect effects through improved resource allocation and possibly higher income.

The economy-wide effects of the different scenarios are represented by the GDP changes of table 8.16. The original scenario ("OECD agriculture") results in GDP increases relative to the base data for most country groups. However, India and food neutral agricultural importers face higher import prices without enjoying better export earnings in sectors where they enjoy a comparative advantage. Similarly, some countries report no economy-wide benefits from the URAA extension for OECD agriculture only. In all the other scenarios, no country or country group is expected to experience falling GDP as a consequence of the broader and/or wider policy changes. If the OECD countries were to extend the percentage of reductions in support imposed under the hypothetical URAA extension to all sectors, then NME income would rise substantially for several country groups. Moreover, OECD countries' own GDP would rise by more in the case of a wider liberalization as well.

If NMEs were to participate in the URAA extension, all countries would have to impose the same reductions in agricultural policy interventions relative to the starting levels of the base data. In comparison to the original case of

Table 8.16 Real GDP Changes from Alternative Scenarios

Country or group		Different policy change scenarios			
Security status	Trade position	OECD agriculture	OECD all sectors	Global agriculture	Global all sectors
(percent change from base)					
Food insecure (INS)	AGREXP	0.09	0.30	0.31	0.82
	PRIEXP	0.01	0.01	0.07	0.23
	PROEXP	0.10	0.27	0.25	0.94
	INDIA	-0.01	0.06	0.02	0.35
	AGRIMP	0.00	0.05	0.07	0.36
Food neutral (NEU)	AGREXP	0.02	0.03	0.07	0.25
	PROEXP	0.01	0.04	0.08	0.28
	CHINA	0.00	0.11	0.13	0.53
	AGRIMP	-0.03	0.02	0.21	0.39
Food secure (SEC)	AUSNZL	0.00	0.03	0.00	0.03
	NAFTA	0.02	0.04	0.02	0.04
	EU	0.12	0.13	0.12	0.13
	ROECD	0.17	0.21	0.18	0.22
	OTH	0.01	0.05	0.02	0.18

Note: The results represented here are dependent upon the model structure, the scenario design, and assumptions made with respect to key parameters such as elasticities, technologies, and exchange rate mechanisms and therefore may not be comparable to the results of other analyses.

an OECD-only URAA extension on agriculture, the NMEs clearly benefit. Lower import barriers allow more exchange among NMEs as well as developed countries, so each group has improved ability to emphasize those pursuits where it enjoys comparative advantage. Total wealth increases when each individual NME can focus more on those sectors where they do have a comparative advantage. (As noted in the discussion of the base data, NMEs usually cannot enjoy great benefits through their comparative advantages internally, as is the case of large developed countries, but must instead rely on trade with other countries to generate such opportunities.) In addition, by reducing export subsidies as well as import barriers, producer and consumer incentives may be better aligned as domestic market distortions are reduced. These effects lead to an improved allocation of resources within NMEs and, consequently, higher returns to their resources.

The global and multisector scenarios, in which all countries conduct URAA type reductions on domestic and trade measures for agriculture and trade measures for other sectors, give the highest increases in GDP results for all countries and country groups. GTAP estimates represented in table 8.17 show that the OECD members' economies are improved about as much with or without the participation by NMEs, whereas the NMEs make more progress in

this scenario than any other. The GDP of NMEs is 0.2–0.9 percent higher than in the base period following such a global and multisector agreement.

The effects of these alternative scenarios on food security will depend on changes in prices and income. The indicators of food security that can be produced from GTAP output are shown in table 8.17. The first rows of data (“OECD, agriculture only”) reproduce the indicators of the initial scenario. The other scenario results are described below.

The OECD multisector reform scenario presents mixed results for food security. Food *availability*, as measured by average food consumption per capita, in food insecure and food neutral NMEs would be generally improved, with the exception of food insecure countries that rely on processed food sector exports, if OECD countries reduce trade barriers in all sectors and domestic support to agriculture. The scenario results also indicate increased self-sufficiency ratios which may be taken as an indication of improved food *stability*, at least in respect to external shocks. The factor income of unskilled labor increases, but the price rises are generally greater, resulting in less food *access* on the part of many food insecure and food neutral country groups (relative to the base data without any reform). However, food insecure NMEs which export agricultural products do experience greater food purchasing power. Compared to the base scenario of an agriculture-only URAA extension by OECD countries, both food availability and food accessibility are unambiguously improved (for example, experience less deterioration) according to the indicators used here, while self-sufficiency ratios tend to increase less.

A global URAA extension relating to agriculture produces generally favorable results for the food security indicators. The food *availability* indicator (average consumption per capita) is higher in all countries and country groups compared to the base data or the initial OECD only scenario. The results for the self-sufficiency ratio, a proxy for food *stability*, are not uniformly higher or lower, although there is perhaps a slight tendency for a greater amount of production relative to consumption. *Access* to food by poorer consumers improves for most country or country aggregates. In general, those NMEs that impose greater barriers to food imports (see table 8.14) benefit the most from reform. Conversely, food purchasing power is lower in those NMEs that have generally lower import barriers and which are more reliant on trade, even though their total factor income is higher, as is the case in India, food insecure processed food exporters, and food neutral agricultural exporting countries. However, unlike the previous scenarios, the majority of food access indicators are positive in the event that NMEs join with OECD countries in reducing trade barriers and domestic support. Furthermore, they are uniformly better off than in the case where the URAA extension of agricultural policy reform is limited to OECD countries only.

The results of the final scenario, which imposes a reduction of trade measures across all sectors and domestic support to agriculture in all countries, offers improvements in food security according to most measures. The excep-

Table 8.17 Food Security Effects of Alternative Scenarios

Country or group		Food consumption		Food self-sufficiency		Unskilled labor	
Food security status	Trade position	Primary food	Processed food	Primary food	Processed food	Factor income	Purchasing power
(percent change from the base)							
SCENARIO: OECD, agriculture only							
Food insecure (INS)	AGREXP	0.2	0.2	0.0	4.3	0.9	0.0
	PRIEXP	0.0	0.0	-0.1	2.9	0.5	0.0
	PROEXP	-0.3	-0.1	5.1	17.2	2.8	-1.3
	INDIA	0.0	0.0	0.1	1.1	0.3	-0.2
	AGRIMP	-0.1	-0.1	0.4	1.5	0.5	-0.5
Food neutral (NEU)	AGREXP	-0.1	0.0	0.8	1.3	0.6	-0.5
	PROEXP	-0.1	-0.1	0.3	1.2	0.3	-0.2
	CHINA	-0.1	-0.1	0.4	0.6	0.2	-0.5
	AGRIMP	-0.1	-0.1	0.8	1.5	0.3	-0.5
SCENARIO: OECD, all sectors							
Food insecure (INS)	AGREXP	0.7	0.9	-1.2	2.0	3.2	1.5
	PRIEXP	0.0	0.0	-0.1	2.8	0.6	0.0
	PROEXP	-0.1	0.2	4.3	14.5	4.4	-0.5
	INDIA	0.0	0.1	0.1	0.6	1.3	-0.1
	AGRIMP	0.1	0.1	0.2	1.0	1.4	-0.2
Food neutral (NEU)	AGREXP	0.0	0.0	0.6	1.2	0.9	-0.4
	PROEXP	0.1	0.1	0.0	0.7	0.9	0.0
	CHINA	0.1	0.2	0.2	0.0	1.5	-0.3
	AGRIMP	0.0	0.0	0.5	1.2	1.1	-0.1
SCENARIO: All countries, agriculture only							
Food insecure (INS)	AGREXP	0.3	0.6	-0.6	2.1	0.7	0.4
	PRIEXP	0.0	0.1	-0.3	1.2	0.0	0.2
	PROEXP	0.2	0.9	3.5	14.2	2.6	-0.4
	INDIA	0.0	0.1	0.0	0.7	0.2	-0.5
	AGRIMP	0.1	0.2	-0.2	0.0	0.2	0.2
Food neutral (NEU)	AGREXP	0.0	0.2	0.6	0.7	0.6	-0.2
	PROEXP	0.2	0.2	-0.2	2.6	0.4	0.5
	CHINA	0.3	0.6	-0.4	-1.5	0.2	0.5
	AGRIMP	0.5	0.8	-2.4	-3.4	0.0	2.3
SCENARIO: All countries, all sectors							
Food insecure (INS)	AGREXP	0.7	1.2	-2.0	0.0	4.1	3.0
	PRIEXP	-0.1	0.0	0.0	1.8	-0.3	0.4
	PROEXP	0.4	1.3	2.7	11.7	5.4	1.8
	INDIA	-0.1	0.1	0.1	0.6	1.0	-0.1
	AGRIMP	0.1	0.3	-0.2	-0.4	1.3	0.7
Food neutral (NEU)	AGREXP	0.0	0.1	0.8	1.0	0.4	-0.1
	PROEXP	0.3	0.4	-0.5	1.1	2.0	1.2
	CHINA	0.4	0.8	-0.5	-2.0	1.9	1.2
	AGRIMP	0.7	1.0	-2.8	-3.7	0.9	2.9

tion is the self-sufficiency ratio, in which case the results are, again, mixed. The measure of average consumption indicates that food *availability* is mostly improved relative to the previous scenarios and certainly better than the base data for all but two country groups, namely food insecure exporters of primary agricultural products and India, in which cases the results are ambiguous or slightly negative. India and food neutral agricultural exporters experience slight reductions in food purchasing power, but unskilled labor earnings rise faster than food prices in most NMEs, allowing them greater *access* to food. In comparison to the first scenario of a URAA extension by OECD members for agricultural sectors only, the global and multisector reduction in market intervention and support generally lead to greater food *access* and food *availability*, as measured by the indicators employed in this study.

As a final point, a URAA extension for all sectors and by all countries at greater levels of reduction (for example, that cut rates of export subsidies and import barriers of all sectors and also of domestic support for agriculture by 50 percent) results in generally more positive effects on the aggregate food security indicators, with the exception of self-sufficiency ratios which sometimes deteriorate relative to the base data. Indicators relating to the food availability and to food access are generally improved, and the changes in these indicators are more significant than those resulting from the experiment of more modest reforms for all sectors in all countries, as shown by the results represented in table 8.18. The exceptions are those countries or country groups where some indicators decline relative to the base data, namely India, food insecure exporters of primary agricultural goods, and food neutral exporters of all agricultural goods. Overall, the greater reduction in support results in traded prices that increase by about two times the previous scenario effects, yet the aggregate measures of food security often show greater availability and access. These results derive from the offsetting effects of the increased efficiency that results from the halving of government intervention. Real GDP of food insecure and food neutral countries increases by at most 0.9 percent under the more modest, previous scenario (URAA extension for all sectors and all countries), but by as much as 1.2 percent when the URAA extension by all countries is more substantive, reducing support by half. Rising factor income of unskilled labor for food insecure and food neutral country groupings is associated with the GDP increases induced by the deeper cuts. In most cases, with the exceptions of two exporting country groups and India, average purchasing power and food consumption rise among these presumably poorer segments within these countries.

Summary of GTAP Results

The GTAP model is applied in the present study of NME food security. GTAP is a global general equilibrium model, so representation extends across all countries or regions and across all sectors. To facilitate analysis, some aggrega-

**Table 8.18 URAA Extension by All Countries and All Sectors,
Percentage Change from Base Data**

<i>Multilateral, multisector URAA extension at original levels of reduction</i>							
Country or group		Food consumption		Food self-sufficiency		Unskilled labor	
Food security status	Trade position	Primary food	Processed food	Primary food	Processed food	Factor income	Purchasing power
(percent change from the base)							
Food insecure (INS)	AGREXP	0.7	1.2	-2.0	0.0	4.1	3.0
	PRIEXP	-0.1	0.0	0.0	1.8	-0.3	0.4
	PROEXP	0.4	1.3	2.7	11.7	5.4	1.8
	INDIA	-0.1	0.1	0.1	0.6	1.0	-0.1
	AGRIMP	0.1	0.3	-0.2	-0.4	1.3	0.7
Food neutral (NEU)	AGREXP	0.0	0.1	0.8	1.0	0.4	-0.1
	PROEXP	0.3	0.4	-0.5	1.1	2.0	1.2
	CHINA	0.4	0.8	-0.5	-2.0	1.9	1.2
	AGRIMP	0.7	1.0	-2.8	-3.7	0.9	2.9
<i>Multilateral, multisector URAA extension at greater levels of reduction (-50%)</i>							
Country or group		Food consumption		Food self-sufficiency		Unskilled labor	
Food security status	Trade position	Primary food	Processed food	Primary food	Processed food	Factor income	Purchasing power
(percent change from the base)							
Food insecure (INS)	AGREXP	1.0	1.6	-3.1	0.2	5.6	3.8
	PRIEXP	-0.1	0.0	0.1	2.8	-0.4	0.6
	PROEXP	0.5	1.7	4.6	18.6	8.1	2.1
	INDIA	-0.2	0.0	0.2	1.3	1.3	-0.6
	AGRIMP	0.1	0.4	-0.2	-0.4	1.9	0.8
Food neutral (NEU)	AGREXP	-0.1	0.1	1.5	1.7	0.7	-0.4
	PROEXP	0.4	0.6	-0.7	1.8	2.9	1.6
	CHINA	0.5	1.1	-0.6	-2.8	2.8	1.5
	AGRIMP	0.9	1.3	-3.5	-5.2	1.2	3.8

tion of sectors and countries is required, but care is taken to preserve certain characteristics in the country groups relevant to the study. The base year is 1997, so these data represent a starting point to all analysis. To evaluate a policy scenario change, an alternate assumption is made about certain policy levers (represented as price wedges) and the model results are compared to the original base data without the policy change. Thus, food security indicators

can be projected for food *availability* and food *access* and, but less reliably for food *stability*, due to the absence of stocks in the model.

The empirical result of a scenario extending the URAA reforms for export subsidies, market access, and domestic support in OECD countries shows that the consequences for NMEs' food security tend to be small. The effect is mixed in terms of food stability. However, the conclusions from the GTAP analysis regarding food stability are limited in any case. This is because self-sufficiency, the food stability indicator produced from GTAP output, may not reflect the insulation of consumption from all sources of volatility. Turning to the conclusions regarding availability of, and access to, food, the indicators show a slight deterioration following the policy change. However, further analysis shows that a wider URAA type agreement that reduces trade measures and domestic support in agriculture and also trade measures in other sectors of OECD countries and the NMEs themselves could lead to greater availability and access to food. This result does not follow from large differences in average price effects of traded goods between liberalization scenarios, but rather from two other factors. First, lower barriers to transmission of border prices into NMEs allow the prices received by producers or paid by consumers to better align these agents' incentives within NMEs and across countries. Second, trade policy reforms are extended to sectors in which NMEs are likely to enjoy some comparative advantages, thereby raising their income and purchasing power.

These results are drawn from a general equilibrium analysis. While there are advantages of using this approach in terms of the broader scope of the analysis, which extends to all sectors, as well as all countries, the details of OECD policy representation are necessarily somewhat stylized. However, this analysis serves to complement the partial equilibrium results, as reported earlier, based on the Aglink model with its more detailed representation of OECD agricultural trade and domestic policies.

CONCLUSIONS

One of the conclusions of this report is that trade liberalization based on a continuation of the URAA spanning all sectors and all countries has small, but noticeable and positive effects for the global food security situation in NMEs. This result derives primarily from two sources: lower barriers to trade on the part of NMEs and extension of trade policy reforms to sectors in which NMEs are likely to enjoy some comparative advantage, thereby raising income levels and their purchasing power, with some exceptions. From the narrow perspective of macro-level food security, the implication is that it would be mildly beneficial for NMEs, overall, to participate fully in a broad, multisectoral round of trade and market liberalization.

This report also concludes that an extension of URAA reforms by OECD countries alone has very small and generally negative impacts on the average

food security situation in NMEs. These small effects follow from three factors. First, OECD policy changes entailed by an extension of URAA reforms result in relatively small changes in world cereal prices. Second, many NMEs are not well integrated with the world market, as manifest in low price transmission and low market response in many domestic markets to changing world prices, often due to their own import barriers and infrastructure deficiencies. And finally, NMEs rely on certain staple food commodities for a share of their consumption which are not directly affected by OECD policies. Moreover, when more substantial OECD agricultural policy reform is examined rather than an extension of the URAA commitments, the direct price effects on global food security indicators remain relatively small. These results indicate that concerns about the possible negative effects of OECD agricultural policy reform on global food security may not be justified.

Nevertheless, food security in individual NMEs or in selected groups of people within a NME could certainly be affected more significantly than the changes measured by the indicators based on averages calculated at the aggregate or national level. Producers in NMEs who must now compete against OECD export subsidies or who cannot access OECD markets due to high trade barriers would benefit if such distorting trade measures were reduced. On the other hand, food insecure importing countries that benefit in the short term from lower import prices resulting from OECD export competition measures may face higher import prices if such measures are further disciplined. Exporting NMEs with preferential trade access arrangements might lose in the short term if these arrangements are eliminated or eroded through trade reforms.

Like any empirical analysis, this study has certain limitations, as described in different parts of the text. For example, the assumption that perfect competition offers a useful representation of world markets is maintained throughout the study, as is the assumption of homogeneous goods when generating certain model results. Perhaps the most important in terms of generalizing the results is the focus of the analysis on a narrow facet of the food security issue—the impact of trade reform. The results of the study, based on a continuation of policy reforms comparable in size to the URAA commitments, indicate that the medium-term implications of trade reform are not fundamental to the broader food security problem faced by many of these countries. In addition, it may be argued that the model results may understate the longer-term impacts. For example, sustained price increases might attract additional investment, leading to deeper penetration of markets in NMEs which may not have been well integrated with the world market in the past. Long-term effects are not represented in the empirical analysis underlying the present study, so no strong conclusions can be reached. However, to the extent that higher commodity prices in world markets or a reduction in NMEs' own policies that distort resource allocations encourage greater investment, liberalization might be expected to have long-run effects of increasing the productivity and, consequently, the wealth of these countries, with positive impacts on their food secu-

rity. If liberalization encourages deeper market penetration so that more regions within NMEs can choose food self-reliance, instead of being forced to attempt food self-sufficiency in the absence of trade opportunities, then the food security of individuals in these regions may also be improved. However, these possible longer-term impacts do not fall within the more narrowly defined scope of the present study, but are perhaps more closely related to the links between trade and poverty reduction and to the broad issue of economic development.

NOTES

1. The term nonmember economy (NME) is used throughout the document to refer to any country or economy that is not an OECD member.
2. Quote from FAO (1996).
3. The Ministerial Decision on Measures Concerning the Possible Negative Effects of the Reform Programme on Least-Developing and Net Food-Importing Developing Countries of the Final Act of the Uruguay Round recognizes that “during the reform programme leading to greater liberalization of trade in agriculture least developed (LDCs) and net food importing developing countries (NFIDC) may experience negative effects of the availability of adequate supplies of basic food-stuffs from external sources on reasonable terms and conditions, including short-term difficulties in financing normal levels of commercial imports of basic food-stuffs.” Special and differential treatment of developing countries covered a range of other matters as well as longer implementation period, special exceptions, best effort indications, and technical assistance. However, at present, many developing countries have expressed dissatisfaction with the implementation of the special and differential treatment.
4. First, both model frameworks focus on medium-term results. Neither Aglink nor GTAP address long-term adjustments, such as the effects of investment or resource shifts which are more likely to be significant over a longer time horizon. Thus, the horizon for the policy effects and food security results of this study is medium term, approximately five years ahead. Second, both frameworks rely on certain assumptions common to partial equilibrium and general equilibrium analyses. Both assume that groups of different classes of commodities can be usefully aggregated for the purposes of understanding the market impacts (homogeneity of goods), and no single participant in the market has significant power over the market outcome (perfect competition). In the case of Aglink, the assumption of homogeneity of goods is generally extended to world markets, whereas GTAP allows imperfect substitution across exporters. As regards resource allocation, GTAP relies on the assumption that resources are perfectly mobile across uses within a country, with the exception of land in which case factor mobility is considered to be sluggish even after a medium-term adjustment period. Third, this study does not recognize food aid explicitly within national exports or imports. While food aid is important for food security and might be considered an OECD trade policy, it is not at this time clear to what extent food aid and commercial trade are substitutes. Nor is it clear the extent to which a food aid allocation would shift to offset any negative effects of a liberalization of other OECD trade policies. Instead of explicitly representing food aid in this study, any quantities of food aid imports are reflected in the quantities of the existing trade positions and in the parameters of the equations governing how these trade volumes respond as prices change.

5. For example, WFM has oilseed meal and vegetable oil aggregates, including oilseed equivalents, whereas Aglink specifies oilseeds separately from oilseed products. Similarly, the milk aggregate of WFM does not correspond to any one product in Aglink. In order to close crop and crop product markets, the “rest of world” aggregates of Aglink were replaced with the individual countries of the WFM. The oilseed and oilseed product trade variables were reconciled by assuming fixed shares in the projection period. While the WFM countries’ livestock product markets are modeled in a manner analogous to the crops, the “rest of world” aggregate of Aglink was not replaced by the WFM countries. These countries generally are not key players in livestock product markets or, where important, may already be identified in Aglink. In addition, livestock products are not as critical to food security as crop and crop products. In any case, Aglink has only a partial representation of many world livestock product markets as splintered by region or quality and it is not immediately apparent how each NME should be represented in such a framework.
6. A floor price may cause asymmetric responses in that the market response to changing world prices may differ depending on whether prices are above or below the trigger level. Similarly, quantity limits on production or trade may affect how—or even if—agents respond to changing market prices. On the other hand, non-negativity conditions on quantities produced and consumed could restrain market response.
7. The starting point varies slightly from the 2000 OECD Agricultural Outlook, particularly in the case of the market access work. In order to introduce the substantial model changes necessary to complete the analysis of tariffs and tariff-rate quotas, the baseline solution no longer matches the original Outlook, but the deviations tend to be relatively small and are not reported here.
8. The underlying assumptions may not be entirely consistent. In particular, the macroeconomic data are not consistent in that economic growth rates and exchange rates for country models of Aglink are late 1999 or early 2000 projections whereas the FAO assumptions are likely to be from late 2000. These exogenous data are not really independent, however, and it would be preferable to draw all macroeconomic data from a single source at a single point in time. This potential limitation is not extremely relevant to the current analysis because our focus is not on the macroeconomic circumstances, but do lessen the consistency of the baseline assumptions.
9. From 2000 to 2005, the prices of rice, wheat, and coarse grains (as represented by the maize price) increase by 12 percent, 25 percent and 19 percent, respectively. As regards other markets, the prices of the oilseed complex also increase, with oilseed prices rising by 16 percent and vegetable oil and oilseed meal by 20 percent and 13 percent respectively. Meat prices increase within the same range as crop prices whereas dairy prices exhibit stronger growth of 21 percent to 35 percent, depending upon the product.
10. The FAO recently revised Chinese grain stocks higher by 250–300 kt. However, this adjustment is not taken into account in the present study.
11. Transmission of world prices to Chinese domestic prices is also relatively low. The relevant agricultural commodity markets of China are already represented in Aglink, so they need not be derived from WFM.
12. The first scenario of the current study is restricted to an extension of the URAA export subsidy restrictions in order to be consistent with the Aglink market access scenario and the GTAP scenarios. Another change from the original report in order to maintain consistency across the scenarios reported in the text regards government stock-holding. In the export subsidy elimination scenario of the original

report, automatic policies to purchase stocks at support prices (for example, into EU cereal intervention stocks) were suppressed in order to achieve a more sustainable long-term solution without rapidly growing stocks and with lower prices. Thus, market prices fell below government support prices for OECD member commodities where government intervenes by purchasing stocks. In the first scenario of the present study, the URAA extension represents a smaller change to government policy than the export subsidy elimination, so the results are perhaps sustainable although government stocks do continue growing throughout the baseline in some cases. Still, the export subsidy scenario with automatic government stockholding activated is consistent with the market access scenario. In any case, the export subsidy elimination scenario is reproduced in the present report, as summarized in the main text.

13. The method employed here is the same as is used in the preliminary market access work. However, the addition of the NME representations derived from WFM and the merge of the two alternate baselines has created some differences. These are small and are not reported, but they will change both the starting point of the analysis (the baseline) and the response of developing countries (in that the rest of world crop aggregates of Aglink have been replaced by the sum of the developing countries).
14. Using the Agricultural Market Access Database (AMAD), tariff-rate quota (TRQ) data are identified for several OECD members and for the Aglink commodities. The list of countries for which some TRQs are represented are: Australia, Canada, the European Union, Korea, Japan, Poland, and the United States. The list of commodities where TRQs are relevant and modeled varies by country, but includes beef, butter, cheese, coarse grains, oilseeds, oilseed meal, pork, rice, skim milk powder, and wheat. Aglink is revised in order to allow a switching regime in which the domestic price in the presence of an import TRQ is allowed to range from the world price with in-quota tariff up to the world price with over-quota tariff and internal price clearing in between, with corresponding imports below, above, or at the quota level, respectively. Moreover, these changes are reconciled with Aglink data on domestic and world prices and also with the constraints imposed by domestic policy depending upon the circumstances of a particular country and commodity pair.
15. The preceding section used a different empirical tool, Aglink, to do two different scenarios: an extension of URAA export subsidy reductions and an extension of URAA market access augmentations. The implementation is described in other documents, but it merits noting that the commitments were usually recognized explicitly. As stated earlier, by identifying and then lowering the limits, the results depended in part on the baseline: If the use of a particular country's trade policy for a given commodity did not approach the URAA limits in the baseline projections, then the scenario was unlikely to have any effect on the imports or exports of that commodity.
16. In the GTAP version 5.3 database, there are no data available for each bilateral trade flow and for each internal price wedge to indicate the degree by which bounds on support exceed applied rates of support, if at all.
17. On the other hand, the differing treatment of policies in the two frameworks precludes easy comparisons across the model results. Thus, while results may appear to differ at times, the differences are more modest if care is taken to identify those variables that are comparable. For example, some part of any apparent discrepancy may be caused by the definition of the markets for world or traded goods, reflecting the different assumptions regarding homogeneity/heterogeneity of products in world markets. Perhaps a more useful comparison is to other recent studies using a

similar framework, such as USDA/ERS (2001). Even in this case, although the results appear to be similar in broad terms, the two studies differ in terms of base data, country and commodity aggregation, and scenario design, so a more detailed examination of the results is not presented here

18. Note that these are real prices relative to the numeraire (the traded price index of primary factors). Moreover, the experimental design assumes most sources of income growth are set at exogenous levels: factor endowments are constant and no productivity growth is assumed to occur. Consequently, the GDP gains in a policy change scenario that arises from improved allocation of existing resources rather than from the application of some new pool of resources or from a rise in productivity in any country or country group—even though the changing prices may encourage greater investment that, in turn, eventually would lead to an expansion in capital and productivity. This caveat highlights the medium-term nature of the results
19. The scenario lowers the price wedges that benefit cereal and oilseed production, leading to lower production of these commodities. As a consequence of falling output quantities and any reduction in price wedges applied on land rented/purchased for these uses where existing domestic support based on area is reduced, the input demand by these sectors for land decreases, leading to falling land prices. Other crops compete against cereals and oilseeds for inputs, particularly land, so this sector benefits indirectly from the policy reform as input prices decrease, whereas other crops receive relatively little government support in OECD countries so there are few offsetting direct effects in the URAA extension scenario.
20. In comparison with the change in food consumption results (also represented in table 8.16) the decrease in purchasing power of low-skilled laborers for food insecure agricultural exporters is more pronounced for all regions. This indicates that unskilled labor wages do not increase as fast as total domestic income. The main reason for this is that land prices, the specific factor in agriculture, increases more. This is especially true for the agricultural exporters. In this context, it is important to reiterate the assumption that the unskilled labor is perfectly mobile across uses within a country/region, whereas land is assumed not to be perfectly mobile. If the assumption of perfectly mobile unskilled labor over a medium-term horizon were relaxed, labor markets would be more segmented and the impact of the various scenarios on factor income accruing to unskilled labor might resemble the results for the factor income of land.

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