Winners and Losers

IMPACT OF THE DOHA ROUND ON DEVELOPING COUNTRIES

Sandra Polaski

CARNEGIE ENDOWMENT
for International Peace

Winners and Losers

IMPACT OF THE DOHA ROUND ON DEVELOPING COUNTRIES

Sandra Polaski

CARNEGIE ENDOWMENT
for International Peace

For electronic copies of this report, visit **www.CarnegieEndowment.org/trade**. Limited print copies are also available. To request a copy, send an e-mail to pubs@CarnegieEndowment.org.

Carnegie Endowment for International Peace

1779 Massachusetts Avenue, N.W.
Washington, D.C. 20036
202-483-7600
Fax 202-483-1840
www.CarnegieEndowment.org

About the Author

Sandra Polaski is senior associate and director of the Trade, Equity, and Development project at the Carnegie Endowment. Before joining the Endowment, she served as the U.S. Secretary of State's special representative for international labor affairs, the senior State Department official dealing with such matters. She played a leading role in the development of U.S. government policy on international labor issues, and integrated those issues into U.S. trade and foreign policy. Prior to that, she was the director of research for the North American Commission on Labor Cooperation, a NAFTA-related intergovernmental body.

Cover photo: Tomasz Tomaszewski/National Geographic Image Collection

Table of Contents

Acknowledgments

This report is the product of a team organized by the Trade, Equity, and Development Project of the Carnegie Endowment for International Peace, which included external experts as well as Carnegie staff. It was led by project director Sandra Polaski. The team consisted of chief modeler Zhi Wang, expert advisor Sherman Robinson, researchers Kate Vyborny and Jennifer Maul, program assistants Gretchen Smith and Nicole Brown, copyeditor Alfred F. Imhoff, designers Laurie Rosenthal and Pete Lindeman, and production manager Phyllis Jask.

We are deeply grateful to the Rockefeller Foundation and its Global Inclusion Program for generous funding and continuous engagement and support throughout the project.

We benefited greatly from the comments, criticisms, and questions of numerous policy makers, modelers, and other economists as we presented early versions of the model results and implications at meetings in Geneva, Washington, Brussels, and Paris.

The work of external modelers and experts does not imply any responsibility for the contents of the final report or for any remaining errors, which rests with the main author, Sandra Polaski. The policy conclusions and recommendations are also those of Sandra Polaski, and they do not necessarily represent the views of the Carnegie Endowment for International Peace or those of the external experts or the institutions with which they are affiliated.

List of Tables, Figures, and Boxes

Tables

Figures

Boxes

Overview of the Report

World trade negotiations appear to be stalemated. Meeting in Hong Kong in December 2005, trade ministers from World Trade Organization (WTO) member countries were unable to bridge major disagreements in the Doha Round negotiations, so called because they were launched in Doha, Qatar, in 2001. Why are these negotiations so difficult? The answers lie mainly in the developing world.

A Changing World of Trade

The global trade regime expanded during the past two decades to encompass most developing countries, including China, which was outside the capitalist trading system in earlier rounds of trade talks. Countries like India were less engaged in earlier rounds, reflecting economies that were largely closed at the time. Now, however, these fast-growing countries have become major players in the global economy and global trade regime. As they join global trade negotiations, they bring their own offensive and defensive concerns. Some want to liberalize sectors in which they are competitive, such as agriculture, textiles, and apparel—the same sectors that are the most protected in wealthy countries, reflecting strong domestic constituencies resistant to change. Developing countries also have defensive concerns. Many of them have agricultural sectors that employ large shares of their population but are not competitive in global markets. And many want to maintain trade barriers to nurture fledgling domestic manufacturing and service sectors. The different priorities of developed and developing countries make it inevitable that current and future bargaining rounds will be more complex and difficult than past negotiations.

What would it take to produce a global trade agreement that addresses the interests of both developed and developing countries? To analyze the underlying economic interests of the WTO's diverse members and the potential effects of the Doha Round negotiations, the Trade, Equity, and Development Project of the Carnegie Endowment for International Peace commissioned a model of global trade as a tool to estimate the impact of different trade policy scenarios. It is one of the newest in a series of models built to analyze the Doha Round, using the latest global trade data.

In comparison with other models, the Carnegie model makes several improvements. Most notable are more accurate representations of the way labor markets function in developing countries. Most models assume that all labor, including unskilled labor, is fully employed. Yet this assumption is far from the reality of developing countries. The Carnegie model incorporates actual unemployment rates. Most models treat agricultural labor as identical to urban

unskilled labor, an inaccurate assumption that can produce inaccurate results. The Carnegie model treats agricultural labor markets separately from urban unskilled labor markets in developing countries. These innovations make the Carnegie model more accurate in gauging the impact of trade policies on countries with large unskilled and agricultural labor forces.

The Carnegie model was used to simulate a range of plausible outcomes from the Doha Round. The central scenario anticipates an ambitious expansion of market access for manufactured goods, a more modest expansion for agricultural products, reductions of domestic subsidies and elimination of export subsidies for agricultural products. It requires lesser measures by developing countries and none by the least developed countries (LDCs), based on guidelines already agreed. A second main scenario was constructed after the Hong Kong meeting to simulate agreements reached there. In this scenario, the same level of tariff cuts is applied to both agriculture and manufacturing. The reductions are set at levels close to proposals that are now on the negotiating table.

Findings That Defy Conventional Wisdom about the Doha Round

The most important finding at the aggregate, global level is that *any of the plausible trade scenarios will produce only modest gains, on the order of a one-time increase in world income of $40 to $60 billion.* This represents an increase of less than 0.2 percent of current global gross domestic product (GDP). The limited nature of the gains from the Doha Round goes far in explaining the lack of urgency demonstrated by WTO negotiators. Given relatively low gains, the adjustment costs to which countries expose themselves when they change trade policies may loom larger than in the past. Losses of existing jobs and firms are often more painful politically than potential gains in future growth. Major countries are likely to insist that any agreement must accommodate their main defensive interests. As a result, the Doha Round will probably achieve only modest changes in any sector.

The modest overall gains would have quite different economic effects on different countries and regions. *There are both net winners and net losers under different scenarios, and the poorest countries are among the net losers under all likely Doha scenarios.* At the country level, maximum gains or losses are about 1 percent of GDP for the most affected economies. The biggest gainer is China, with gains ranging from 0.8 to 1.2 percent of GDP under different scenarios. The biggest losers are some Sub-Saharan African countries, which see a reduction in income of just under 1 percent. Most countries' gains or losses range from 0 to 0.5 percent of current GDP.

Among developing countries, about 90 percent of the gains from Doha scenarios would come from liberalization of trade in manufactured goods. Most developing countries gain from liberalization of trade in manufactured goods, with China gaining the most and Asian countries gaining more than Latin American and African countries.

The benefits of agricultural trade liberalization flow overwhelmingly to rich countries, while developing countries actually suffer slight losses as a group. There are great differences in the impact on different developing countries. A few countries gain, notably Brazil, Argentina, and Thailand, but more suffer small losses from agricultural liberalization. The losers include many of the poorest countries in the world, including Bangladesh and the countries of East Africa and the rest of Sub-Saharan Africa. Middle Eastern and North African countries, Vietnam, Mexico, and China also experience losses.

These results run counter to a commonly held view about the Doha Round, that agricultural liberalization benefits developing countries and will augment their growth and development. Instead, agricultural liberalization benefits only a relatively small subset of developing countries, whereas manufacturing liberalization is more important to most developing countries.

There are several reasons why the developing world does not gain broadly from agricultural liberalization. Many poor countries are net food importers. Many lose relative advantages they now enjoy under special preference programs. However, a more fundamental problem arises from the reality that low-productivity, small-scale subsistence farming makes up a large portion of agricultural activity in many developing countries. The products of subsistence farmers are generally not competitive on global markets.

The pervasiveness of noncompetitive, small-scale farming in many developing countries has led them to demand special consideration for their agricultural sectors in the Doha Round. To test the impact on other countries of taking account of these agricultural concerns, we simulated a scenario in which developing countries are allowed to shield agricultural products from tariff liberalization. The results of this scenario are surprising and important. *Special treatment could be extended with only minor reductions in other countries' gains from the Doha Round, even for countries that are major agricultural exporters.* As for the developing countries themselves, India and Vietnam experience slightly greater overall income gains under this scenario, despite some loss of efficiency in their economies from continued tariffs. Bangladesh and the East African countries experience smaller losses if these exceptions are allowed.

Another striking result from the model is the possibility that the poorest countries may lose from any agreement unless *additional* special measures are taken on their behalf. *The results show that Bangladesh, East Africa, and the rest of Sub-Saharan Africa are adversely affected in almost every scenario.*

Although the Carnegie model was constructed primarily to assess the impact of the Doha Round on developing countries, interesting results also emerge for the developed world. All high-income countries and regions experience small gains from the main scenarios, and the gains come mainly from the liberalization of manufactured rather than agricultural goods. The United States gains more from liberalization of manufacturing than of agriculture. For the fifteen Western and Central European members of the European Union (EU) and for Japan, manufacturing accounts for most gains, but agriculture contributes a greater share of gains than in the United States, as higher levels of distortions are removed in the EU and Japan. The gains are not without a cost, however. Income from farmland declines dramatically, by 26 percent in the EU and 23 percent in Japan.

World export and import prices for all agricultural products increase under the main scenarios. By contrast, *liberalization of manufactured goods intensifies competition in several manufacturing sectors—including apparel, metal products, and motor vehicles and parts—and world prices decline slightly.* These price trends are at odds with a long-standing historical pattern of declining prices for agricultural commodities relative to manufactured goods.

Trade liberalization for manufactured goods increases demand for unskilled labor in most of the developing world. *However, wages do not increase*, due to the abundant supply of labor and the fact that liberalized trade in labor-intensive manufactures drives down world prices for such goods. Under the main scenarios, employment of unskilled labor

increases by about 1 percent in the manufacturing sector for developing countries as a group, although the gain is unevenly distributed among countries and across manufacturing subsectors. Increases in unskilled employment of 1 percent or more are realized by China, Indonesia, the other members of the Association of Southeast Asian Nations (ASEAN), and India. Once again, *the three poorest countries/regions in the model (Bangladesh, East Africa, and the rest of Sub-Saharan Africa) actually lose unskilled jobs in manufacturing industries.* Income for agricultural labor and land increases in developing countries, except in Mexico, India, Bangladesh, and Vietnam. For developing countries as a group, agricultural employment barely increases (0.17 percent) under the main scenarios, but is somewhat more robust under the special scenario for developing country agriculture (0.3 percent).

Global trade models do not capture the costs incurred as economies adjust to trade reform, with some labor and capital idled by changes in trade patterns. At least in the short term, this will subtract from overall income gains and have a potentially large negative impact on the affected individuals and households. As a result of omitting these costs, models tend to systematically overstate the gains from trade or understate the losses. The effects are likely to be relatively greater in developing countries, because they have less diversified economies, with fewer alternative sources of employment than developed countries.

From the Perspectives of Equity and Poverty, a Complicated Picture Emerges

The overall gains to the world are divided fairly evenly between the developed and developing worlds. *The big winner in the developing world, China, is also home to large numbers of poor people, with more than 200 million living on less than $1 per day and an additional 600 million living on less than $2 per day.* A Doha pact that lowers tariffs in low-skilled manufactured products could increase employment there and boost the incomes of the poor. *However, in the countries that lose from the Doha Round, including Bangladesh and many countries in Sub-Saharan Africa, there are even more desperately poor people (267 million) living on less than $1 per day and almost as many very poor people (486 million) living on less than $2 per day.* Most of the world's poor people are concentrated in rural areas and depend on agriculture for their incomes. This is true in China, Bangladesh, and Sub-Saharan Africa, as well as in other countries that have large numbers of poor people, most notably India. All of these countries lose from agricultural liberalization. Whether a pact would help or hurt their poor citizens on a net basis depends heavily on the details of the outcome. For example, *countries like India, Indonesia, and Kenya will require exceptions for the products produced by their subsistence farmers if they are to avoid increases in poverty.*

Comparison with Other Trade Models

This report compares results from the Carnegie model with several other models, including the newest World Bank model. On some of the most surprising results, other models show similar patterns, although these results often are not highlighted in reports on those models.

Conclusions and Recommendations

It is important not to overstate the possible gains from the Doha Round, as has been done by many political leaders, commentators, and activists. It has been fashionable to state that trade can do more than development aid to lift

people out of poverty in developing countries. Though this may be theoretically true, it is clear from the Carnegie model and a close study of most other recent models that trade is not a panacea for poverty alleviation or for development more generally. Trade is one factor among many that can contribute to economic growth and rising incomes, but its contribution is likely to be very modest. At the same time, changes in existing trade policies can also cause economic contraction and must be designed and implemented with great care. An unrealistic expectation of gains can lead to pressure for inappropriate policies and could create a bandwagon effect where the very legitimate defensive concerns of developing countries are ignored to achieve illusory gains. Errors in analysis can lead to increases in poverty, not the hoped-for reductions, in a broad range of developing countries. For the poorest countries, where there is little margin for error, the risks are particularly acute.

The report concludes with a set of recommendations meant to address the interests and problems of the developing world in the Doha Round. These include:

- Many developing countries will require very long phase-in periods and a careful sequencing of sectoral liberalization measures, to take account of the impact of trade changes on their less diversified economies.
- Special treatment for developing country agricultural sectors will be needed because of the high concentrations of employment in those sectors and the long and difficult process of raising productivity levels and developing new skills among the hundreds of millions of subsistence farmers in the world.
- The Doha Round should include additional development assistance for agriculture in developing countries, because the transition to more modern sectors will require resources beyond what is domestically available in poor countries. Major new aid commitments by multilateral development agencies and bilateral donors are needed.
- For the LDCs, additional measures will be needed to ensure that they are not net losers from the Doha Round. In Hong Kong, developed countries agreed to extend duty-free and quota-free market access for most exports of LDCs; however, their most competitive products can be excluded. The agreement should be extended to include all products of LDCs by a firm future date. The final plan should also eliminate cumbersome rules of origin that block imports of some products from LDCs and reduce their opportunity to achieve economies of scale.
- Middle-income countries should also extend this access to the LDCs. China established a positive precedent by offering preferential access to many products of the least developed ASEAN members as part of a regional free trade agreement, although there are many exceptions. Preferential access should be extended by other middle-income developing countries and by China to LDCs in other regions.
- A solution must also be found for the group of low-income countries that are just above the threshold for LDC status, because they may be made worse off by the effort to help the poorest. Some access to the special benefits should be extended to these countries as well.
- Trade adjustment assistance programs for poor people in low-income countries should be part of a Doha package. This can be done through multilateral development agencies, such as the World Bank, or through bilateral assistance. To date, such programs have not been adopted or even discussed. They should be added to the Doha agenda.

CHAPTER 1

Introduction: A Changing World of Trade

Efforts to liberalize global trade through the World Trade Organization (WTO) have made limited progress since the current round of negotiations was launched in Doha, Qatar, in 2001. Meeting in Hong Kong in December 2005, trade ministers from the 149 WTO member countries resolved only a few issues, while postponing the deadline for resolution of the main controversies until April 30, 2006. Despite the presence of the most senior negotiators and the glare of media attention, member countries were unable to break stalemates that exist in virtually every major area of the negotiations.

Why are these negotiations so difficult? The answers lie mainly in the developing world. Earlier trade rounds primarily involved developed countries and addressed their priorities. During the past twenty years, however, the global trade regime has expanded to include most of the developing world, including communist countries such as China, which were outside the capitalist trading system in earlier rounds of trade talks. India and a number of smaller countries were less engaged in earlier rounds, reflecting economies that were largely closed at the time. The relative weight of these countries in the global economy has grown enormously over the same period, and it will continue to expand due to higher rates of growth in these countries compared with mature economies.

As developing countries join global trade negotiations, they bring their own offensive and defensive concerns. Offensively, they want to liberalize sectors in which they are competitive, such as agriculture, textiles, and apparel. These sectors were liberalized least in earlier trade rounds, due to strong domestic constituencies in developed countries. The developing countries also have their own defensive concerns, often involving agricultural sectors that employ large shares of their population but are not competitive in global markets, or even in domestic markets in the absence of tariffs. Many are also concerned defensively about manufacturing and service sectors, where they hope to nurture domestic industries behind trade barriers. In most developing countries, growing manufacturing and service sectors are seen as essential to absorb growing labor forces and large numbers of low-income, low-productivity farmers.

The different priorities of developed and developing countries make it inevitable that current and future bargaining rounds will be even more complex and difficult than past negotiations. At the same time, the size and high growth rates of many developing economies mean that their presence in the global trading system is welcome. In recognition of the new reality, the current negotiations were named the "Doha Development Round" and were launched with a commitment by wealthy countries to pay

special attention to the needs and interests of developing countries. Arguably, without this commitment to redress perceived imbalances in the global trading system that favored rich countries, the launch of negotiations would not have been possible. After 2001, however, the interests of developing countries did not receive the promised prioritization. The summit of trade ministers held in Cancún, Mexico, in 2003 broke down in acrimony, largely due to these countries' perception of their continued marginalization in the negotiations. At the Hong Kong ministerial, at least some progress was made on the demands of the poorest countries, although most of these concessions will take effect only if the talks produce an overall agreement, an achievement that still appears out of reach.[1]

What would it take to reach a global trade agreement that addresses the interests of developing countries and holds the potential to lift their incomes, while at the same time offering sufficiently expanded opportunities for developed countries to win their assent? Answering this question is not a simple matter. Global trade is carried out through myriad two-way trade relationships between countries that have different sets of assets, capabilities, and vulnerabilities. Differences in the size and skills of workforces, suitability for cultivating different agricultural crops, and amount of capital available for investment mean that a particular trade rule change will affect countries differently. Finding a mix of trade policy changes that offers opportunities for all, or even for most, is complex and difficult.

To analyze the underlying economic interests of the WTO's diverse members and to identify combinations of trade policies that would produce widely distributed benefits, the Trade, Equity, and Development Project of the Carnegie Endowment for International Peace commissioned an applied general equilibrium (AGE) model of global trade.[2] AGE models are computer-based simulations of how economies work. In the case of global trade models, the entire world economy is modeled, including the maze of bilateral trade relationships.

Once such a model is built, it can be used as a laboratory for policy experiments in which various policies are changed and the results are traced through the model for their impact on different sectors, different economic actors, and the overall welfare of countries and the global economy. The Carnegie model was used to simulate the impact on different countries and regions of various trade proposals that approximate those under consideration in the Doha Round. Scenarios were constructed that capture plausible outcomes from the round.

This report presents the results of these trade policy simulations. The model and a description of how it represents the world's economies are presented in chapter 2, with a more detailed specification of the model provided in appendix A and a sensitivity analysis in Appendix B. In chapter 3, the main results of the trade policy simulations are reported. Chapter 4 provides an overview of several other important models and a comparison of their structures and results. In chapter 5, the conclusions and implications that can be drawn from the Carnegie model results are discussed and policy recommendations are presented.

CHAPTER 2

A Description of the Model

The Carnegie model is one of the newest in a series of models built for the purpose of analyzing and projecting possible impacts of the Doha Round. Applied general equilibrium (AGE) trade models create a simulation of the workings of actual economies as they engage in trade, represented through an extensive series of equations that establish the relationships between economic variables. The AGE model used in this analysis shares many basic features with other current models. The important distinguishing features of this model are discussed below.

The Carnegie model is a multicountry, multisector general equilibrium model. It uses data from the Global Trade Analysis Project (GTAP) database Version 6.0, the newest compilation of global trade data, which is used in most recent major models.[3] Additional data are drawn from various national and intergovernmental sources, as noted where the data appear. The data are used to construct a baseline representation of the current global economy. This serves as a basis for comparison with the impact of simulations of different trade policy scenarios, such as those that might be agreed in the World Trade Organization (WTO). The scenarios are described below. The results of the simulations show changes in prices, terms of trade, and net trade volumes induced by different trade policy changes, along with changes in returns to factors of production (land, labor, and capital) and employment. The model also captures gains from the more efficient use of resources and from the transfer of technology, which increases as trade barriers are lowered. Technology transfer is assumed to flow in one direction—from more developed regions to less developed regions.

The model is global in scope, covering all countries (including nonmembers of the WTO). To make global models computable (and because of data limitations) it is necessary to aggregate smaller countries. In the Carnegie model, eleven large countries, including nine developing countries, are modeled separately, and the remaining countries are aggregated into thirteen regions (table 2.1). The model covers all sectors, including agriculture, manufacturing, and services. Again, due to the technical limitations of models, sectors must be aggregated into a workable number. In the Carnegie model, there are twenty-seven sectoral aggregations (table 2.2). There are six factors of production: agricultural land, natural resources, capital, agricultural labor, unskilled labor, and skilled labor. The way labor is modeled for developing countries, which is unique to the Carnegie model, is discussed below. The model incorporates considerable detail on domestic production and consumption within each country or region as well as international trade flows at the bilateral and global levels. A fuller technical discussion of the model is found in appendix A.

Table 2.1 Countries and Regions in the Model

Region	Country
China	China
Indonesia	Indonesia
Vietnam	Vietnam
Rest of ASEAN	Brunei
	Cambodia
	Laos
	Myanmar
	Philippines
	Thailand
	Timor-Leste
India	India
Bangladesh	Bangladesh
Rest of South Asia	Afghanistan
	Bhutan
	Maldives
	Nepal
	Pakistan
	Sri Lanka
Russia and Former Soviet Union	Armenia
	Azerbaijan
	Belarus
	Estonia
	Georgia
	Kazakhstan
	Kyrgyzstan
	Latvia
	Lithuania
	Moldova
	Russia
	Tajikistan
	Turkmenistan
	Ukraine
	Uzbekistan
Middle East and North Africa	Algeria
	Bahrain
	Egypt
	Iran
	Iraq
	Israel
	Jordan
	Kuwait
	Lebanon
	Libya
	Morocco
	Oman
	Palestinian Territory
	Qatar
	Saudi Arabia
	Syria
	Tunisia
	Turkey
	United Arab Emirates
	Yemen
South Africa	South Africa
East Africa	Malawi
	Tanzania
	Uganda

Region	Country
Rest of Sub-Saharan Africa	Angola
	Benin
	Botswana
	Burkina Faso
	Burundi
	Cameroon
	Cape Verde
	Central African Republic
	Chad
	Comoros
	Congo
	Côte d'Ivoire
	Democratic Republic of Congo
	Djibouti
	Equatorial Guinea
	Eritrea
	Ethiopia
	Gabon
	Gambia
	Ghana
	Guinea
	Guinea Bissau
	Kenya
	Lesotho
	Liberia
	Madagascar
	Mali
	Mauritania
	Mauritius
	Mozambique
	Namibia
	Niger
	Nigeria
	Rwanda
	São Tomé and Príncipe
	Senegal
	Seychelles
	Sierra Leone
	Somalia
	Sudan
	Swaziland
	Togo
	Zambia
	Zimbabwe
Brazil	Brazil
Mexico	Mexico
Argentina	Argentina
Rest of Latin America	Bolivia
	Chile
	Colombia
	Ecuador
	Falkland Islands (Malvinas)
	French Guiana
	Guyana
	Paraguay
	Peru
	Suriname
	Uruguay
	Venezuela

Table 2.1 (continued) Countries and Regions in the Model

Region	Country
Central America and Caribbean	Anguilla
	Antigua and Barbuda
	Aruba
	Bahamas
	Barbados
	Belize
	British Virgin Islands
	Cayman Islands
	Costa Rica
	Cuba
	Dominica
	Dominican Republic
	El Salvador
	Grenada
	Guadeloupe
	Guatemala
	Haiti
	Honduras
	Jamaica
	Martinique
	Montserrat
	Netherlands Antilles
	Nicaragua
	Panama
	Puerto Rico
	Saint Kitts and Nevis
	Saint Lucia
	Saint Vincent and the Grenadines
	Trinidad and Tobago
	Turks and Caicos
	U.S. Virgin Islands
Rest of the World	Albania
	American Samoa
	Andorra
	Bermuda
	Bosnia and Herzegovina
	Bulgaria
	Cook Islands
	Croatia
	Faroe Islands
	Fiji
	Former Yugoslav Republic of Macedonia
	French Polynesia
	Gibraltar
	Greenland
	Guam
	Kiribati
	Macau
	Marshall Islands
	Micronesia, Federated States of
	Monaco
	Mongolia
	Nauru
	New Caledonia
	Niue
	Norfolk Island
	North Korea
	Northern Mariana Islands
	Palau
	Papua New Guinea
	Romania
	Saint Pierre and Miquelon
	Samoa
	San Marino
	Serbia and Montenegro
	Solomon Islands
	Tokelau
	Tonga
	Tuvalu
	Vanuatu
	Wallis and Futuna
Asian Newly Industrialized Economies	Hong Kong
	Malaysia
	Singapore
	South Korea
	Taiwan
United States	United States
European Union 15	Austria
	Belgium
	Denmark
	Finland
	France
	Germany
	Greece
	Ireland
	Italy
	Luxembourg
	Netherlands
	Portugal
	Spain
	Sweden
	United Kingdom
European Union 10	Cyprus
	Czech Republic
	Hungary
	Malta
	Poland
	Slovakia
	Slovenia
	Estonia
	Latvia
	Lithuania
Japan	Japan
Rest of OECD	Australia
	Canada
	Iceland
	Lichtenstein
	New Zealand
	Norway
	Switzerland

Note: ASEAN = Association of Southeast Asian Nations. OECD = Organization for Economic Cooperation and Development.

Table 2.2. Sectors in the Model

Sector	Description
Land-intensive agriculture	
1. Grains	Rice, wheat, maize, oats, sorghum, millet, barley, rye and other grains.
2. Oilseeds	Soybeans, peanuts, flaxseed, cottonseed, sunflower seed, safflower seed, and other oilseeds.
Labor-intensive agriculture	
3. Vegetables and fruits	Vegetables, fruits, and nuts.
4. Other crops	Sugar cane, sugar beet, cotton and other plant-based fibers, other crops.
5. Livestock	Bovine cattle, sheep, goats, horses; raw milk, wool, silk-worm cocoons, other animal products.
Processed agriculture	
6. Meat and dairy products	Meat of cattle, sheep, goats, poultry, and other meat products; milk, cheese, yogurt, and other dairy products.
7. Sugar	Sugar.
8. Processed foods	Processed rice, vegetable oils and fats, other food products.
9. Beverages and tobacco	Beer, wine, spirits, water, other beverages; cigarettes, cigars, and other processed tobacco.
Resource based products	
10. Forestry and fishery	Forestry, logging, hunting, game propagation, fishing, fish farming.
11. Crude oil and natural gas	Crude oil and natural gas.
Labor-intensive and other manufactures	
12. Textiles	Textiles and man-made fibers.
13. Apparel	Garments and fur.
14. Leather and footwear	Luggage, handbags, saddlery, harness, footwear, and other leather goods.
15. Other manufactures	Manufactures not classified elsewhere. Includes such categories as cinematic films and sound tracks, video games, jewelry, and sports equipment.
16. Wood and paper products	Furniture, other wood products; books, publications, and other paper products.
Intermediate products	
17. Petroleum, coal, and mineral products	Coal peat, lignite, metal ores, uranium and thorium ores, gasoline, petroleum products, coal products, other mineral products.
18. Chemical, rubber, and plastic products	Chemical, rubber, and plastic products.
19. Metals and metal products	Iron, steel, other metals, and metal products.
Capital-intensive finished products	
20. Motor vehicles and other transport equipment	Motor vehicles, trailers, semi-trailers, parts, and other transport equipment.
21. Electronic equipment	Office, accounting, computing, radio, television, and communication equipment.
22. Other machinery	Machinery and equipment not classified elsewhere.
Services	
23. Trade and transportation	Trade services; land, water, and air transportation.
24. Financial services, banking, and insurance	Banking and financial services, insurance, pension funding, real estate activities.
25. Communication, health, education, and public services	Communication, public administration, defense, education, health, social work, recycling, post and telecommunications, research and development, compulsory social security.
26. Recreational and other services	Hotels and restaurants, activities of travel agencies, recreational, cultural, and sporting activities.
27. Housing, utilities, and construction	Electricity, manufacture and distribution of gas, water, construction, sewage, refuse disposal, and sanitation.

Note: A sector listing with Global Trade Analysis Project (GTAP) and International Standard Industry Classification (ISIC) concordances is available in table A.2.

AGE models are not meant to be forecasts of economic outcomes, because many factors will determine the actual impact of trade policy changes on the real world. The reliability of findings from AGE models is constrained by data limitations and the necessity to simplify economic realities in order to make the models computable. The Carnegie model shares these constraints, and the results should not be viewed as predictions of economic performance. What the Carnegie model, like other well-constructed models, *can* do is to provide a

comparison of the relative effects of alternative trade policy proposals when all other factors are held constant. This capacity makes the model an extremely useful tool for policy makers and the public in deciding between competing proposals.

Distinguishing Features of the Model

AGE models can be extended or adapted in various ways to provide greater detail on particular aspects of economic activity or to attempt greater accuracy in the representation of economic reality. The approaches taken in different models will differ according to the trade and economic policy issues that are of greatest interest to those constructing the models and designing policy simulations.

In the case of the Carnegie model, important objectives were to explore the impact of possible trade policy changes on economic growth, employment, agriculture, and low-skilled manufacturing in developing countries. Because the majority of the world's population lives in those countries, and the vast majority of livelihoods there depend on the agricultural sector or unskilled urban occupations, the impact of global trade policies on these individuals and households will have an important effect on global economic activity, stability, and growth. If global trade extends opportunities to these individuals and households—the global majority—the global trading system can realize its potential to contribute to poverty alleviation, equity, and broad-based growth. If these individuals and households do not benefit, or if they face worse economic circumstances as a result of global trade rules, the impact of trade will be to concentrate wealth in a relatively small number of countries, firms, and households. This would call into question both the legitimacy and sustainability of an open global trade regime.

Trade policy changes tend to affect individuals and households more through effects on earnings, such as changes in employment or wages or the prices of agricultural products sold, than through effects on consumption, such as changes in the prices of goods purchased.[4] The impact of trade policies on demand in the agricultural sector and in labor markets of each country is an important factor in gauging the welfare results for the poor and for others whose main asset is their labor. AGE models are well suited for probing these effects, because they capture the gains or losses to both producers and consumers, through wage and price changes that are induced by trade liberalization.

The importance of agriculture and unskilled labor demand for the livelihoods of the global majority makes it imperative to represent the markets for agricultural and unskilled labor in developing countries as accurately as possible in the model. The Carnegie model makes several important innovations in this regard compared with other models.[5]

Most general equilibrium models include only two classes of labor, skilled and unskilled, without distinguishing between unskilled labor in urban and agricultural labor markets. In many developing countries, however, a large share of the economically active population is engaged in small-scale agriculture. The labor market in that sector is quite distinct from urban labor markets. To reflect this reality, the Carnegie model disaggregates labor into three types: agricultural labor, urban unskilled labor, and urban skilled labor.

Most models assume that all labor, including unskilled labor, is fully employed. Unemployment is not taken into account. Any increases (or decreases) in demand for labor caused by trade policy changes will be shown in the model results as rising (or declining) wages. This assumption is highly inaccurate for the

Table 2.3. Unemployment Rate for Urban Unskilled Labor in Developing Countries
(PERCENT)

China	3.6
Indonesia	8.0
Vietnam	3.1
Rest of ASEAN	5.5
India	9.2
Bangladesh	27.0
Rest of South Asia	9.3
Middle East and North Africa	10.6
South Africa	21.4
East Africa	7.2
Rest of Sub-Saharan Africa	16.9
Brazil	8.6
Mexico	1.7
Argentina	16.4
Rest of Latin America	10.5
Central America and Caribbean	13.6

Source: LABORSTA database, International Labor Organization, http://laborsta.ilo.org; Global Trade Analysis Project database Version 6.0.

labor markets of developing countries. Typically, those countries have unemployment in urban areas and underemployment in rural areas that creates a supply of labor willing to migrate to urban areas if demand exists. In some developing countries, urban unemployment and rural underemployment can be very high. As a result, even if demand for labor increases, wages may not increase, depending on the extent of surplus labor supply. The Carnegie model does not assume full employment of urban unskilled labor in developing countries. Rather, it incorporates actual unemployment rates in those countries, presented in table 2.3. In countries with an abundant supply of unskilled labor, wages do not increase in the short term. This is represented in the model as a fixed real wage for urban unskilled labor when unemployment is present, a reasonable representation of reality in most developing countries in the short term.[6]

Unskilled labor employment (or unemployment) is endogenous in the model; that is, it is determined by changes in labor demand as trade policies change. As mentioned above, the agricultural labor market is modeled separately, with wages that are lower than urban unskilled wages. Agricultural wages are set by supply and demand for labor in the agricultural sector. Increasing demand for agricultural products will drive up wages, but they may still remain below urban unskilled wages. The rural and urban unskilled labor markets are linked by migration.[7] If demand for unskilled labor in urban areas is strong, some rural workers will migrate to seek jobs. Conversely, if the agricultural sector grows while urban unemployment persists, some jobless unskilled workers in the cities may return to work in agriculture.

Skilled labor markets in developing countries and all labor markets in developed countries are modeled in the usual way in the Carnegie model, with the assumption of full employment. Though this assumption is not accurate, unemployment in those labor markets is not so high as to introduce large distortions in the simulation results that are the focus of this report.

A sensitivity analysis was conducted to assess the impact of the approach to developing country labor markets taken in the Carnegie model. The analysis showed that recognizing the existence of unemployment among unskilled urban workers in developing countries in the model had a very significant impact on results for those countries. Under different scenarios, gains in real income for developing countries as a group were up to twice as large or even higher when unemployment was modeled as under the assumption of full employment. Overall, developing countries' share of the global gains from trade liberalization is significantly higher when unemployment in their economies is taken into account.

The results for different developing countries vary widely, depending on factors such as the level of unemployment and the competitiveness of sectors that use unskilled labor in those economies. For example, China's overall

income gains are more than twice as large when unemployment is included in the model. At the same time, a few developing countries that are less competitive would see smaller gains or larger losses because of the extra advantage that their more competitive counterparts enjoy when wages are constrained by unemployment. Mexico and Central America gain less and Bangladesh loses more in the face of competition from more efficient countries with reserves of unemployed labor.

The sensitivity analysis suggests that models that do not acknowledge unemployment in developing countries probably understate gains for countries that have competitive manufacturing sectors to a significant degree, while minimizing the negative effects on less competitive developing countries.

Separating unskilled labor into agricultural and urban unskilled labor forces has a lesser effect on the results. However, the effect is in the opposite direction from that of unemployment. Depending on the scenario, the gains to developing countries as a group are about 2 to 6 percent less if these labor forces are modeled separately rather than as a single unskilled labor group. This suggests that models that combine these two distinct groups into one will tend to *overstate* the gains to developing countries, although the overstatement will be small.

The results are reported in greater detail in appendix B.

Characteristics of the Global Economy as Represented in the Model

The main data used in the Carnegie model to represent the existing global economy are presented in tables A.5 and A.6 of appendix A. Table A.5 covers measures such as gross domestic product (GDP), trade flows, trade dependence, and factor endowments for each country and region. These variables help to explain both existing patterns of trade and the potential impact of trade policy changes. Table A.6 presents the existing net trade patterns across the world.

A key factor in understanding existing trade patterns is the distribution of land, labor, and capital in the global economic system. The combination of these factors of production in each country's endowment determines its comparative advantage relative to others in the world economy. Because these endowments are distributed unevenly, countries have different relative strengths and costs of production. For example, if a country has a large supply of unskilled labor but little capital, its cost of labor will be lower relative to its cost of capital. Goods that it produces using unskilled labor intensively will be relatively inexpensive, both domestically and if exported to countries that have relatively scarce (and therefore more expensive) supplies of such labor. Similarly, a country that has abundant land and capital but relatively scarce labor will tend to produce agricultural crops that can be farmed in mechanized ways and export them to other countries with differing factor endowments and costs.

The data presented in table A.5 show that the high-income regions—the United States, European Union (EU), Japan, other high-income members of the Organization for Economic Cooperation and Development (OECD), and the newly industrialized economies (NIEs) of Asia—are home to only about 16 percent of the global labor force but possess 78 percent of the world's capital stock. In contrast, developing regions are home to more than 84 percent of the global labor force but possess just 22 percent of the world's capital stock. The high-income regions are also relatively abundant in skilled labor, with 36 percent of the world's skilled labor, more than twice their share of the total global labor force.

Land is more abundant in the developing world, which accounts for 73 percent of the world endowment of agricultural land.

Figures 2.1 through 2.3 present the proportion of each class of labor (agricultural, urban unskilled, and skilled) in the total economically active population for each country or region. The x (horizontal) axis shows the level of GDP per economically active person, which is a measure of how much wealth is created by each participant in the labor force.[8] Figure 2.1 indicates that economies with large proportions of their labor force in agriculture have relatively low levels of GDP per worker. The trend line indicates that wealth per worker increases as the share of agricultural labor declines. It also shows that some of the most populous countries in the world, including China, India, Bangladesh, and Indonesia, continue to have very high proportions of their labor force in agriculture. Figure 2.2 suggests that countries become richer as their share of unskilled labor in sectors other than agriculture increases.

Figure 2.3 and the detailed inset show an even stronger correlation between the endowment of skilled labor in an economy and its ability to generate higher levels of GDP per worker. Countries such as China and India, notwithstanding recent growth and diversification, still have low shares of skilled labor (7.5 and 5.4 percent, respectively) in their total labor endowment.

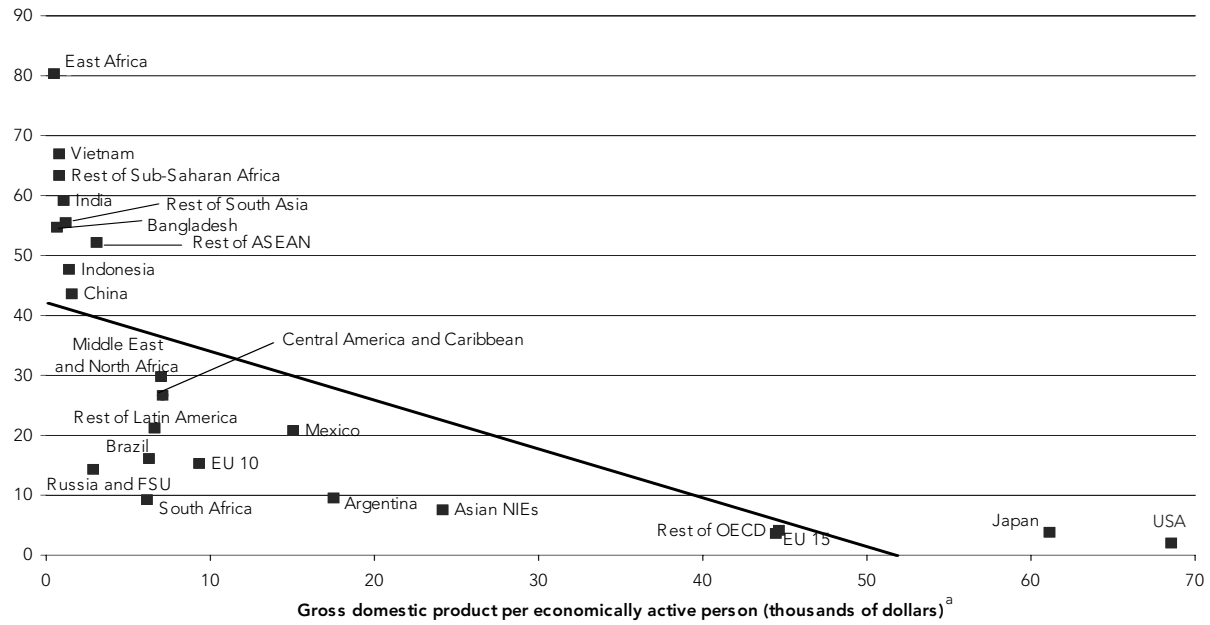
The ratio of capital to labor, which is the accumulated capital per worker measured in dollars, is shown in figure 2.4 and the two related insets. Japan has the highest capital intensity, with $220,500 of accumulated capital per worker, while the U.S. ratio is $153,500 per worker. In the fifteen pre-2004 members of the EU (EU 15), the ratio is $128,900 per worker. In China, despite high inflows of capital in recent years, the ratio is $3,700 of accumulated capital per worker. The figure for India is $2,300. The lowest capital/labor ratios are found in the least developed countries (LDCs), including Bangladesh ($1,500) and East Africa, which includes Tanzania, Malawi, and Uganda ($800).

Figure 2.5 and the inset present the ratio of land to labor. With respect to land, Japan, the Asian NIEs, China, Indonesia, Vietnam, and Bangladesh are poorly endowed with arable land relative to the size of their labor force. Their labor share is much greater than their land share in the total world endowment (see table A.5). Conditions are just the opposite in the United States, other high-income OECD countries (including Canada, Australia, and New Zealand), Argentina, Brazil, South Africa, Russia, and the rest of the former Soviet Union, where land is relatively abundant compared with labor. The EU, India, both North Africa and Sub-Saharan Africa, the Middle East, and Mexico have intermediate amounts of arable land relative to the size of their labor force (their land share and labor share in total world endowment are roughly the same). The relative abundance of land and the ratio of land to labor are not as strongly correlated with overall GDP per worker as is the abundance of skilled labor or the capital/labor ratio. This reflects the fact that the productivity of agricultural land varies widely, depending on inherent factors such as fertility and climate as well as the level of technology used.

Another important characteristic of economies is their level of dependence on trade. This is a function of the share of their economic output that is exported and the share of consumption by households, investment by firms, and spending by government that is imported. Figure 2.6 presents the share of output that is exported by each economy, arrayed from the most trade dependent to the least. By far the most trade-dependent region in terms of exports is the Association of Southeast Asian Nations (ASEAN) region, which includes Thailand and the Philippines, which export a

Figure 2.1. Agricultural Labor as a Share of Total Labor

(PERCENT)

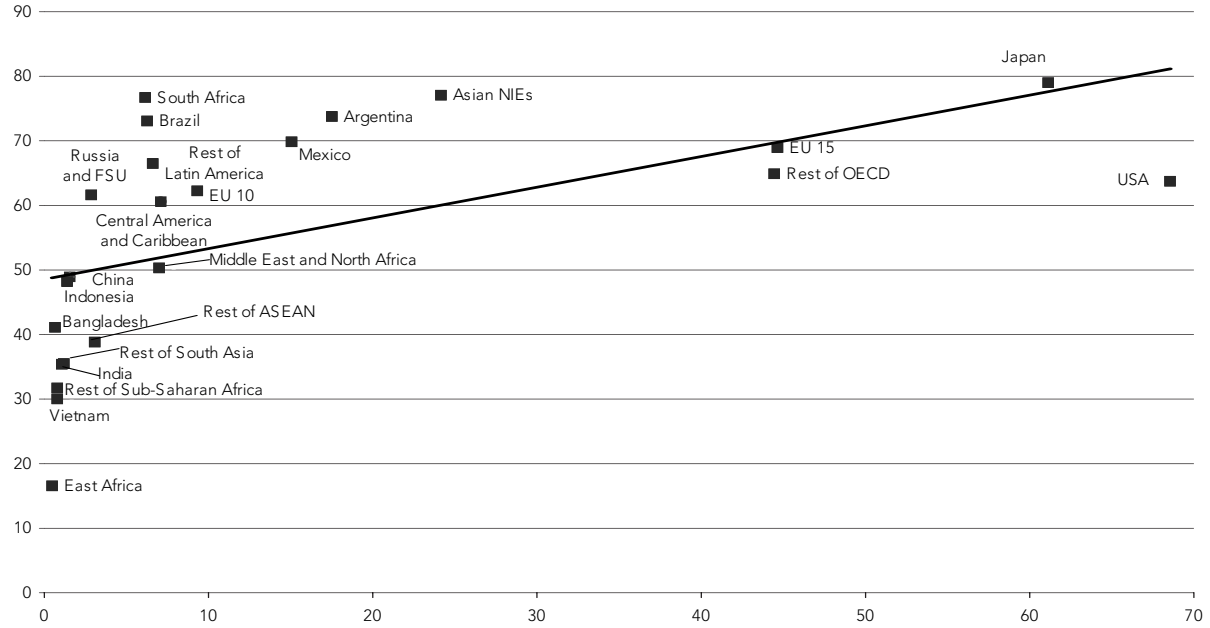


Sources: GDP data from Global Trade Analysis Project database Version 6.0. Betina V. Dimaranan and Robert A. McDougall, eds., *Global Trade, Assistance, and Production: The GTAP 6 Data Base,* (West Lafayette, Ind.: Center for Global Trade Analysis, Purdue University, 2006). Labor data from LABORSTA database, International Labor Organization, http://laborsta.ilo.org.

a. Gross Domestic Product in 2001 US Dollars.

Figure 2.2. Urban Unskilled Labor as a Share of Total Labor

(PERCENT)

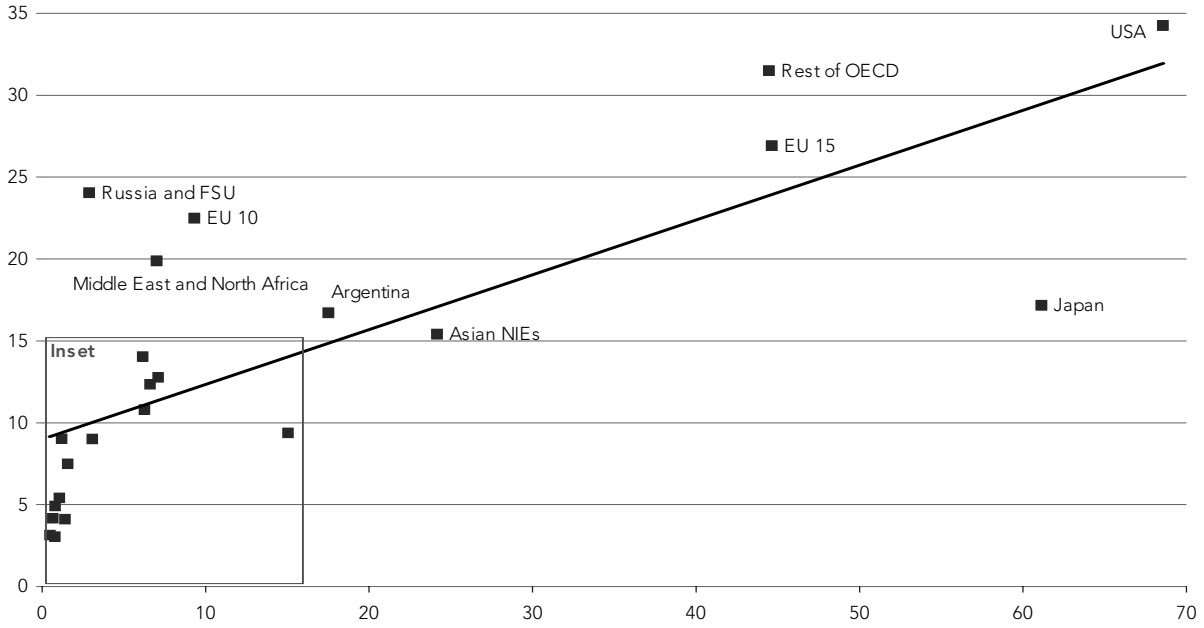


Sources: GDP data from Global Trade Analysis Project database Version 6.0. Labor data from LABORSTA database, International Labor Organization (ILO), http://laborsta.ilo.org.

Note: Urban unskilled labor includes ILO occupation groups 3-5 (clerical and related workers; sales workers; service workers) and 7-9, (production and related workers, transport equipment operators, and laborers).

Figure 2.3. Skilled Labor as a Share of Total Labor

(PERCENT)



Sources: GDP data from Global Trade Analysis Project database Version 6.0. Labor data from LABORSTA database, International Labor Organization (ILO), http://laborsta.ilo.org.

Note: Skilled labor includes ILO occupation groups 0-2 (professional, technical, and related workers; administrative and managerial workers).

Figure 2.3 Inset. Skilled Labor as a Share of Total Labor

(PERCENT)

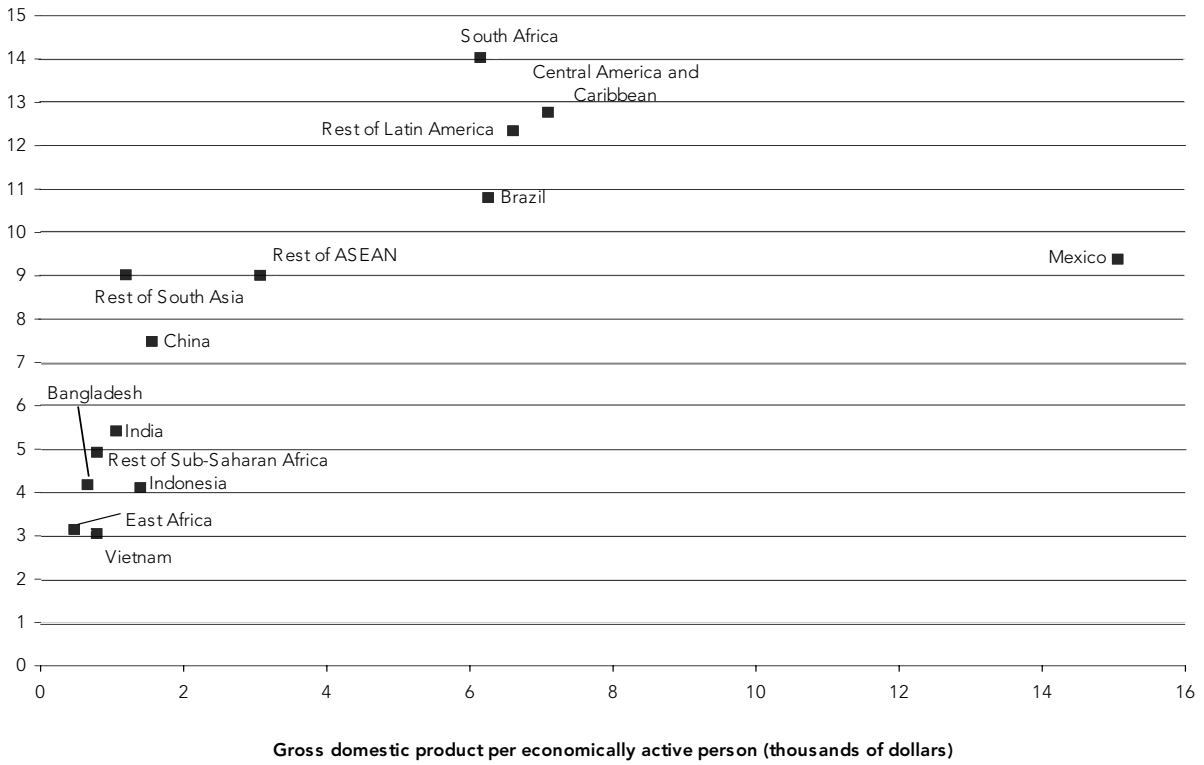
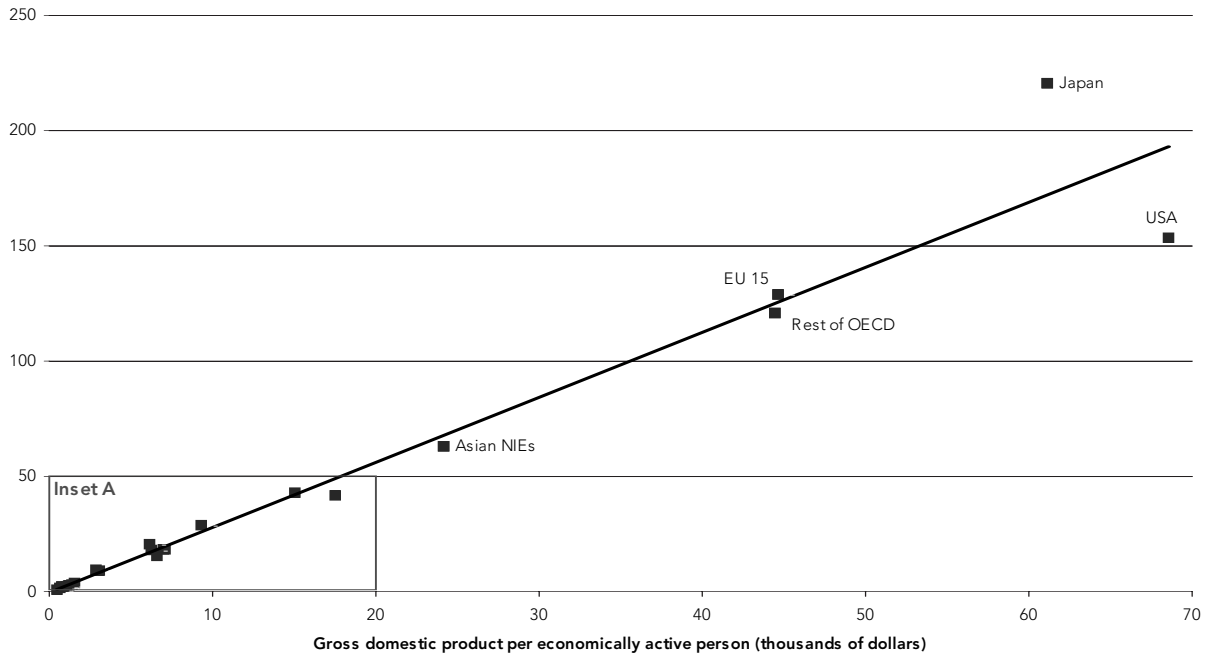


Figure 2.4. Capital/Labor Ratio

(CAPITAL PER ECONOMICALLY ACTIVE PERSON, THOUSANDS OF DOLLARS)



Sources: GDP per economically active person calculated from Global Trade Analysis Project database Version 6.0 and from labor data from LABORSTA database, International Labor Organization, http://laborsta.ilo.org. Capital endowments calculated from the 2001 multi-regional Social Accounting Matrix estimated by the modeler from GTAP database Version 6.0, and from labor data from *FAO Statistical Year Book*, (Rome: UN Food and Agriculture Organization, 2002).

Figure 2.4 Inset A. Capital/Labor Ratio

(CAPITAL PER ECONOMICALLY ACTIVE PERSON, THOUSANDS OF DOLLARS)

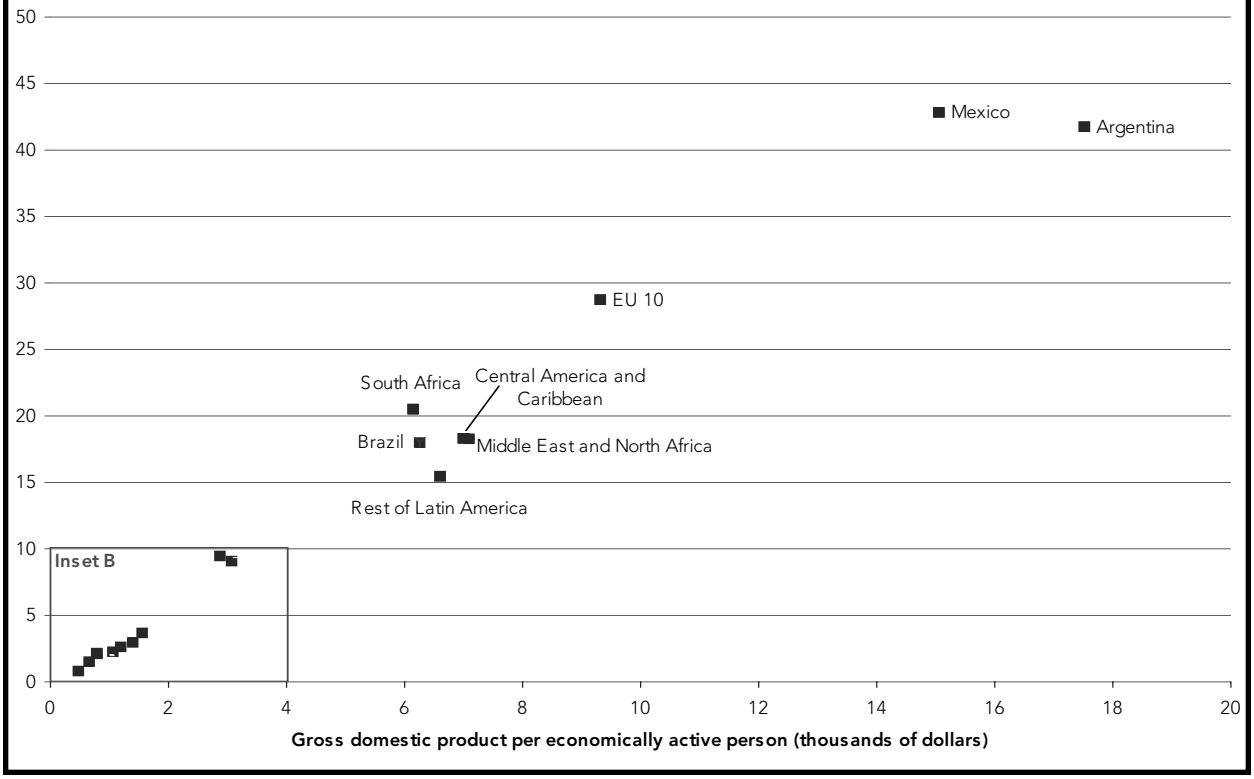
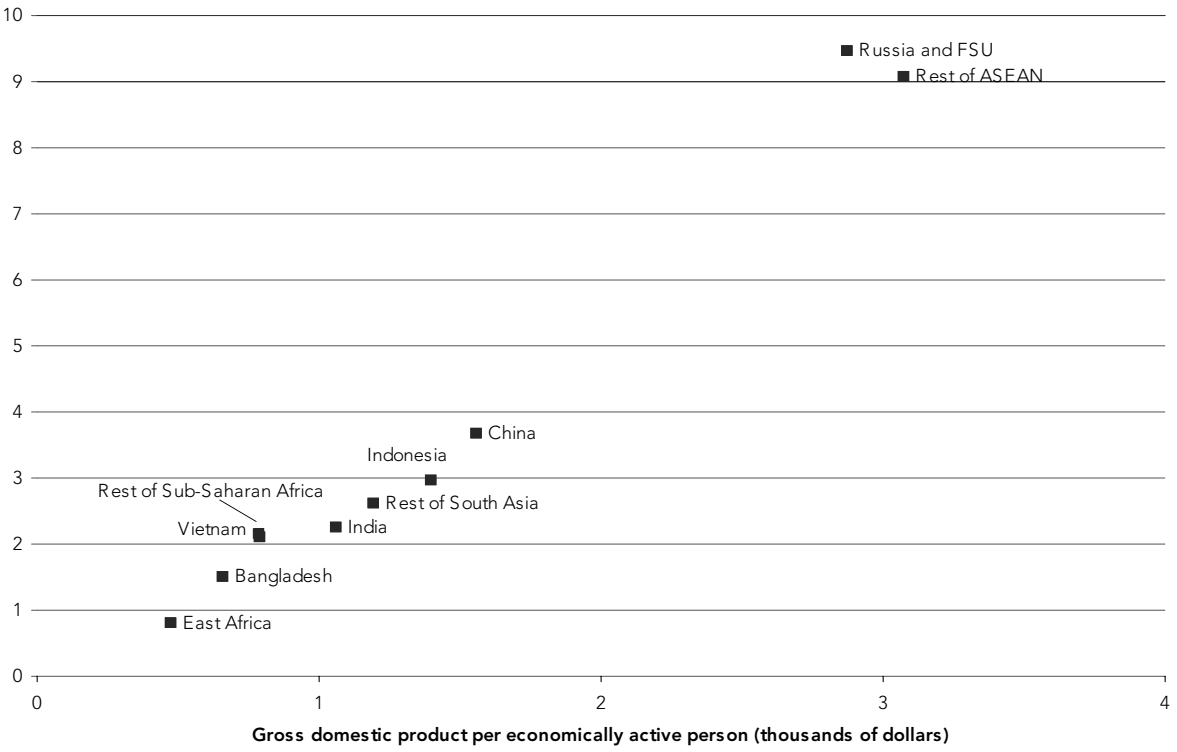


Figure 2.4 Inset B. Capital/Labor Ratio
(CAPITAL PER ECONOMICALLY ACTIVE PERSON, THOUSANDS OF DOLLARS)



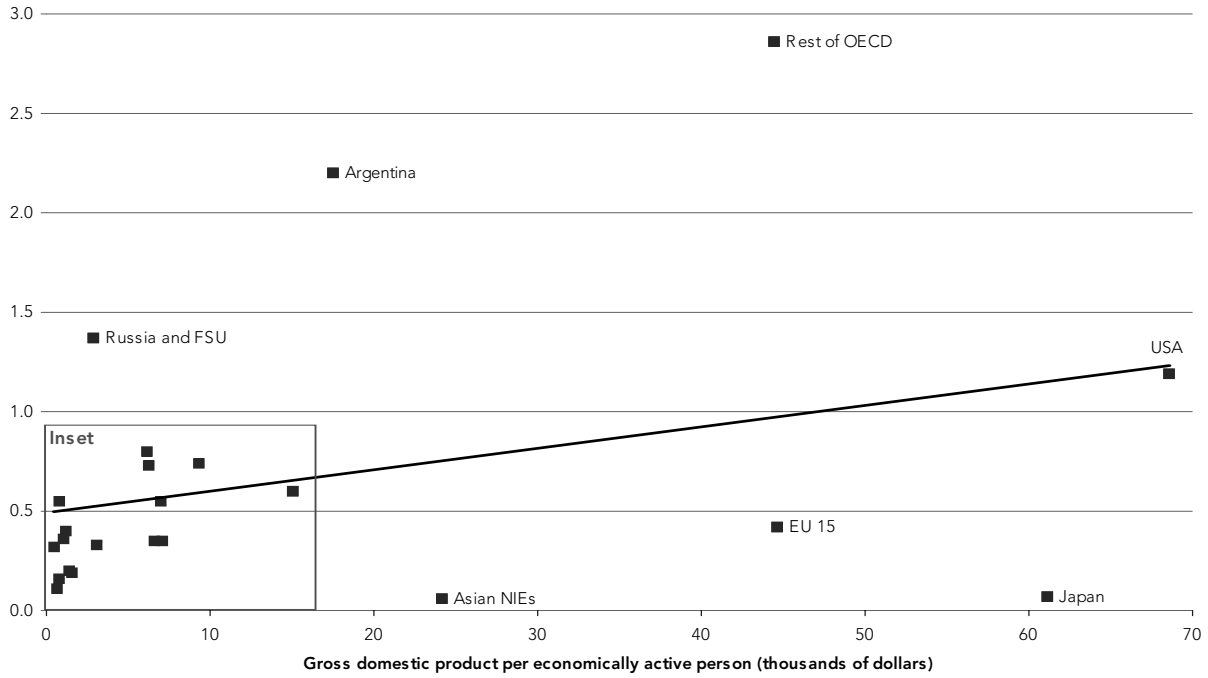
range of agricultural and manufactured goods, as well as smaller countries such as Cambodia that are heavily dependent on exports from a single sector such as apparel. It may surprise some that China is much less trade dependent as measured by the share of output that is exported than the ASEAN group or the Asian NIEs, Indonesia, the ten newly acceded members of the EU, or South Africa. At the other extreme, the United States, Japan, Argentina, and India export the smallest shares of their output, ranging from 8.8 to 12.6 percent.

Figure 2.7 presents figures for the share of domestic absorption of goods and services that is imported. These figures indicate that the importance of trade can be quite different for economies that might be similar in other ways, such as their factor endowments. For example, Vietnam, with the highest share of imports at 76 percent of absorption, is much more import dependent than similarly endowed ASEAN countries, which import 50 percent, or China, which imports 24 percent of what it absorbs. As with exports, the least import-dependent countries, in terms of share of absorption, are Japan, Argentina, India, and the United States, with imports making up only 9.9 to 12.7 percent of absorption.

Trade Policy Scenarios Modeled

The model was used to conduct simulations of the impact of a range of possible trade policy changes. The scenarios that were constructed were designed to capture plausible outcomes from the Doha Round of negotiations. Because the negotiations have not reached a consensus on most issues, scenarios that capture a range of outcomes on each major issue were modeled. A scenario of full trade liberalization

Figure 2.5. Land/Labor Ratio
(HECTARES PER ECONOMICALLY ACTIVE PERSON)



Sources: GDP per economically active person calculated from data from Global Trade Analysis Project database Version 6.0, and from labor data from LABORSTA database, International Labor Organization, http://laborsta.ilo.org. Land endowment per economically active person calculated from land and labor data from *FAO Statistical Year Book*, (Rome: UN Food and Agriculture Organization, 2002).

Figure 2.5 Inset. Land/Labor Ratio
(HECTARES PER ECONOMICALLY ACTIVE PERSON)

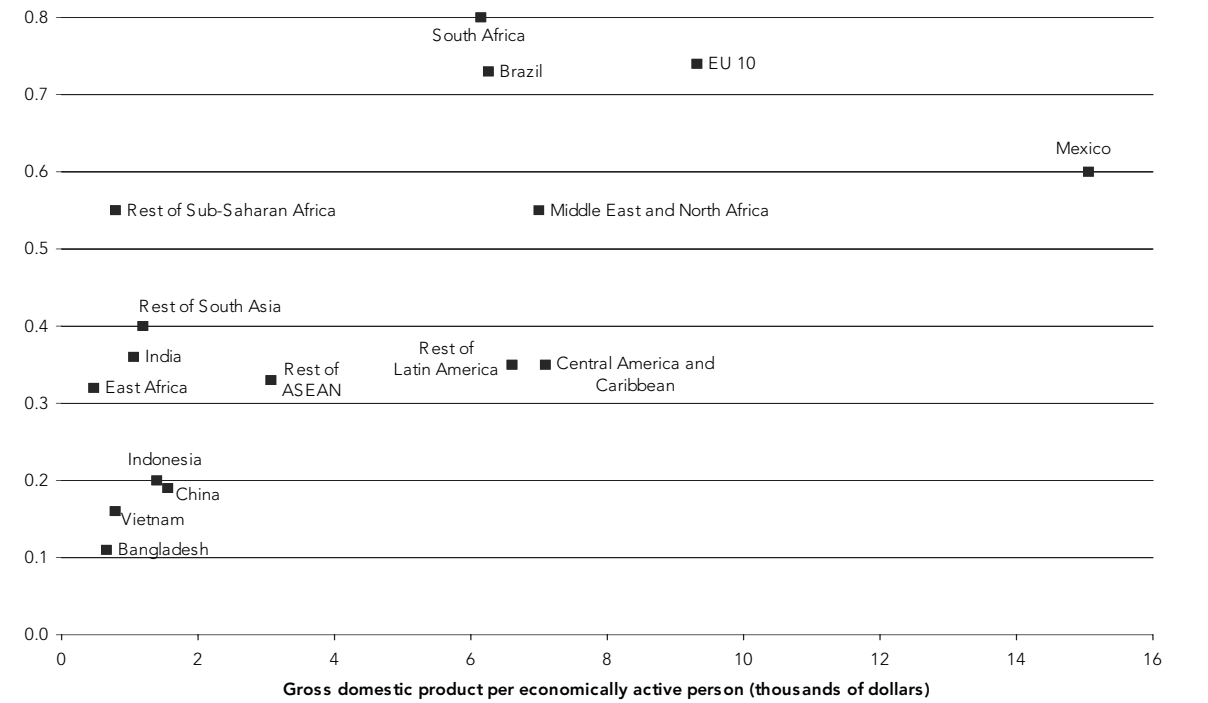
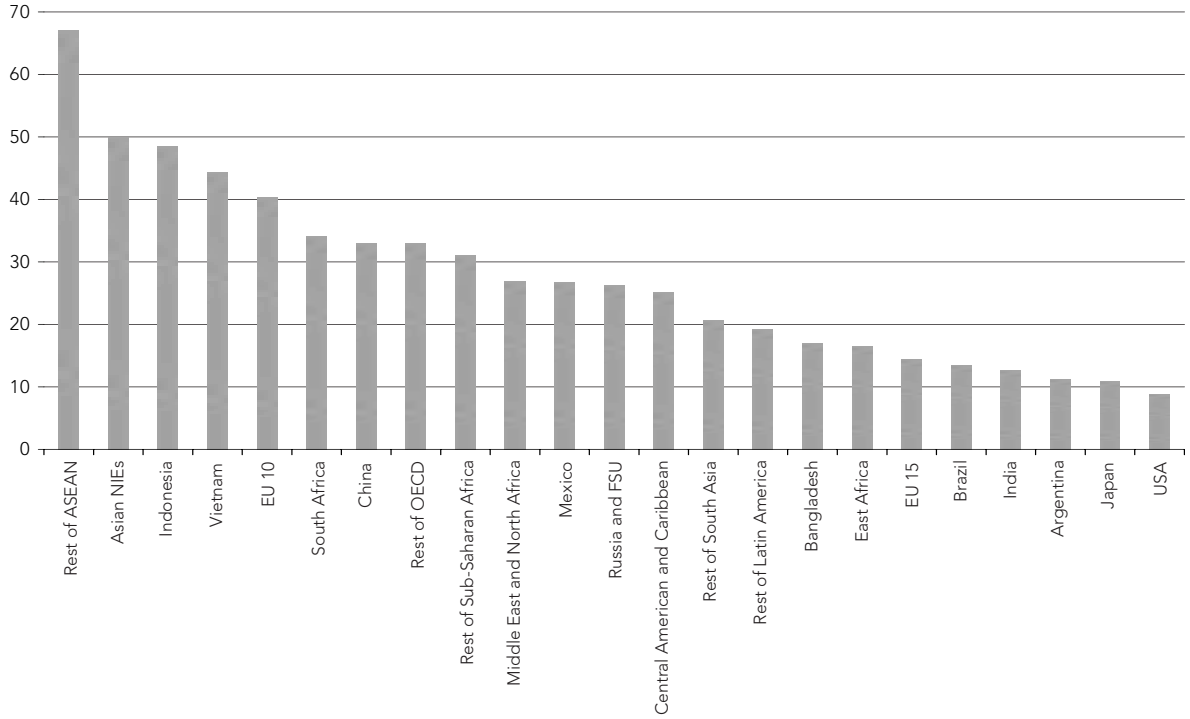


Figure 2.6. Exports as a Share of Output

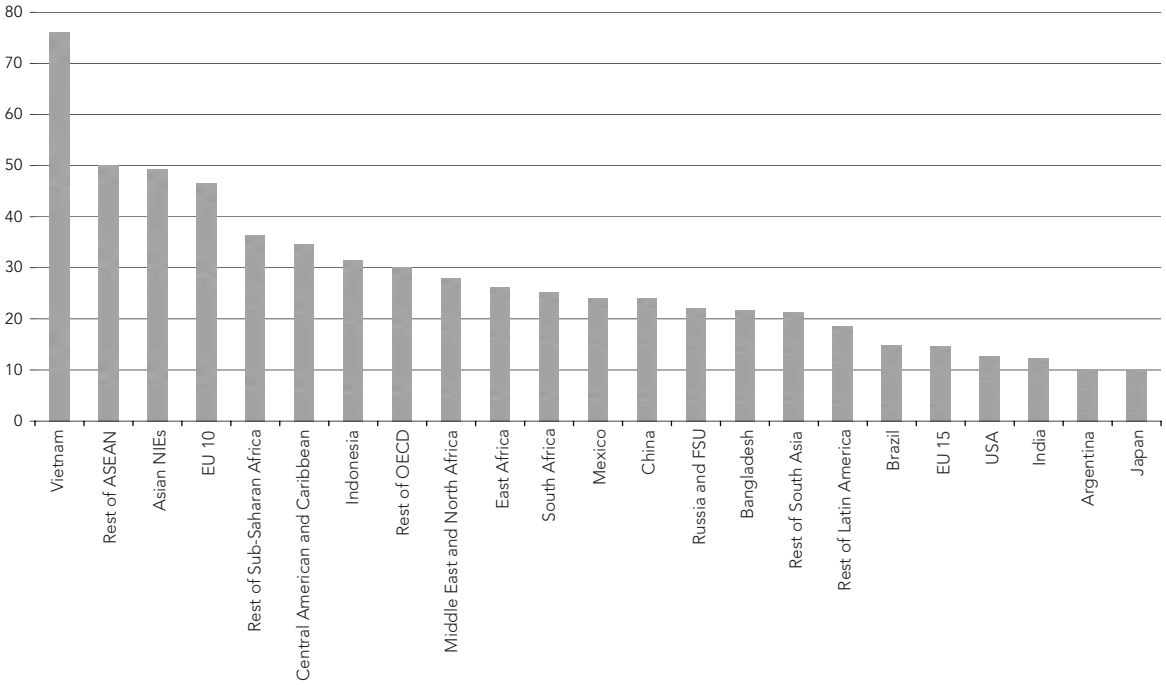
(PERCENT)



Source: Calculated from the 2001 multiregional Social Accounting Matrix estimated by the modeler from GTAP database Version 6.0. Betina V. Dimaranan and Robert A. McDougall, eds., *Global Trade, Assistance, and Production: The GTAP 6 Data Base* (West Lafayette, Ind.: Center for Global Trade Analysis, Purdue University, 2006).

Figure 2.7. Imports as a Share of Absorption

(PERCENT)



Source: Calculated from the 2001 multiregional Social Accounting Matrix estimated by the modeler from GTAP database Version 6.0. Betina V. Dimaranan and Robert A. McDougall, eds., *Global Trade, Assistance, and Production: The GTAP 6 Data Base* (West Lafayette, Ind.: Center for Global Trade Analysis, Purdue University, 2006).

was also modeled as a reference point. The main scenarios are described below and additional details are provided in table 2.4.

In all the scenarios, reductions in tariffs and other forms of border protection are made from applied, rather than bound, rates.[9] Applied rates are the tariffs that are actually charged by countries, while bound rates are the maximum tariffs that may be charged by a country under its WTO commitments. Negotiations on tariff reductions at the WTO usually take the form of agreements to reduce bound tariffs. We chose to model reductions from applied rather than bound rates for two reasons. First, and most important, we wanted to capture the impact of *actual* changes in tariffs on production, trade, demand for labor, and other economic measures. Reductions in bound tariffs may not produce any reduction in applied tariffs if the gap between bound and applied is large. We wanted to use the model to simulate the impact on the real world economy of real changes in trade policies.

Second, a number of other models use scenarios that take reductions from bound tariffs, often using the bands or thresholds for different levels of reductions that have been proposed in past negotiating sessions. This is a useful exercise, but there was no particular value in repeating it here. In addition, the precision of using very specific thresholds coupled with specific levels of tariff reductions within each band, or particular coefficients for the size of cuts, means that these scenarios quickly lose relevance if other bands are proposed or agreed to in the negotiations. By contrast, the method we chose, reductions to applied tariffs, can be thought of as an end point that would be achieved by any of various formulas of reductions in bound rates. When new proposals are made, their proponents (and others) often calculate the resulting impact on applied tariffs, which can be used for comparison with our scenarios.

The same approach was taken to reductions of subsidies and domestic support, which were reduced from applied rather than bound rates.[10]

The central Doha scenario that we constructed entails an ambitious expansion of market access for manufactured goods (50 percent reductions in applied tariffs and other border protection by developed countries and 33 percent reductions by developing countries); a modestly ambitious expansion of market access for agricultural products (36 percent reductions in applied tariffs and other border protection by developed countries and 24 percent reductions by developing countries); reductions of domestic subsidies for agricultural products by one-third by all countries except LDCs; and the elimination of agricultural export subsidies by all countries except LDCs. The scenario does not include market access liberalization by the LDCs, in line with agreements already made in the Doha Round.[11]

The scenario was constructed separately for agricultural measures (scenario 1) and manufacturing measures (scenario 2) and then cumulated (scenario 3). The results are sometimes presented for the separate components, to draw attention to the contribution of that sector for each country or group of countries. It should be noted that the combined results for the overall scenario differ slightly from the sum of the two sectoral scenarios. Because of the presence of initial unemployment in unskilled labor markets, if the overall scenario generates a higher level of demand for either agricultural or unskilled labor or both, it may generate further increases in total production and wage income due to general equilibrium effects.

We then varied different elements of this central scenario to simulate other plausible outcomes of the Doha Round. First, we allowed developing countries to exclude an unlimited

Table 2.4. Scenarios Modeled

Policy Measure	(1) Doha Scenario for Agriculture	(2) Doha Scenario for Manufactures	(3) Central Doha Scenario	(4) Central Doha Scenario with "Special Products" for Developing Countries	(5) Modest Scenario for Manufactures	(6) Hong Kong Scenario	(7) Limited Scenario for Agriculture	(8) Scenario with Limited Agriculture and Ambitious Manufacturing	(9) Full Liberalization
Reduction in Applied Tariffs and Other Border Protection (AVEs)[a]									
Agricultural products									
Developed countries	Reduced by 36%	No change	Reduced by 36%	Reduced by 36%	No change	Reduced by 36%	Reduced by 25%	Reduced by 25%	Reduced to zero
Developing countries	Reduced by 24%	No change	Reduced by 24%	No change	No change	Reduced by 24%	Reduced by 15%	Reduced by 15%	Reduced to zero
Manufactured products									
Developed countries	No change	Reduced by 50%	Reduced by 50%	Reduced by 50%	Reduced by 36%	Reduced by 36%	No change	Reduced by 50%	Reduced to zero
Developing countries	No change	Reduced by 33%	Reduced by 33%	Reduced by 33%	Reduced by 24%	Reduced by 24%	No change	Reduced by 33%	Reduced to zero
Export subsidies									
Developed countries	Eliminated	No change	Eliminated	Eliminated	No change	Eliminated	Eliminated	Eliminated	Eliminated
Developing countries	Eliminated	No change	Eliminated	Eliminated	No change	Eliminated	Eliminated	Eliminated	Eliminated
Domestic support									
Developed countries	Reduced by 1/3	No change	Reduced by 1/3	Reduced by 1/3	No change	Reduced by 1/3	Reduced by 25%	Reduced by 25%	Eliminated
Developing countries	Reduced by 1/3	No change	Reduced by 1/3	No change	No change	Reduced by 1/3	Reduced by 15%	Reduced by 15%	Eliminated
Special treatment[b]									
Least Developed Countries do not make reductions in scenarios 1–8									None

a. Trade-weighted ad valorem equivalent (AVE) protection. An ad valorem equivalent is a conversion of a specific tariff (a specific amount per unit traded) into an ad valorem tariff (a percentage of the value of the good) with an equivalent value.

b. Because of aggregation, special treatment for least developed countries in the model applies to the following countries or regions: Bangladesh, East Africa, and the rest of Sub-Saharan Africa.

number of agricultural products from market liberalization measures (scenario 4). The purpose of this scenario was to test the impact of two agreements already reached in the round. The first, included in the July 2004 Framework Agreement, was that "developing country Members will have the flexibility to designate an appropriate number of products as Special Products, based on criteria of food security, livelihood security and rural development needs." The second agreement, which originated in that framework and was further elaborated in the Declaration adopted at the Hong Kong ministerial in December 2005, allows developing country members recourse to a "Special Safeguard Mechanism" to temporarily protect agricultural products faced with a surge in the volume of imports or lower import prices that threaten domestic producers.[12] The scenario we modeled simulates an outer bound of any agreement that might be reached under this framework, in that it represents the extreme case in which developing countries effectively shelter all their agricultural products.

The second variation entails a less ambitious expansion in market access for manufactured products only (scenario 5). As already noted, the central scenario was quite ambitious with regard to manufacturing trade liberalization, incorporating 50 percent reductions in applied tariffs and other border protection by developed countries and a 33 percent reduction by developing countries. Scenario 5 simulates the impact of more modest liberalization in that sector, with 36 percent reductions by developed countries and 24 percent by developing countries. It is analogous to scenario 2, in that it includes only manufactured products.

The Hong Kong Declaration instructed negotiators "to ensure that there is a comparably high level of ambition in market access for Agriculture and NAMA (nonagricultural market access)."[13] Therefore, we then cumulated the modest manufacturing liberalization scenario with our central Doha agricultural scenario (scenario 1) to create an alternate overall scenario in which tariffs and other border protection for *both* agricultural and manufactured goods are reduced by 36 percent by developed countries and 24 percent by developing countries, with no reductions by LDCs. Agricultural domestic support is reduced by one-third by all but the LDCs and all agricultural export subsidies are eliminated, as agreed to in Hong Kong. We name this the "Hong Kong scenario" (scenario 6). As always, these reductions are taken from applied rates. In the case of agriculture, this level of liberalization is a reasonable approximation of the impact of actual proposals that have been tabled in the Doha Round, most notably that of the EU. This scenario takes up the Hong Kong mandate for a comparable level of ambition in manufactures, to produce a simulation that approximates the current state of the negotiations.

Finally, we constructed a scenario that significantly scales back the level of ambition in agriculture to reflect the lower bound of proposals currently tabled in the Doha Round (scenario 7). In this scenario, both applied agricultural border protection and domestic subsidies are reduced by 25 percent by developed countries and 15 percent by developing countries, with no reductions by LDCs. This can be taken as a rough approximation of the end point of market access expansion if countries are allowed to designate a significant percentage of agricultural tariff lines as "sensitive products" that would be subject to lesser liberalization. For example, the EU currently proposes to exempt 8 percent of agricultural tariff lines under this rubric. In scenario 8, this scenario is combined with the ambitious liberalization of the manufactures sector in scenario 2.

Full trade liberalization is designated scenario 9.

We did not model the liberalization of the service sectors for two reasons. First, most barriers to trade in services arise from complex and interacting regulations in the host country that cannot be easily reduced to a numerical formula, as is done for tariffs and domestic subsidies. Second, the structure of negotiations over services in the WTO is quite different from other negotiations, with countries making offers that other individual countries may accept and reciprocate, or refuse, resulting in a series of bilateral deals. By contrast, other sectors are negotiated on a multilateral basis, with all parties (or all similarly situated parties) making the same changes in trade rules. Because of this bilateral character of services talks and the lack of reliable data to quantify the resulting multiplicity of trade policy changes that could occur, it is difficult to model service liberalization with any reliability. Although we did not model changes in barriers to trade in services, all service sectors are included in the model and experience indirect effects from liberalization in other sectors.

The simulations were conducted on a comparative static basis; that is, the baseline equilibrium in the model was compared with the final equilibrium after the specified trade policy changes in each scenario were made. This approach captures changes in prices, production, trade, and overall income that are induced by the policy change.[14]

CHAPTER 3

The Results of Doha Round Trade Simulations

The trade scenarios that were modeled, simulating a range of plausible outcomes of the Doha Round, generate income gains at the global level that are positive but quite modest. Depending on the level of ambition in the scenario, the one-time gains for the global economy range from $40 to $60 billion, an increase of about 0.2 percent (one-fifth of 1 percent) of current global gross domestic product (GDP).

These overall gains would have quite different economic effects for different countries and regions. There are both net winners and net losers, as well as sectoral winners and losers, under different scenarios. The varied impacts of these potential trade policy changes provide important insights into the interests and concerns of different countries as the global trade regime is renegotiated.

In this chapter, we first present the main results of the modeled scenarios for the global economy as a whole. Following that, we show the distribution of gains or losses by sector for developed and developing countries as groups. We then trace sectoral and overall results for each developing country or region on a disaggregated basis. Next, we present the main effects experienced by each developed country or region. We then discuss the income gains as a percentage of current GDP for each country or region.

We then turn to the underlying changes that account for these effects. We present changes in world prices, terms of trade, and net trade patterns, followed by changes in factor returns and employment of agricultural and unskilled labor. We then show the adjustments that occur in production structures in each country or region and the redistribution of value added between countries. In the final section of the chapter, we briefly discuss the adjustment costs of the changes induced by trade policy.

Global Results

The results from the trade liberalization scenarios for the global economy as a whole are presented in table 3.1. The measure used is the change in real income.[15] In the first column, the change is presented in 2001 dollars, and the second column gives the percentage change from the base year global GDP.

The first scenario represents moderate liberalization in agricultural trade, while the second scenario represents ambitious liberalization of trade in manufactured goods. These scenarios are labeled the Doha scenario for agriculture and Doha scenario for manufactures. The data indicate that the gains from these plausible liberalization scenarios would come overwhelmingly from manufacturing trade. This is unsurprising, for several reasons. Most obvious, perhaps, is that the manufacturing scenario is

Table 3.1. Global Real Income Gains from Trade Scenarios

Scenarios	Gain (billions of dollars)	Gain over Base Year GDP (percent)
(1) Doha Scenario for Agriculture	5.4	0.02
(2) Doha Scenario for Manufactures	53.1	0.17
(3) Central Doha Scenario	58.6	0.19
(4) Central Doha Scenario with "Special Products" for Developing Countries	57.7	0.18
(5) Modest Scenario for Manufactures	38.1	0.12
(6) Hong Kong Scenario	43.4	0.14
(7) Limited Scenario for Agriculture	2.9	0.009
(8) Scenario with Limited Agriculture and Ambitious Manufacturing	56.0	0.18
(9) Full Liberalization	168.1	0.53

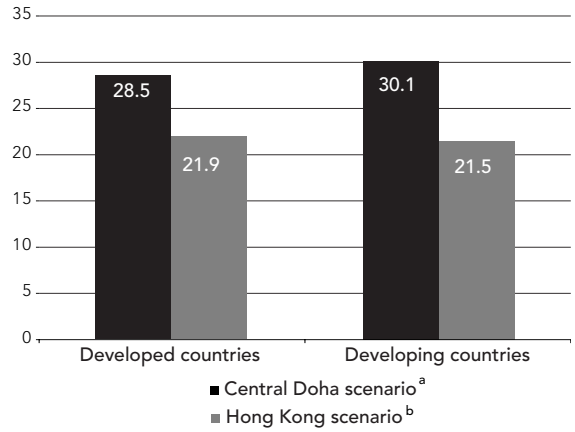
more ambitious. More fundamentally, the value of current global agricultural trade is $783 billion, while current manufacturing trade amounts to $6.57 trillion, or 89 percent of combined global trade in agricultural and manufactured goods.[16] The third scenario combines the gains from liberalization under the first and second scenarios. This scenario is referred to as the central Doha scenario (or scenario 3).

The fourth scenario represents a variation on the central Doha scenario in which developing countries are allowed to forgo the liberalization of their own agricultural sectors (referred to as the central scenario with special products for developing countries). As discussed in chapter 2 above, this scenario is meant to test the impact of interim agreements and proposals for the special and differential treatment of developing countries' agricultural sectors, in recognition of the livelihood, food security, and rural development concerns in this sector. The scenario models an extreme version of that approach, in which developing countries make no reductions at all in tariffs or domestic support. This contrasts with the proposal of the G-33 group of developing countries, a main proponent of special and differential treatment for developing country agriculture, which proposes that 20 percent of agricultural tariff lines be exempted from full liberalization for developing countries.[17] The result indicates that, at the global level, income gains are reduced only slightly compared with the scenario in which developing countries reduce tariffs by two-thirds as much as developed countries. Similar results appear for both developed countries as a group and developing countries as a group, as well as at disaggregated country and region levels (these results are discussed below).

The next scenario (scenario 5) is a further variation on the central scenario. In this scenario, market access for manufactured goods is increased more modestly, to the same degree as for agricultural goods. It is then combined with scenario 1 to form scenario 6, which approximates the agreement in Hong Kong in December 2005 that negotiators should achieve a comparable level of ambition in market access liberalization for agriculture and nonagricultural goods (the latter include manufactures and other nonagricultural products such as minerals). Overall global gains are about 26 percent lower if manufacturing liberalization goals are scaled back to the same level as agricultural liberalization.

The following scenario (scenario 7) represents more modest cuts in agricultural tariffs and subsidies. In scenario 8, it is combined with the high level of ambition in manufacturing market access of the central scenario. It is interesting to note that global gains still amount to more than 95 percent of those under more ambitious agricultural liberalization. This is a function of the relatively small weight of agriculture in global trade and its relatively small contribution to the

Figure 3.1. Global Distribution of Gains under Central Doha and Hong Kong Scenarios
(CHANGE IN REAL INCOME, BILLIONS OF DOLLARS)



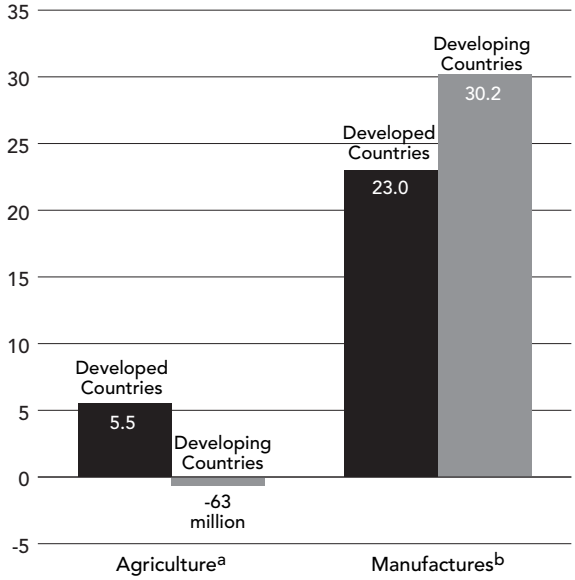
a. Scenario 3. See Table 2.4.
b. Scenario 6.

overall gains that can be realized from further trade liberalization.

The results of scenarios 6 and 8 indicate that the manufacturing sector is indeed the source of major global gains. Reducing market access liberalization for agriculture by about one-third reduces overall global gains by only 4 percent. By contrast, a somewhat smaller reduction in market access liberalization for manufactured goods (about 28 percent) reduces overall global gains by 26 percent, nearly the same amount.

The final scenario is full free trade.[18] This is not a realistic outcome for the Doha Round. Indeed, nothing even close to this level of ambition has been proposed by any party. However, it is a useful reference point to establish the magnitude of gains that could be achieved if all tariffs and subsidies were reduced to zero and all other barriers to trade were abolished. This measure is particularly useful in comparing the results of different models, because most modelers include a full liberalization scenario while other scenarios differ considerably among models and are harder to compare. This topic is explored further in chapter 4.

Figure 3.2. Gains (Losses) for Developed and Developing Countries under Doha Scenarios for Agriculture and Manufactures
(CHANGE IN REAL INCOME, BILLIONS OF DOLLARS)



a. Scenario 1.
b. Scenario 2.

The gains to the global economy in terms of percentage change are quite small. All the plausible Doha scenarios produce global gains of less than 0.2 percent of the global economy. Even full trade liberalization produces a global income gain of only about 0.5 percent. This result is consistent with findings from most other models, discussed in chapter 4.

The Distribution of Gains between Developed and Developing Countries

The modest overall gains are distributed relatively evenly between developed and developing countries, as seen in figure 3.1. However, the distribution at the sectoral level is quite different between developed and developing countries. Figure 3.2 presents the income gains or losses for each group of countries from separate liberalization scenarios for agricultural and manufacturing sectors.

Developed countries receive all the gains from agricultural liberalization. Their gains arise

from two main sources. First, many developed countries protect their agricultural sectors extensively, through tariffs, subsidies, and other measures. This protection is inefficient for those economies. The elimination of the distorting measures leads to better use of resources and efficiency gains to the overall economies. Second, some developed countries are very efficient producers of agricultural commodities, even without domestic protection and subsidies, and would gain global market share in agriculture if other countries opened their markets.

As a group, developing countries lose slightly from agricultural trade liberalization.[19] There is great heterogeneity among the results for different developing countries, discussed below. Numerous factors contribute to the overall result. They include the fact that developing countries cannot afford inefficient subsidies for their farmers to the extent employed by wealthier countries, and therefore they do not employ such subsidies on comparable scales. Thus, rules that reduce these subsidies do not increase efficiency in developing countries as extensively as they do in the United States, the European Union (EU), and Japan.

Second, many agricultural products of developing countries are not competitive in global markets. Some developing countries would suffer from the loss of the preferential market access terms that they now enjoy in developed country markets because their margin of preference would be eroded by a general lowering of tariffs and they would lose market share to more competitive producers. Some countries would lose current shares of their own domestic markets to more efficiently produced imports if they lower tariffs, potentially creating more unemployment and an economy that is worse off overall. This is particularly likely if low-productivity subsistence agriculture is a major component of overall economic activity in a country, a point discussed further below.

Third, many developing countries are net importers of agricultural and food products. If reductions in global agricultural production and export subsidies lead to an increase in world prices, as expected in the short and medium term, they will pay more for their imports.

These results run counter to a commonly held view about the Doha Round, namely, that agricultural liberalization benefits developing countries and therefore is key to achieving the development goals of the round. In fact, agricultural liberalization benefits only a relatively small subset of developing countries. The actual distribution of gains and losses is discussed below.

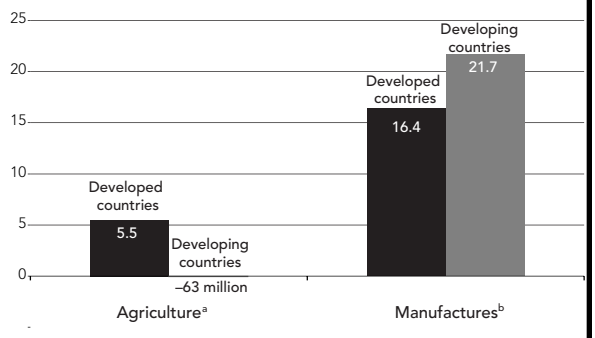
By contrast, developing countries as a group gain substantially from the liberalization of manufactured goods. This is partly attributable to a more ambitious scenario for manufacturing than for agricultural liberalization in the central Doha scenario. However, the alternative scenario that includes comparably ambitious market access liberalization for both sectors also shows markedly greater gains for developing countries from manufacturing than from agricultural liberalization (figure 3.3). Under this balanced scenario, developed and developing countries gain about equally overall, but with different contributions from agriculture and manufactures.

The Results for Developing Countries

As noted above, the results for the global economy and for developing countries as a group mask the wide differences in outcomes for individual developing countries and regions. Disaggregated results demonstrate the extent of heterogeneity among them. Four main themes emerge:

- First, most developing countries gain from the liberalization of trade in manufactured

Figure 3.3. Gains (Losses) for Developed and Developing Countries under Hong Kong Scenarios for Agriculture and Manufactures
(CHANGE IN REAL INCOME, BILLIONS OF DOLLARS)



a. Scenario 1.
b. Scenario 5.

goods, with Asian countries gaining more than Latin American and African countries.

- Second, agricultural liberalization alone does not benefit most developing countries or regions. Those benefiting include Brazil, Argentina, most of Latin America, South Africa, and some Association of Southeast Asian Nations (ASEAN) member countries, notably Thailand. However, more than half the countries or regions in the developing world would be net losers in terms of their overall real income if agriculture were the only sector to be liberalized.
- Third, granting extensive special and differential treatment to developing countries with respect to their own agricultural liberalization has only a small negative impact on other countries' income gains from the Doha Round.
- Fourth, there is a possibility that the poorest countries may lose from any likely Doha agreement unless special measures are taken on their behalf. The results show that Bangladesh, East Africa, and the rest of Sub-Saharan Africa are adversely affected in almost every scenario.

This section presents gains or losses for developing countries in absolute terms. Gains or losses relative to each country's current GDP are presented below in the section "Income Gains Relative to GDP."

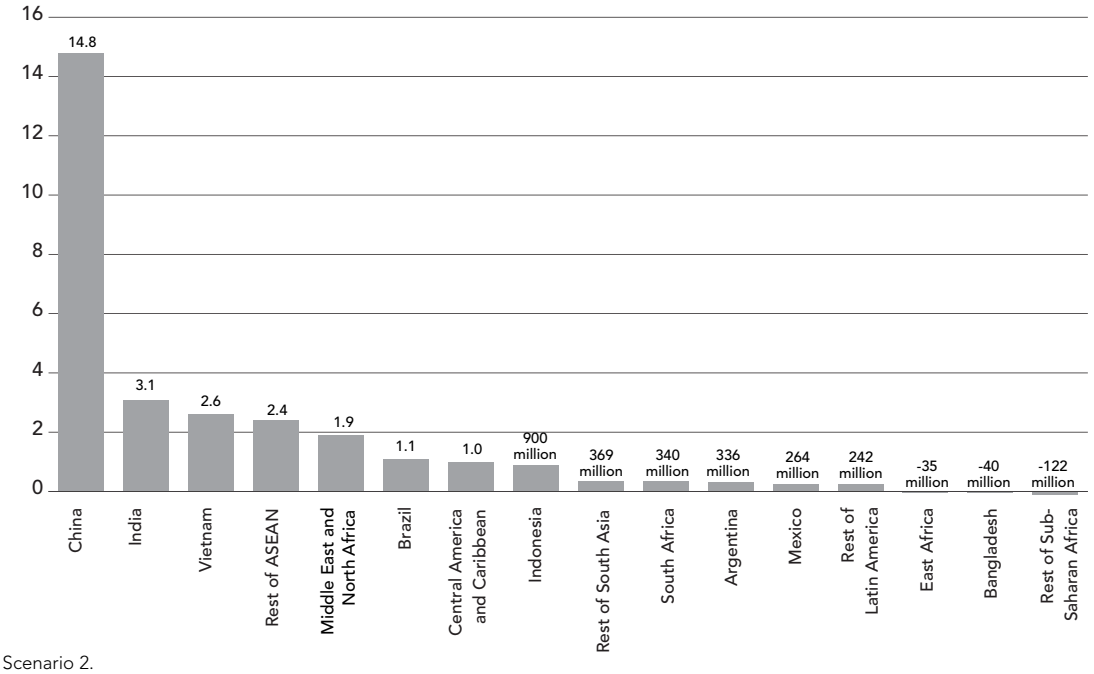
On the first theme, figure 3.4 presents the real income gains or losses from manufacturing liberalization alone for individual developing countries and regions. These results are based on the ambitious central Doha manufacturing scenario (with 50 percent reductions in applied tariffs and other border protection by developed countries and 33 percent reductions by developing countries). Most regions gain, with the largest gains by far going to China, followed by other South and East Asian countries. The Middle Eastern and North African countries experience gains as well. Smaller gains are realized by most Latin American countries and South Africa. There are some net losers from manufacturing liberalization, notably Bangladesh and East and Sub-Saharan Africa.

If more modest reductions are made to manufacturing protection (36 percent reductions in applied border protection by developed countries, and 24 percent reductions by developing countries) overall gains are about 28 percent lower for developing countries as a group, with a similar distribution of gains among countries, as shown in figure 3.5. Though most developing countries and regions see positive but reduced income gains, the three countries or regions that are net losers under either manufacturing scenario—Bangladesh and East and Sub-Saharan Africa—lose less if tariffs are reduced less. This suggests that in terms of manufactured goods, the main impact on these least developed countries (LDCs) arises from preference erosion, as the relative difference between their current preferential market access and the terms for other countries decreases.

An alternative way to measure the impact of manufacturing liberalization on developing countries or regions is to trace the change in their share of world export markets for

Figure 3.4. Manufacturing Liberalization: Developing Country Winners and Losers under Doha Scenario for Manufactures[a]

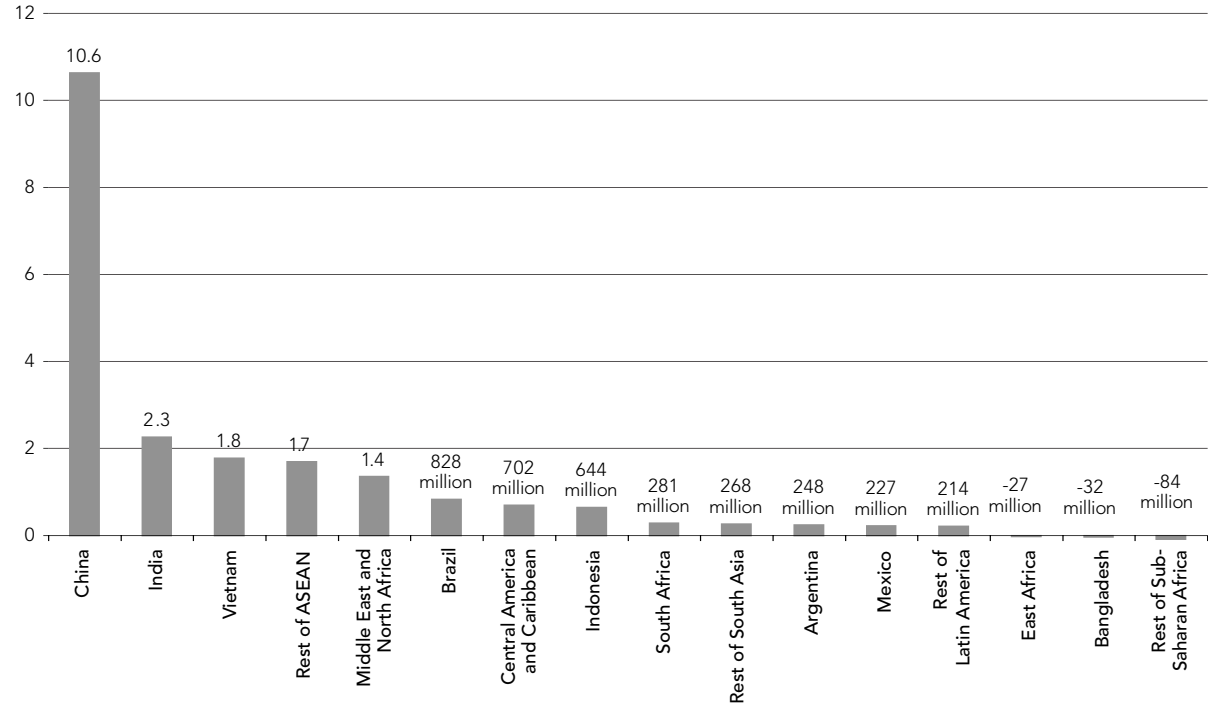
(CHANGE IN REAL INCOME, BILLIONS OF DOLLARS)



a. Scenario 2.

Figure 3.5. Manufacturing Liberalization: Developing Country Winners and Losers under Modest Scenario for Manufactures[a]

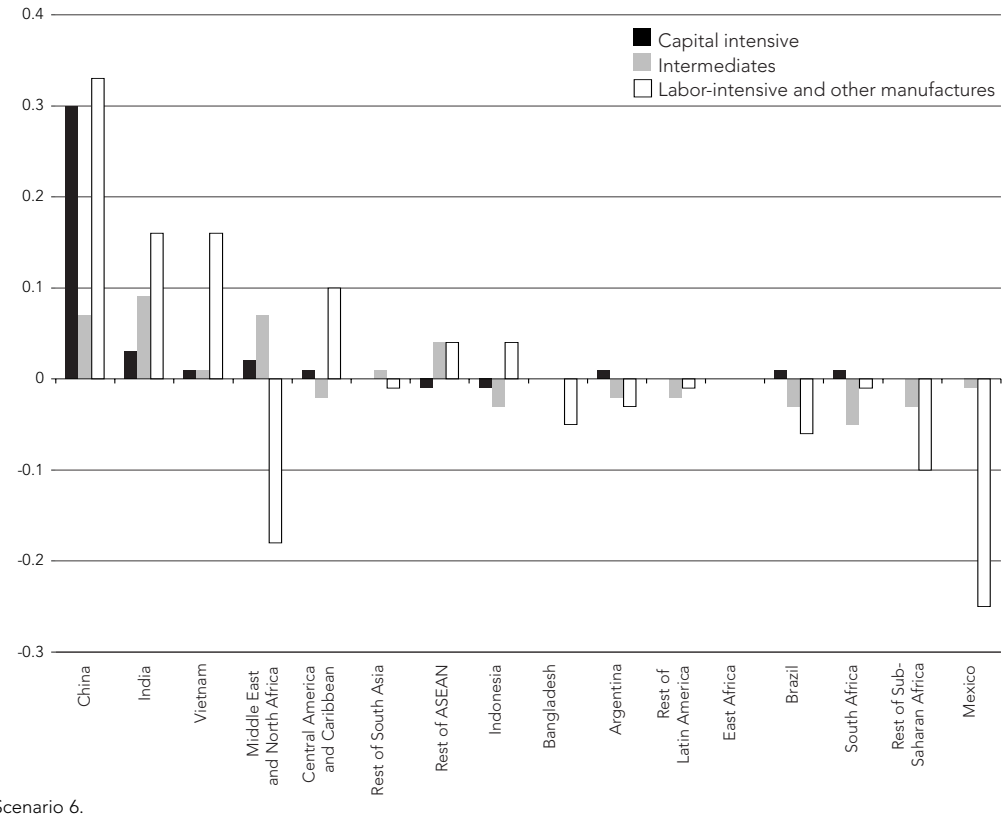
(CHANGE IN REAL INCOME, BILLIONS OF DOLLARS)



a. Scenario 5.

Figure 3.6. Gains (Losses) of World Export Market Share for Developing Countries' Manufactures Exports under Hong Kong Scenario, by sub-sector[a]

(CHANGE IN PERCENTAGE OF WORLD EXPORT MARKET)



a. Scenario 6.

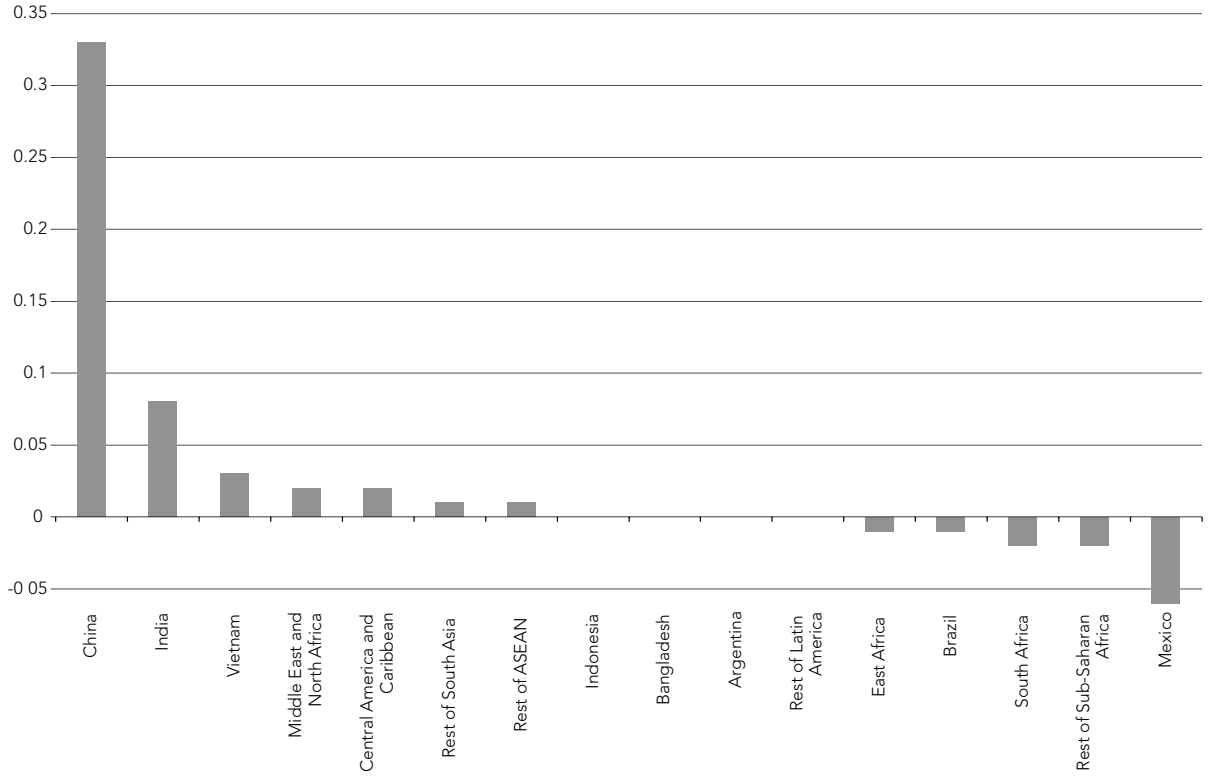
manufactured goods. Figure 3.6 presents the change in each country's share of the world market for manufactures under the Hong Kong scenario.[29] Again, China is the big winner. It should be noted that although the changes in market share seem small (less than 0.4 percent, in China's case), these are percentages of the huge world market for manufactures, which currently amounts to $6.57 trillion. The increase in China's share would be worth about $22 billion. India and Vietnam also experience gains in world market share, although much less than those of China. Smaller gains for some products but losses for others accrue to Central America and the Caribbean, the Middle East and North Africa, other ASEAN members, Indonesia, and the rest of South Asia. Mexico experiences the largest losses in market share, reflecting the erosion of its current advantages in access to the U.S. market under the North American Free Trade Agreement. Sub-Saharan Africa loses world market share in some or all manufactured products.

Overall gains or losses of world export market share under the Hong Kong scenario are presented in figure 3.7.

The second main finding for developing countries, that agricultural liberalization alone benefits only a minority of them, is illustrated in figure 3.8. Most developing countries and regions do not benefit from agricultural liberalization in terms of overall real income, and the effects are highly differentiated.[21] Argentina, Brazil, and some ASEAN countries, notably Thailand, are the main winners. It is noteworthy that even for these competitive agricultural exporters, the gains are small. Gains from manufacturing liberalization (figures 3.4 and 3.5) were measured in billions of dollars, while the highest gains from agricultural liberalization

Figure 3.7. Gains (Losses) of World Export Market Share for Developing Countries' Manufactures Exports under Hong Kong Scenario[a]

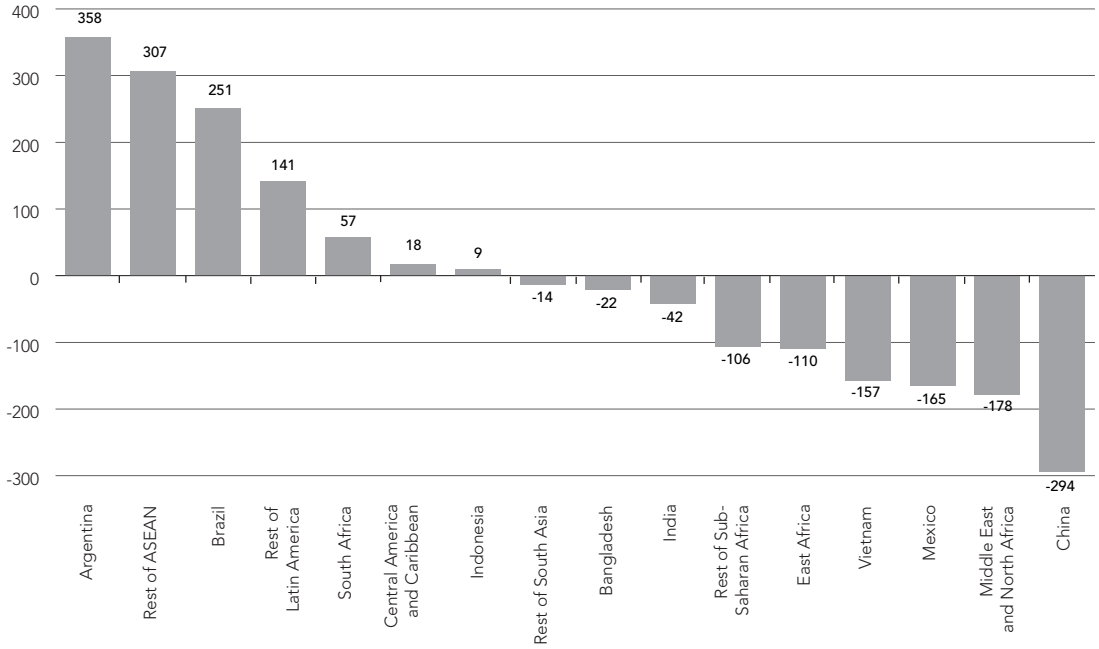
(CHANGE IN PERCENTAGE OF WORLD EXPORT MARKET)



a. Scenario 6.

Figure 3.8. Agricultural Liberalization: Developing Country Winners and Losers under Doha Scenario for Agriculture[a]

(CHANGE IN REAL INCOME, MILLIONS OF DOLLARS)



a. Scenario 1.

amount to only $358 million (for Argentina). Most of Latin America and South Africa benefit, although on a very small scale.

More than half of the countries or regions in the developing world would be net losers in terms of their overall real income if agriculture were the only sector to be liberalized, although the losses, like the gains, are relatively small. The losers include many of the world's LDCs, including Bangladesh and the countries of East Africa and the rest of Sub-Saharan Africa. The Middle East and North Africa, Vietnam, and Mexico experience losses, which partly offset the gains they enjoy under the liberalization of the manufacturing sector. India also is a net loser, on a very small scale.

China comes out as the biggest single loser from agriculture-only liberalization. China has already agreed to substantial agriculture sector liberalization under its World Trade Organization (WTO) accession agreement, and it is expected to experience employment losses from those measures. The model demonstrates that further liberalization of the sector in the Doha Round would inflict additional losses on China. Although China's losses are greater in absolute terms than those of other countries, as a percentage of Chinese GDP the losses are small.

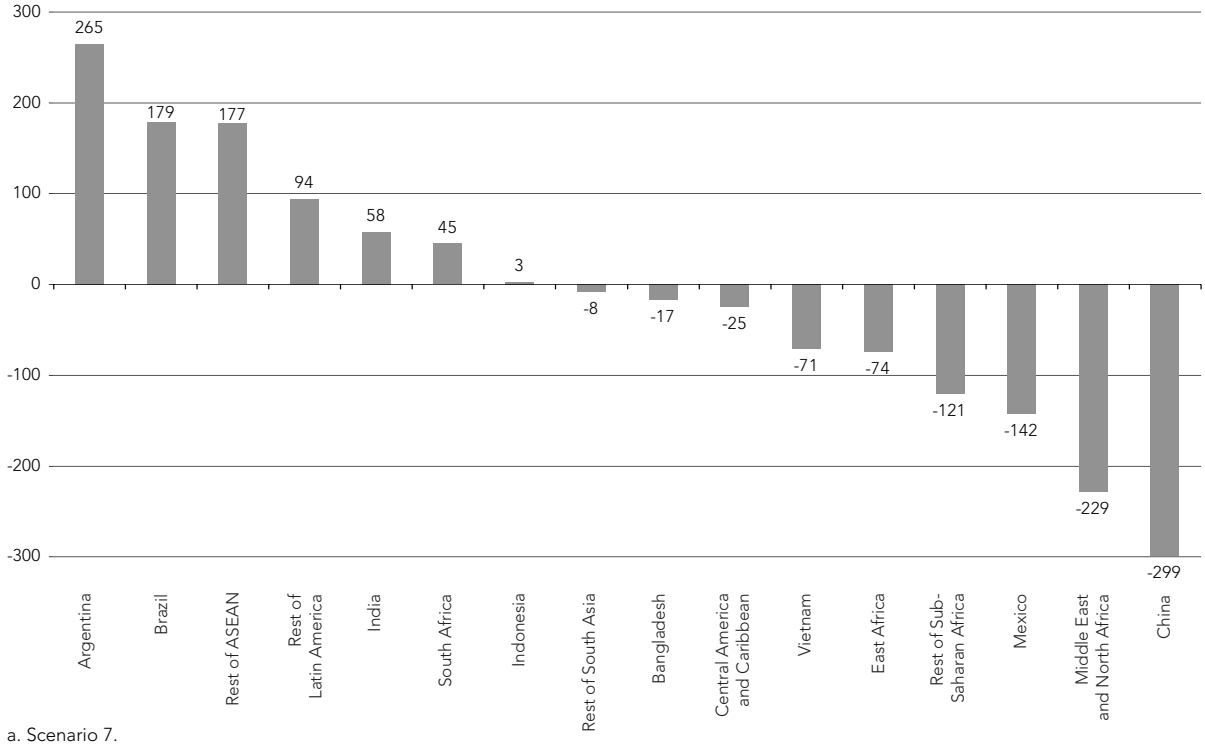
As with manufacturing liberalization, we also tested a scenario in which more modest reductions are made to tariffs, subsidies, and other protection for agricultural products (scenario 7). Under this scenario, developed countries reduce border protection and domestic support by 25 percent while developing countries make reductions of 15 percent in these types of protection. Both eliminate export subsidies. LDCs make no changes. The results, presented in figure 3.9, indicate that several developing countries or regions gain more (or lose less) in terms of overall real income under the more modest agricultural scenario. India moves from being a net loser to a net winner (although on a very small scale), while Vietnam, Bangladesh, the rest of South Asia, East Africa, and Mexico remain losers but lose less. However, other developing countries fare less well under the more modest scenario. China, the Middle East, North Africa, and the rest of Sub-Saharan Africa face slightly larger losses, while Indonesia and the rest of ASEAN, South Africa, Brazil, Argentina, and the rest of South America experience smaller gains. Central America and the Caribbean shift from very small gains to very small losses.

Figure 3.10 presents changes in world export market share for agricultural products under the Hong Kong scenario. The overall pattern is somewhat similar to the pattern of real income gains and losses, but significant variations emerge that reflect the relative weight and efficiency of agriculture in different developing economies. Brazil dramatically outstrips other Latin American and ASEAN countries in terms of increased overall market share, a reflection of its size and the fact that many of its agricultural products are globally competitive. However, Brazil loses market share in labor-intensive products. Market share in some or all products is lost by East African and other Sub-Saharan African countries, Indonesia, and Bangladesh. This is particularly noteworthy because many commentators have based calls for progress on agricultural liberalization in the Doha Round on the supposed benefits it would bring to low-income African countries.

Other studies have shown that losses for some of these countries arise from the erosion of preferences they currently enjoy in wealthy country markets, particularly those of the EU.[22] However, a more fundamental problem is the structure of the agricultural sector in many developing countries, where low-productivity, small-scale subsistence farming makes up a

Figure 3.9. Agricultural Liberalization: Developing Country Winners and Losers under Limited Scenario for Agriculture[a]

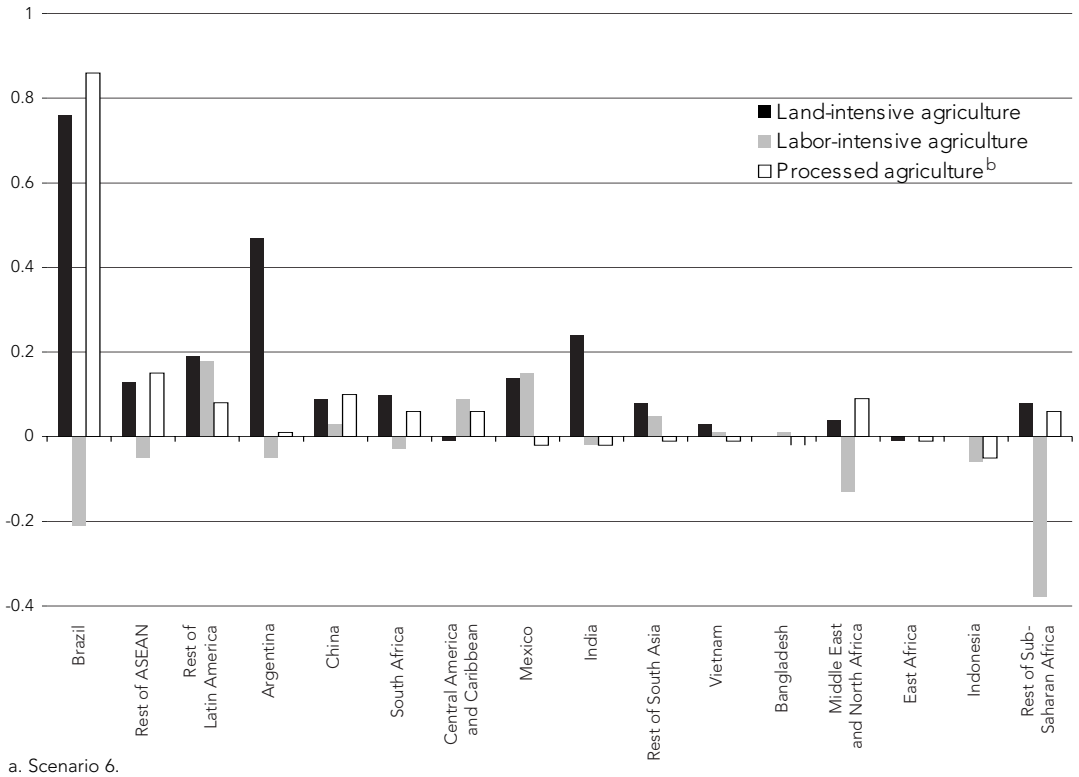
(CHANGE IN REAL INCOME, MILLIONS OF DOLLARS)



a. Scenario 7.

Figure 3.10. Gains (Losses) of World Export Market Share for Developing Countries' Agriculture Exports under Hong Kong Scenario, by sub-sector[a]

(CHANGE IN PERCENTAGE OF WORLD EXPORT MARKET)



a. Scenario 6.
b. includes meat, dairy products, and sugar.

large portion of agricultural activity. The products of such farms are generally not competitive in global markets, due to problems of scale, productivity, and access to export facilities. Some developing countries' agricultural sectors are so dominated by this type of low-productivity farming that they have few or no globally competitive agricultural exports. This is true of many LDCs and other low-income countries. Other developing countries have some agricultural subsectors that are competitive on export markets, while low-productivity, small-scale farming persists more broadly. The distribution of economic activity and employment in the competitive and noncompetitive sectors will be an important determinant of whether a particular country gains or loses from agricultural liberalization. For example, countries such as Indonesia and India might benefit from lowered barriers abroad for certain products in which they can compete. However, lowering their own trade barriers on crops cultivated by their small-scale farmers could lead to displacement of those crops by cheaper imports. If these farmers make up a significant share of the working population, the net effect could be negative for the overall economy. As a result, such countries are concerned as much or more with their defensive interests in global agricultural trade as with opening markets abroad for their competitive agricultural products.

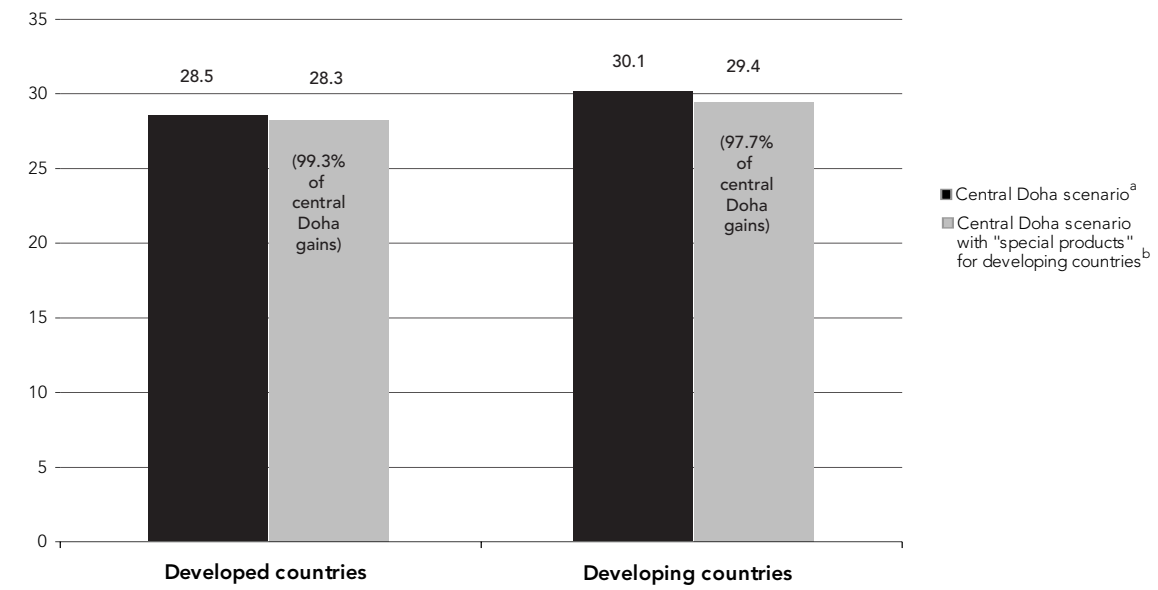
The pervasiveness of small-scale farming in many developing countries has led them to demand special consideration for their agricultural sectors in negotiations at the WTO. Their concerns have already produced agreement that they will have the flexibility to designate a number (still to be agreed) of agricultural products as "special products" subject to less liberalization, based on food security, livelihood security, and rural development concerns.[23] It has also been agreed that they will have recourse to a "special safeguard mechanism" that would allow them to restrict imports based on volume surges or declining prices, with details yet to be negotiated.

To test the impact on other countries of extending such special and differential treatment to the agricultural sectors of countries with these concerns, we constructed scenario 4, which allows developing countries to shield agricultural products from liberalization. The scenario we modeled simulates an outer bound of special and differential treatment. It represents the extreme case in which developing countries are permitted and choose to shelter *all* their agricultural products.

The results of this scenario constitute the third major finding from the model with respect to developing countries. Special and differential treatment could be extended to their agricultural sectors with only minor reductions in other countries' income gains from the Doha Round, as seen in figure 3.11. A more limited approach—such as the G-33's proposal that 20 percent of agricultural tariff lines be excluded from liberalization by developing countries—could be expected to have even more modest effects.

Several factors explain the minimal impact of allowing special and differential treatment for developing countries' agricultural sectors. With respect to most developed countries, export gains from trade liberalization are to be expected in their most competitive sectors, typically services and manufactures. For those developed countries that currently protect their agricultural sectors, such as the United States, EU members, and Japan, agricultural liberalization offers gains primarily through the channel of their own increased efficiency in resource allocation. Competitive agricultural exporters among high-income countries, such as the United States, Canada, and Australia, are likely to see gains primarily in the markets of other high-income countries, particularly those that

Figure 3.11. Impact of Flexibility for "Special Products" on Real Income Gains for Developed and Developing Countries
(CHANGE IN REAL INCOME, BILLIONS OF DOLLARS)



a. Scenario 3.
b. Scenario 4.

currently have high levels of protection, such as Japan and the EU members. For developing countries, most gains from agricultural liberalization also arise from increased exports to wealthy country markets and, to a much smaller degree, from gains in resource allocation efficiency.

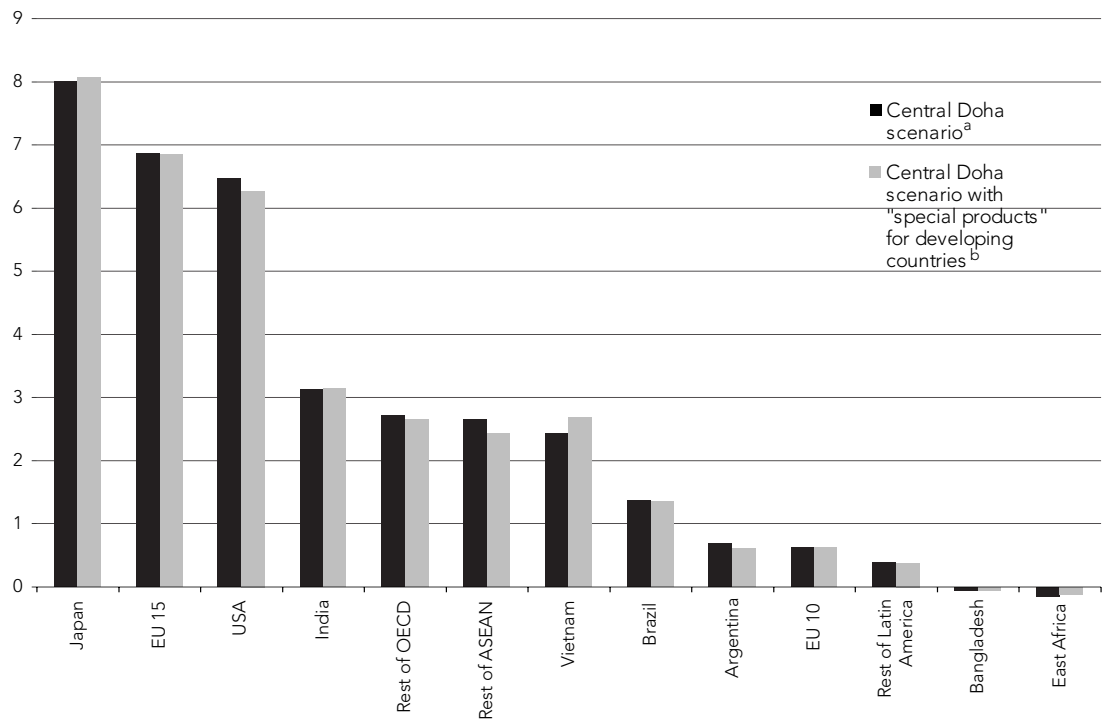
The results of simulations done by the World Bank suggest a similar outcome. Under the Bank's central Doha scenario (World Bank scenario 7), increases in agriculture and food exports from high-income countries go entirely to other high-income countries.[24] Their agricultural exports to developing countries do not increase at all. For developing countries, more than 75 percent of increased agricultural exports go to high-income countries (see table 4.3 in chapter 4).

Figure 3.12 gives disaggregated results for selected countries, including those that are most competitive in world agricultural export markets. The results indicate that any loss of real income gains is minor, even for the group of countries that would be most affected.

India and Vietnam experience slightly greater overall income gains under this scenario, despite allocative efficiency gains they might sacrifice. Bangladesh and the East African countries experience smaller losses. For most countries, there is very little effect from allowing even this extreme version of special and differential treatment for developing countries' agricultural sectors.

The fourth major finding with regard to developing countries is the possibility that the poorest countries may lose from *any* likely Doha scenario unless special measures are taken on their behalf. Figure 3.13 shows that Bangladesh, East Africa, and the rest of Sub-Saharan Africa are adversely affected in every Doha scenario modeled, regardless of whether the level of ambition is modest or high.

Figure 3.12. Impact of Flexibility for "Special Products" on Real Income Gains for Selected Countries
(CHANGE IN REAL INCOME, BILLIONS OF DOLLARS)



a. Scenario 3.
b. Scenario 4.

These results arise from several factors. In the agricultural sector, the most fundamental problems are the concentration of livelihoods in low-productivity agriculture, the lack of competitiveness on world export markets, and the erosion of existing preferences. In the manufacturing sector, some LDCs have begun in recent years to compete in low-skilled manufactured products such as apparel. They have gained small shares in world export markets, often based on preferential access to high-income country markets. They would face problems in a liberalized environment arising from competition from more efficient producers. The solution to these problems is complicated by the current patchwork of preference programs that favor some low-income countries over other similarly situated countries. Possible solutions are discussed in chapter 5.

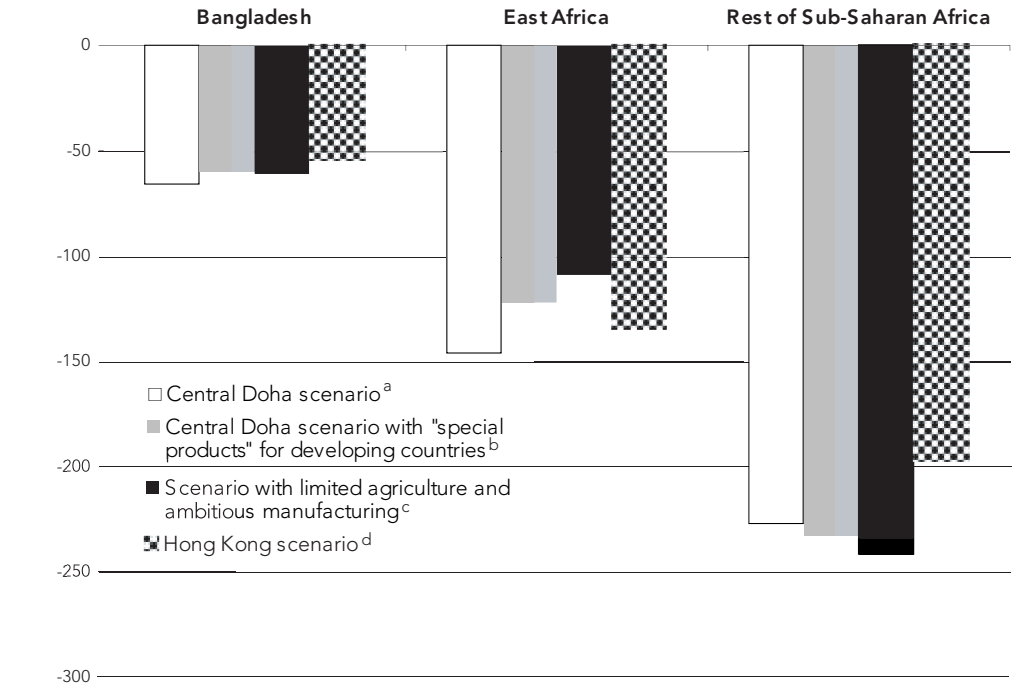
The sectoral composition of real income gains (or losses) to developing countries under the various sectoral scenarios are shown together in figure 3.14. It is noteworthy that even competitive agricultural exporters such as Brazil gain more overall from manufacturing than from agricultural liberalization. Only Argentina gains more from agricultural liberalization.

Total real income gains or losses from both agriculture and manufacturing liberalization under the central Doha and Hong Kong scenarios are presented in figure 3.15. Less ambitious manufacturing liberalization produces smaller gains for most developing countries, while producing smaller losses for the poorest countries.

The Results for Developed Countries

Although the Carnegie model was constructed primarily to assess the impact of Doha liberalization on developing countries, the model is global in scope and interesting results also

Figure 3.13. Poorest Countries Lose Income under All Doha Scenarios
(CHANGE IN REAL INCOME, MILLIONS OF DOLLARS)



a. Scenario 3.
b. Scenario 4.
c. Scenario 8.
d. Scenario 6.

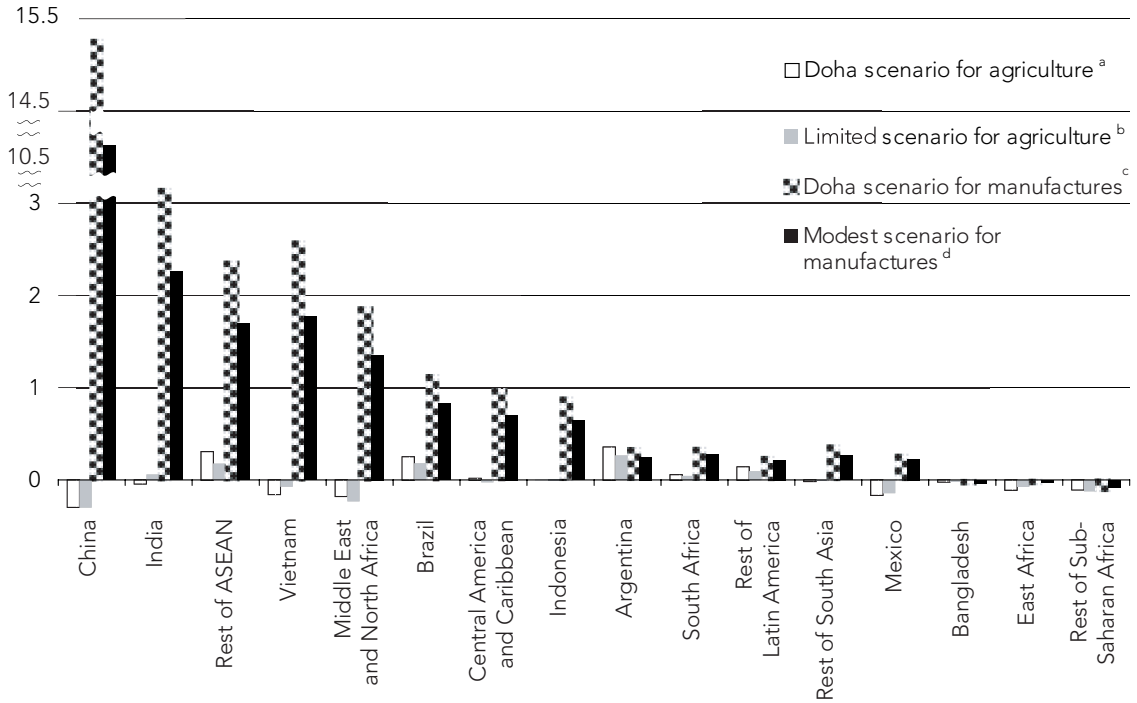
emerge for the developed world. Selected results are presented here.

All developed countries and regions experience positive gains from each of the four overall Doha scenarios modeled, as shown in figure 3.16. In each case, the gains come mainly from the liberalization of manufacturing rather than from the liberalization of agriculture, even taking into account the efficiency gains the countries realize from the liberalization of their own agricultural sectors (figure 3.17). The gains vary depending on the extent of liberalization, although the level of ambition makes more difference in the manufacturing sector than in the agricultural sector for these countries. As noted above, service liberalization was not modeled. Service sector liberalization could be expected to provide additional gains to developed countries.

Figure 3.17 shows that U.S. real income gains arise overwhelmingly from manufacturing liberalization rather than from agricultural liberalization. For the EU 15 (including the Western and Central European members but not the ten new members that acceded in 2004) and Japan, manufacturing accounts for most of the gains, but agricultural liberalization contributes relatively more than in the case of the United States. This is attributable to the removal of higher levels of agricultural distortions and resulting gains in efficiency in the European and Japanese economies.

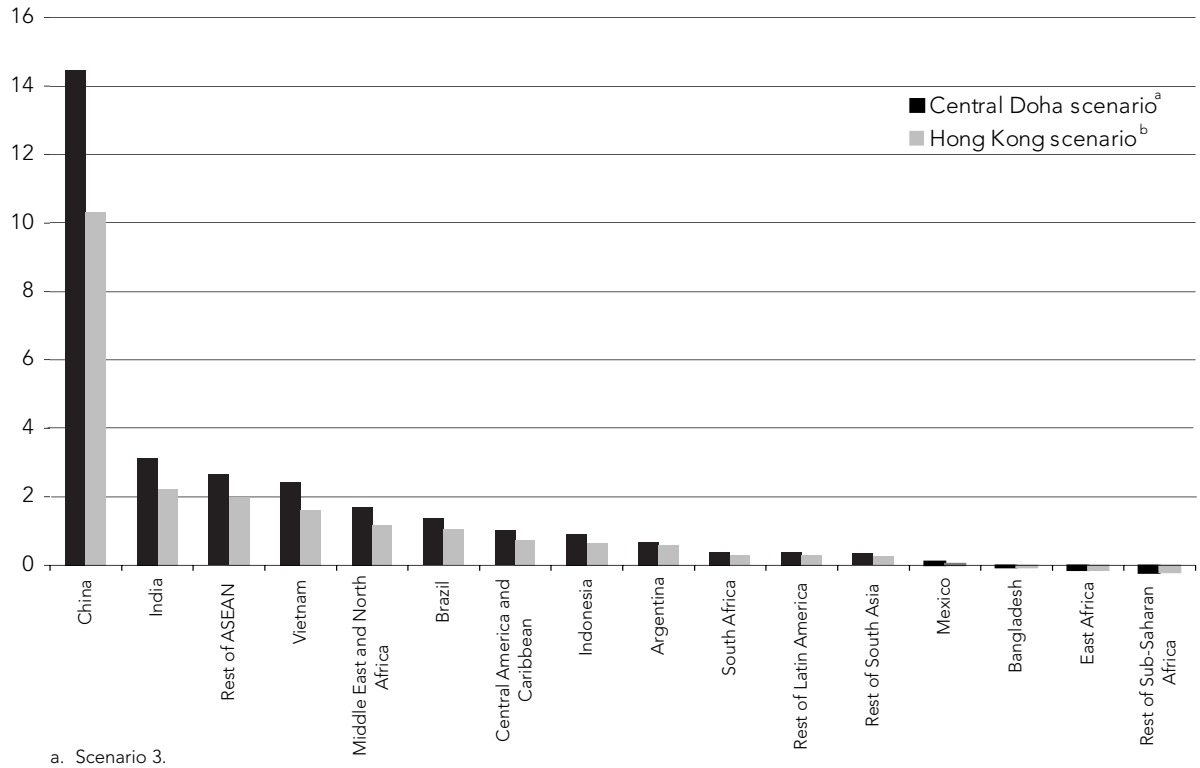
Changes in the share of world export markets for developed countries are shown in figures 3.18 and 3.19. The patterns shown offer insights into the political economy of different countries' negotiating postures in the Doha Round. For the EU 15, expected losses in the world agricultural market are offset by gains in the larger world markets for capital-intensive and intermediate manufactures, which are higher value-added products. The opposite is true for

Figure 3.14. Sectoral Composition of Real Income Gains for Developing Countries
(CHANGE IN REAL INCOME, BILLIONS OF DOLLARS)



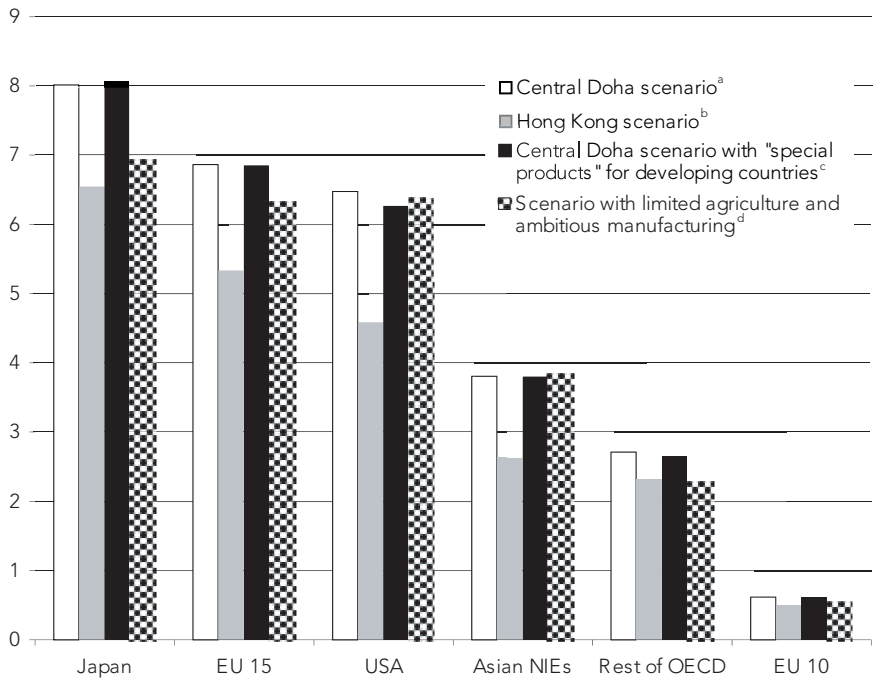
a. Scenario 1.
b. Scenario 7.
c. Scenario 2.
d. Scenario 5.

Figure 3.15. Real Income Gains (Losses) for Developing Countries under Overall Scenarios
(CHANGE IN REAL INCOME, BILLIONS OF DOLLARS)



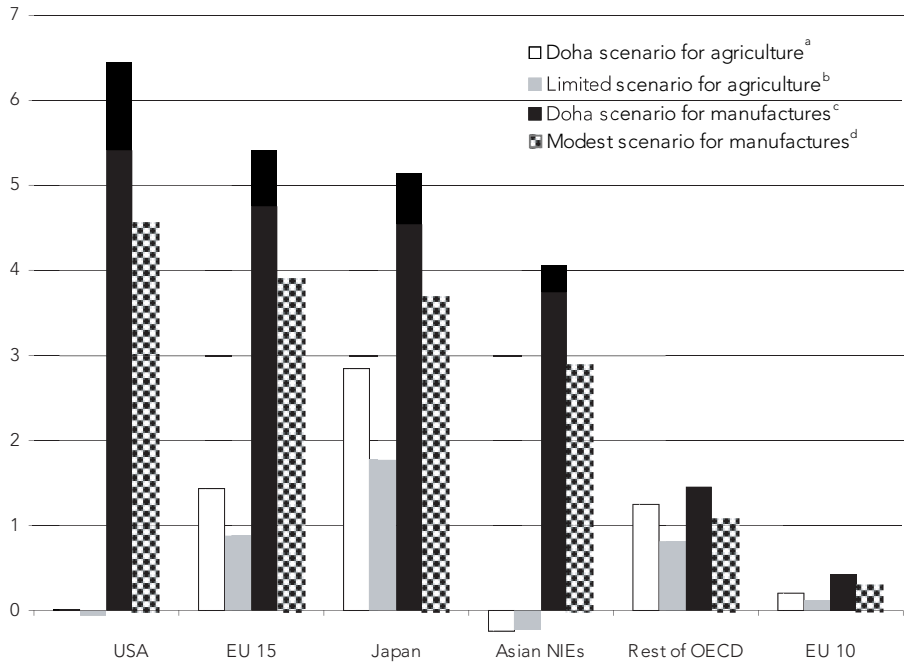
a. Scenario 3.
b. Scenario 6.

Figure 3.16. Real Income Gains for Developed Countries under Overall Scenarios
(CHANGE IN REAL INCOME, BILLIONS OF DOLLARS)



a. Scenario 3.
b. Scenario 6.
c. Scenario 4.
d. Scenario 8.

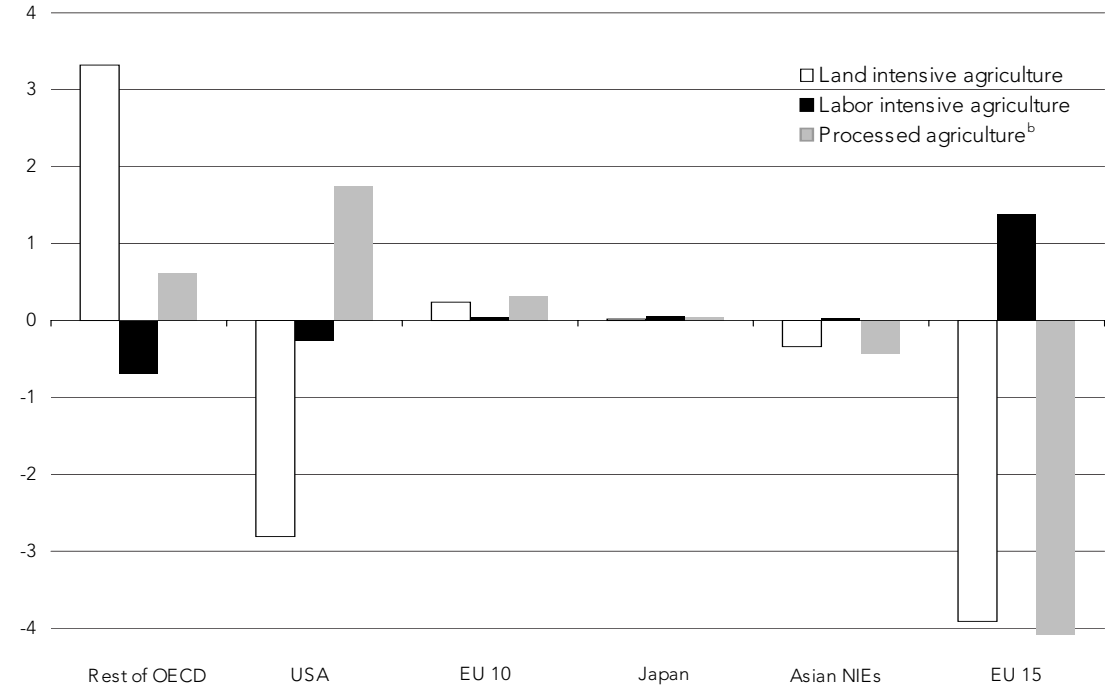
Figure 3.17. Sectoral Composition of Real Income Gains for Developed Countries
(CHANGE IN REAL INCOME, BILLIONS OF DOLLARS)



a. Scenario 1.
b. Scenario 7.
c. Scenario 2.
d. Scenario 5.

Figure 3.18. Gains (Losses) of World Export Market Share for Developed Countries' Agriculture Exports under Hong Kong Scenario, by sub-sector[a]

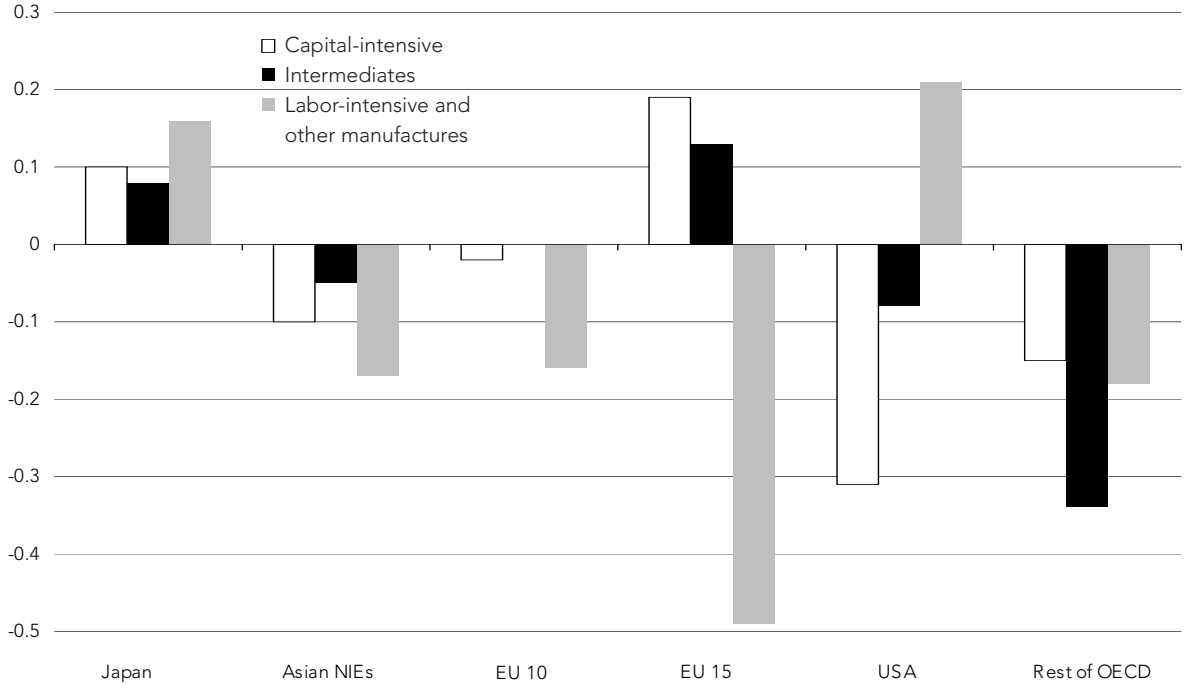
(CHANGE IN PERCENTAGE OF WORLD EXPORT MARKET)



a. Scenario 6.
b. Includes meat, dairy products, and sugar.

Figure 3.19. Gains (Losses) of World Export Market Share for Developed Countries' Manufactures Exports under Hong Kong Scenario, by sub-sector[a]

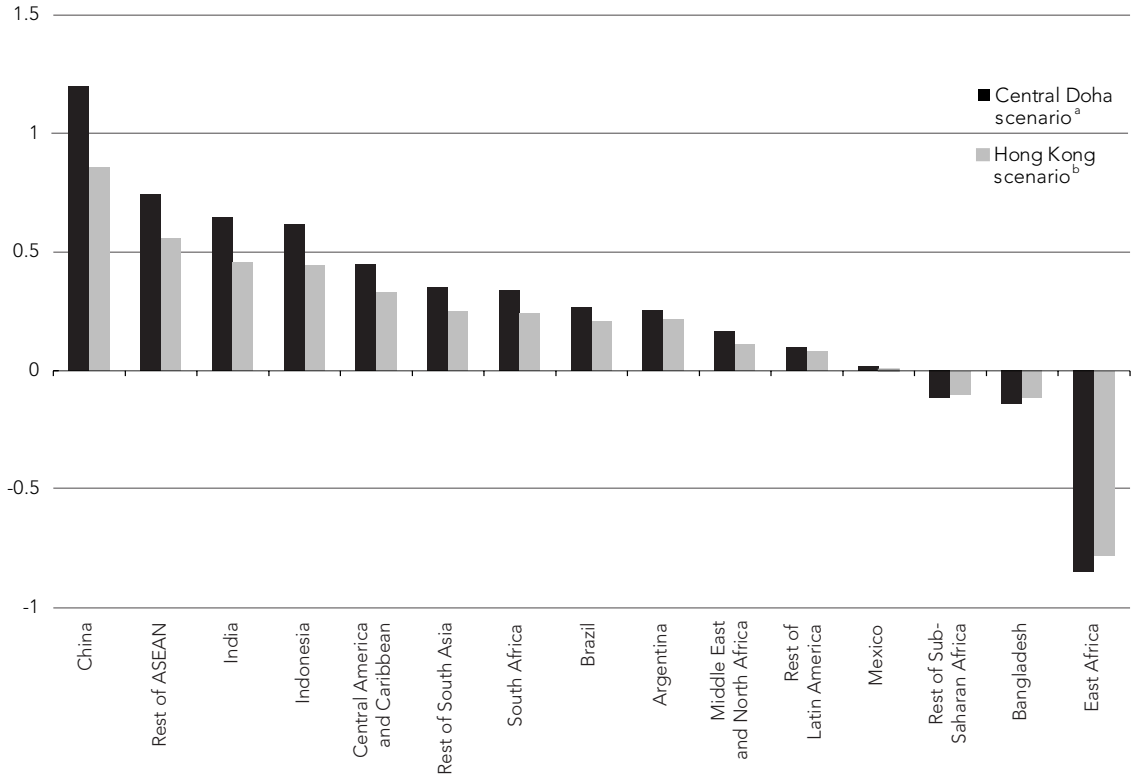
(CHANGE IN PERCENTAGE OF WORLD EXPORT MARKET)



a. Scenario 6.

Figure 3.20. Developing Country Real Income Gains (Losses) as a Percentage of GDP under Central Doha and Hong Kong Scenarios

(PERCENT GAIN OF REAL INCOME OVER BASE YEAR GDP)



Note: Vietnam experiences significantly greater real income gains in the simulation than the countries shown, gains of 7.2 percent under the central Doha scenario and 4.9 percent under the Hong Kong scenario. However, this is attributable to the assumption that it accedes to the World Trade Organization during the period simulated, not to gains from the policy changes of the scenario itself.

a. Scenario 3.

b. Scenario 6.

countries like Australia and Canada (grouped in the rest of OECD), which lose manufacturing market share but gain share in the world agricultural market. The United States loses market share in land- and labor-intensive agriculture while gaining market share in processed agriculture and food. Its share of capital-intensive and intermediate manufactures markets declines, although its share of labor-intensive and other manufactures increases. This category includes such high value-added products as motion pictures, video games, and photographic film.

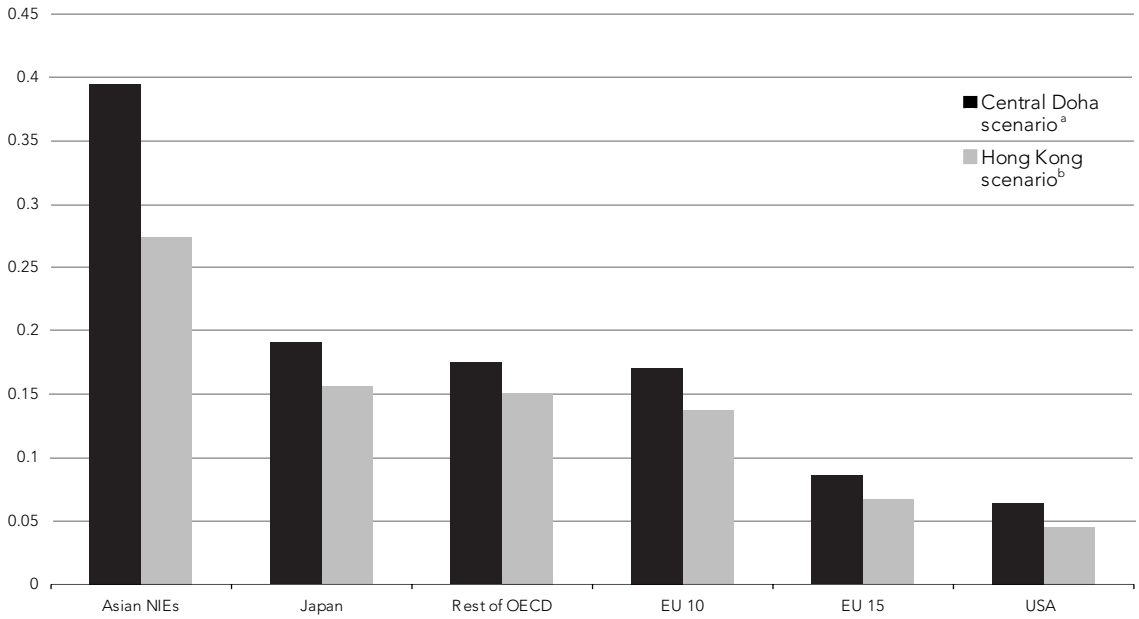
Income Gains Relative to GDP

Given the huge differences in the sizes of economies in both the developed and developing worlds, it is instructive to assess the gains for each country or region as a percentage of its current GDP, to see the relative importance of trade changes to each economy. Figures 3.20 and 3.21 present the gains or losses under the central Doha and Hong Kong scenarios for developing and developed countries respectively.

Maximum gains and losses are about 1 percent of GDP for the most affected economies. The biggest gainer is China, with an increase ranging from 0.8 to 1.2 percent under the two scenarios. The biggest losers are the three countries of East Africa, who see a reduction in income of about 0.8 percent under either scenario. Because of the way countries are aggregated, the average gains or losses for the many countries in the rest of Sub-Saharan Africa appear to be less than

Figure 3.21. Developed Country Real Income Gains as a Percentage of GDP under Central Doha and Hong Kong Scenarios

(PERCENT GAIN OF REAL INCOME OVER BASE YEAR GDP)



a. Scenario 3.
b. Scenario 6.

those for Tanzania, Uganda, and Malawi. However, this is probably an artifact of aggregation. It is likely that many other Sub-Saharan African countries whose economies share similar structures and endowments with the East African countries experience similar magnitudes of losses. Most countries' gains or losses range from 0 to 0.5 percent. The average increase in real income for developing countries would amount to 0.48 percent (less than one-half of one percent) under the most ambitious scenario modeled, while for developed countries the average increase in real income would be 0.11 percent. Under the more realistic Hong Kong scenario, developing countries gain real income of 0.34 percent and developed countries gain 0.09 percent (less than one-tenth of one percent).

Underlying Changes in World Prices, Terms of Trade, and Net Trade Patterns

To understand the factors that contribute to these outcomes, we now turn to the changes in world prices and net trade patterns that occur under the main scenarios. Table 3.2 summarizes changes in average world export prices for each of the 27 sectors that occur under two sectoral and two overall Doha scenarios. Table 3.3 presents the same data for world import prices.

World export and import prices for all agricultural products increase under both of the overall scenarios. Increases range from about 0.5 to about 6.5 percent for major categories of agricultural and food imports. By contrast, manufacturing liberalization intensifies competition in several manufacturing sectors, including apparel, metal products, and motor vehicles and parts, with export prices declining slightly. Prices for most other manufactured goods increase slightly or remain unchanged. Figure 3.22 presents the changes in agricultural and manufactures export prices under the Hong Kong scenario.

These sectoral price changes contribute to changes in the terms of trade for each country or region. A country's terms of trade are defined as

Table 3.2. Percentage Change in World Export Prices under Different Scenarios

Sector	(1) Doha Scenario for Agriculture	(2) Doha Scenario for Manufactures	(3) Central Doha Scenario	(6) Hong Kong Scenario
Grains	3.53	0.18	3.73	3.67
Oilseeds	3.76	0.11	3.89	3.85
Vegetables and fruits	0.74	0.23	0.98	0.91
Other crops	0.75	0.24	1.00	0.93
Livestock	0.55	0.34	0.89	0.79
Meat and dairy products	5.53	0.26	5.69	5.65
Sugar	1.94	0.02	1.93	1.93
Processed foods	0.79	0.21	1.01	0.95
Beverages and tobacco	0.24	0.24	0.48	0.41
Forestry and fishery	0.17	0.24	0.40	0.34
Crude oil and natural gas	-0.03	0.06	0.02	0.01
Textiles	-0.06	0.10	0.05	0.02
Apparel	-0.04	-0.09	-0.13	-0.10
Leather and footwear	0.03	0.25	0.27	0.20
Other manufactures	-0.07	0.15	0.08	0.04
Wood and paper products	-0.01	0.19	0.17	0.13
Petroleum, coal, and mineral products	-0.03	0.19	0.17	0.13
Chemical, rubber, and plastic products	-0.09	0.16	0.08	0.04
Metals and metal products	-0.05	0.04	-0.02	-0.03
Motor vehicles and other transport equipment	-0.10	0.10	-0.01	-0.03
Electronic equipment	-0.10	0.13	0.03	0.00
Other machinery	-0.11	0.16	0.06	0.01
Trade and transportation	-0.08	0.38	0.30	0.19
Financial services, banking, and insurance	-0.07	0.31	0.24	0.15
Communication, health, education, and public services	-0.05	0.21	0.16	0.10
Recreational and other services	-0.08	0.31	0.23	0.15
Housing, utilities, and construction	-0.08	0.16	0.08	0.04

the ratio between prices for its exports and prices for its imports. For example, if a country exports mainly agricultural goods and world agricultural prices increase while it imports mainly manufactured goods and those prices remain steady or decline, the country would experience an improvement in its terms of trade. Table 3.4 gives figures for terms of trade changes arising from two sectoral and two overall Doha scenarios. Sectoral contributions to changes in terms of trade can be seen in the first two columns. The overall Doha and Hong Kong scenarios, reflecting different levels of ambition in different sectors, produce similar changes in the patterns of terms of trade, with differences in the level but not the direction of change.

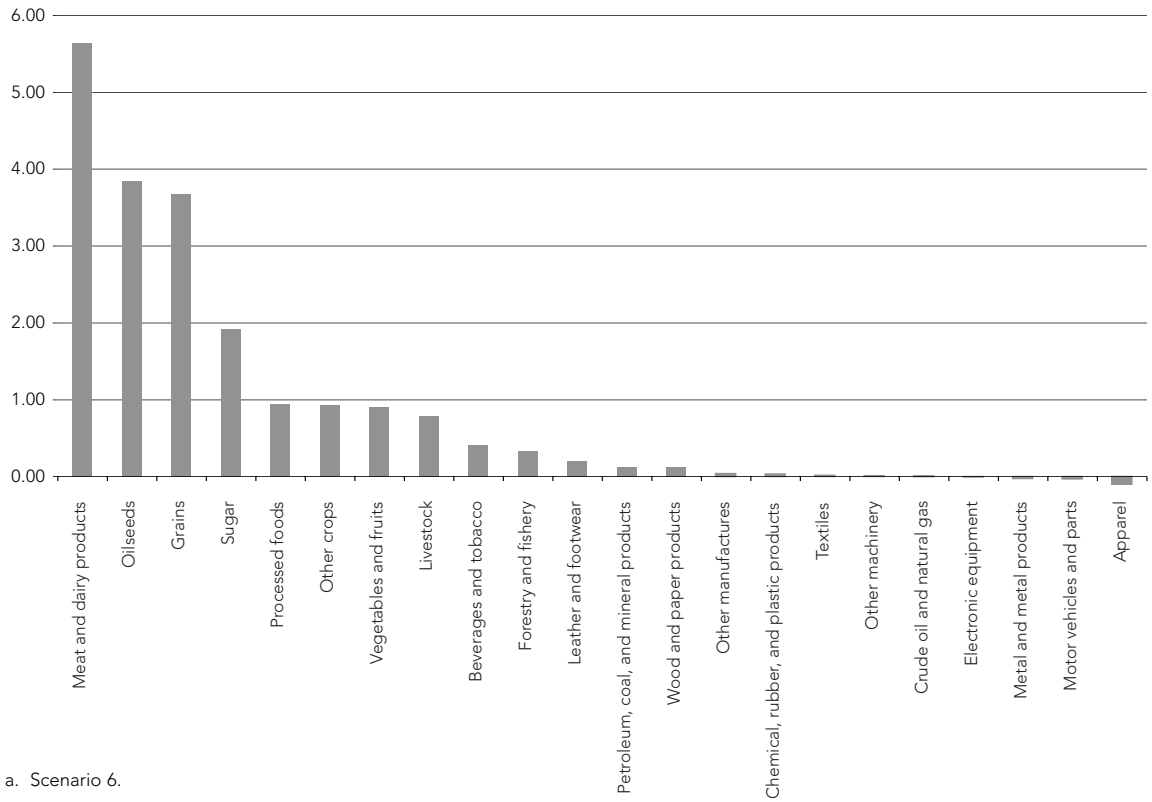
The overall scenarios produce improvements in the terms of trade for the EU 15 and the Asian newly industrialized economies (NIEs), but deteriorations for all other countries and regions. Gains from small increases in the prices of many manufactured goods exported by China, ASEAN, and Japan are more than offset by increased prices for their agricultural imports. Most developing countries experience a terms-of-trade deterioration under all sectoral and overall scenarios. Even Brazil, which sees improved terms of trade under the agriculture-only scenario, experiences deterioration in the combined scenarios because manufacturing price changes dominate overall effects. For some countries, this deterioration is offset by an increase in the volume of their exports, discussed below. In the case of some of the poorest countries, however, the combination of sectoral price changes compounds losses. For example, the increase in world prices for food and agricultural products that they import is coupled with a decline in world prices for their main manufactured export, apparel. Their manufactured export volumes also decrease. This combination is a key driver of the real income losses for the three poorest country groups (Bangladesh, East Africa, and the rest of Sub-Saharan Africa).

Table 3.3. Percentage Change in World Import Prices under Different Scenarios

Sector	(1) Doha Scenario for Agriculture	(2) Doha Scenario for Manufactures	(3) Central Doha Scenario	(6) Hong Kong Scenario
Grains	3.83	0.18	4.03	3.97
Oilseeds	3.70	0.11	3.82	3.78
Vegetables and fruits	0.67	0.24	0.93	0.85
Other crops	0.72	0.24	0.97	0.90
Livestock	0.55	0.34	0.90	0.80
Meat and dairy products	6.22	0.27	6.38	6.33
Sugar	2.52	0.04	2.52	2.51
Processed foods	0.85	0.21	1.06	1.00
Beverages and tobacco	0.24	0.24	0.48	0.41
Forestry and fishery	0.24	0.18	0.41	0.36
Crude oil and natural gas	-0.03	0.06	0.02	0.01
Textiles	-0.06	0.08	0.02	0.00
Apparel	-0.04	-0.07	-0.12	-0.09
Leather and footwear	0.03	0.29	0.31	0.23
Other manufactures	-0.07	0.11	0.04	0.02
Wood and paper products	-0.02	0.22	0.20	0.15
Petroleum, coal, and mineral products	-0.03	0.19	0.16	0.13
Chemical, rubber, and plastic products	-0.09	0.18	0.10	0.05
Metals and metal products	-0.05	0.06	0.02	0.00
Motor vehicles and other transport equipment	-0.10	0.12	0.02	-0.01
Electronic equipment	-0.10	0.13	0.04	0.00
Other machinery	-0.10	0.16	0.06	0.02
Trade and transportation	-0.08	0.37	0.29	0.19
Financial services, banking, and insurance	-0.07	0.31	0.24	0.15
Communication, health, education, and public services	-0.05	0.21	0.16	0.10
Recreational and other services	-0.08	0.30	0.23	0.14
Housing, utilities, and construction	-0.08	0.16	0.08	0.04

Figure 3.22. Impact of Hong Kong Scenario on Global Prices[a]

(PERCENT CHANGE IN WORLD EXPORT PRICES)



a. Scenario 6.

Table 3.4. Percentage Change in International Terms of Trade under Different Scenarios

Country or region	(1) Doha Scenario for Agriculture	(2) Doha Scenario for Manufactures	(3) Central Doha Scenario	(6) Hong Kong Scenario
China	-0.66	0.34	-0.33	-0.49
Indonesia	-0.42	0.37	-0.06	-0.17
Vietnam	-0.49	-1.05	-1.54	-0.97
Rest of ASEAN	-0.35	0.17	-0.19	-0.26
India	-0.88	-0.97	-1.83	-1.62
Bangladesh	-0.43	-0.24	-0.66	-0.58
Rest of South Asia	-0.47	-0.37	-0.84	-0.76
Russia and FSU	-1.13	-0.40	-1.52	-1.45
Middle East and North Africa	-0.93	-0.52	-1.43	-1.32
South Africa	-0.40	-0.30	-0.70	-0.70
East Africa	-0.38	0.05	-0.33	-0.42
Rest of Sub-Saharan Africa	-0.77	-0.04	-0.79	-0.83
Brazil	0.16	-0.46	-0.30	-0.18
Mexico	-0.16	-0.46	-0.62	-0.48
Argentina	-0.03	-0.41	-0.43	-0.36
Rest of Latin America	-0.70	-0.58	-1.26	-1.12
Central America and Caribbean	-0.49	-0.26	-0.74	-0.67
Rest of the world	-0.64	-0.38	-1.02	-0.92
All developing countries	-0.51	-0.31	-0.81	-0.74
Asian NIEs	-0.30	0.74	0.43	0.19
USA	0.01	-0.23	-0.22	-0.17
EU 15	2.68	0.16	2.85	2.76
EU 10	-1.84	-0.41	-2.23	-2.12
Japan	-0.86	0.51	-0.36	-0.50
Rest of OECD	-0.64	-0.18	-0.81	-0.76
All developed countries	-0.18	0.10	-0.07	-0.12

These price trends are at odds with a long-standing historical pattern of declining prices for agricultural commodities relative to manufactured goods. Changes in both the agricultural and manufacturing sectors are involved in this historical shift. Proposed reductions in domestic support for agriculture by high-income countries under various Doha scenarios would tend to lower production. If demand remains steady, lower supply would drive up prices. Eliminating export subsidies would also increase prices to importing countries.

In the manufacturing sector, worldwide liberalization in labor-intensive products intensifies competition and lowers world prices. There is currently excess production capacity relative to demand for many manufactured goods. This is driven by a number of factors, including the end of the Cold War and the merger of two formerly separate production systems; an abundant supply of unskilled labor in very large countries such as China and India (represented in the model as unemployed or underemployed workers who can be drawn into production with no increase in wages or prices); and the end of the apparel quota system, which had encouraged overcapacity in that sector.

Table 3.5 presents the changes in net exports (in millions of 2001 dollars) induced by the Hong Kong scenario. Generally speaking, the implementation of a trade liberalization agreement like the one modeled here would lead to most East and South Asian developing countries exporting more labor-intensive manufactured goods and electronic equipment and importing more manufactured intermediates and capital-intensive products. Brazil and Argentina would see a broad decline in manufactured exports offset by growth in food and agricultural exports. However, a number of the poorest

developing countries experience an overall decline in exports, dominated by declines in labor-intensive exports and processed food. The labor-intensive sectors in the LDCs cannot attract the same level of production resources as they could before Doha Round liberalization, because profitability is reduced by lower world prices for their manufactured exports. As a result, more production resources remain in or return to those countries' agricultural sectors. The elimination of export subsidies and the reduction of domestic farm support in rich countries push up world food prices, increasing the profitability of agricultural exports, but not enough to fully compensate for the losses in manufacturing and processed food. A similar pattern occurs in the Middle East and North Africa; there, however, a significant increase in oil and gas exports and some improvement in meat and dairy exports offset export losses in labor-intensive manufactured goods.

Changes in Factor Returns and Employment

The changes in returns to land, labor, and capital resulting from the Hong Kong scenario and its two sectoral components are reported in table 3.6. The changes induced by the scenarios are consistent with intuition and the aggregate real income changes discussed above. Returns to agricultural land decline in many high-income countries, dramatically in the case of the EU members (by 26 percent) and Japan (by 23 percent), because of reduced farm subsidies and tariffs in those countries. Returns to agricultural land and labor increase in most developing countries, with the largest gains going to landowners in Brazil, Argentina, South Africa, and other Latin American countries. Though the liberalization of manufactured goods increases the demand for labor in the developing world (with the exception of the poorest countries, as discussed above), wages for unskilled labor do not increase, because of both the abundant supply of labor and the fact that liberalized trade in labor-intensive manufactures drives down world prices for such goods and returns to workers and firms in those sectors.

Table 3.7 presents the percentage change in demand for unskilled labor by sector as a result of implementation of the Hong Kong scenario. Employment of unskilled labor increases by 0.76 percent for developing countries as a group, although the gain is unevenly distributed among countries and across manufacturing subsectors. Significant increases in unskilled employment (from 0.6 to 1.4 percent) are realized by China, Indonesia, the rest of ASEAN, and India.[25] Once again, the three poorest regions in the model (Bangladesh, East Africa, and the rest of Sub-Saharan Africa) actually lose unskilled jobs from manufacturing industries, although they may gain some jobs in their primary agricultural sectors. Whether the agricultural employment growth is sufficient to offset the manufacturing job losses depends on the relative size of the sectors in each country, as well as productivity levels in each sector.

Employment of unskilled labor is largely unchanged in the developed countries and regions overall, but there is extensive compositional change in unskilled employment in several countries. In the United States, losses in textiles, apparel, leather, metal products, motor vehicles, and electronic equipment are offset by gains in unskilled employment in other manufacturing and processed food industries. In the EU 15, losses in unskilled employment in most processed foods, textiles, apparel, and leather are offset by employment gains in intermediate and capital-intensive manufacturing sectors, including metal products, motor vehicles, and other machinery. A fairly similar pattern is seen in Japan, which experiences strong growth in demand for unskilled labor in motor vehicle production. Other high-income OECD countries, including Australia, Canada, and New

Table 3.5. Change in Net Exports under Hong Kong Scenario
(MILLIONS OF DOLLARS)

Sector	China	Indonesia	Vietnam	Rest of ASEAN	India	Bangladesh	Rest of South Asia	Russia and FSU	Middle East and North Africa	South Africa	East Africa	Rest of Sub-Saharan Africa	Brazil
Grains	191.07	-5.7	5.42	-9.71	102.47	9.61	36.26	243.96	-59.14	39.43	-2.53	32.2	-56.08
Oilseeds	-97.84	6.14	16.36	-8.71	62.73	1.87	4.54	83.9	31.98	19.91	3.94	69.99	599.28
Vegetables and fruits	106.66	1.27	6.17	25.48	-132.37	-0.47	-3.53	-36.92	-84.07	0.91	1.79	-2.31	-42.58
Other crops	-125.93	-45.62	21.17	-178.61	-29.74	18.91	11.5	-75.45	-87.22	-4.88	22.55	-160.29	-127.32
Livestock	-216.67	2.23	3.94	-19.3	-12.8	0.12	-3.3	-12.84	-56.02	-8.72	-2.4	-16.47	-36.89
Meat and dairy products	-110.69	105.67	8.1	112.12	77.9	2.13	37.5	309.99	570.87	109.56	2.26	490.16	1893.92
Sugar	-13.19	-14.06	-0.87	188.56	29.19	0.39	-41.86	-163.94	-12.39	61.51	15.28	253.44	173.87
Processed foods	407.83	42.38	61.22	643.03	-371.23	-9.55	-79.18	-27.2	23.73	42.25	-18.81	-154.85	276.61
Beverages and tobacco	-17.9	8.44	-16.52	-40.37	0.47	0.19	-4.23	-28.97	-150.95	12.62	-1.01	-7.01	-8.9
Forestry and fishery	-51.28	5.22	5.4	-18.1	-5.69	0.31	5.17	21.38	4.78	13.67	-2.07	2.32	-4.27
Crude oil and natural gas	-212.63	-47.66	-0.7	-59.77	62.21	-0.16	21.81	-41.61	789.29	42.45	-0.25	-27.12	0.88
Textiles	-996.48	91.03	-166.27	73.25	606.74	-26.56	170.6	-97.04	-198.84	-38.5	-3.35	-20.39	-102.23
Apparel	5704.09	366.32	427.42	645.04	555.11	-5.77	240.49	-81.06	-512.58	10.84	-2.06	-25.24	-40.02
Leather and footwear	1692.44	230.61	558.43	61.44	60.73	-32.49	-5.79	-153.06	-161.34	-26.55	-1.64	-36.66	-102.86
Other manufactures	-483.77	-76.78	0.32	-207.29	-78.9	2.66	11.8	-85.82	94.11	-9.88	-0.64	-200.2	-106.9
Wood and paper products	-524.89	69.83	2.73	-20.66	-59.09	2.04	-19.78	-96.61	-330.17	-173.83	0.57	-11.61	-82.17
Petroleum, coal, and mineral products	-183.65	-83.42	-22.79	-116.05	-234.25	10.5	-70.12	338.32	113.85	-328.02	-1.53	-17.13	-64.04
Chemical, rubber, and plastic products	-2100.49	-74.9	-51.93	141.91	-112.39	3.6	-71.83	-158.76	277.92	-147.92	-4.51	-21.85	-554.49
Metals and metal products	-508.01	-78.12	-20.94	-321.34	-334.47	0.96	-42.04	680.98	100.91	300.07	-11.18	-82.05	-108.98
Motor vehicles and other transport equipment	-1029.04	-133.44	-5.07	-479.38	-119.79	0.69	-99.82	-354.39	-458.15	43.17	-2.24	-58.15	34.9
Electronic equipment	2028.03	-25.64	1.55	520.52	-74.11	1.47	-18.31	-168.95	83.25	-11.97	-1.58	-4.38	-341.78
Other machinery	-2009.09	-36.9	16.98	77.81	-374.82	3.77	-92.56	-275.53	-550.15	19.52	-3.67	-13.51	-880.59

Table 3.5. (continued) Change in Net Exports under Hong Kong Scenario

Sector	Mexico	Argentina	Rest of Latin America	Central America and Caribbean	Rest of World	All Developing Countries	Asian NIEs	USA	EU 15	EU 10	Japan	Rest of OECD	All Developed Countries
Grains	-144.36	98.42	-18.27	-51.32	62.12	473.85	2.26	708.3	-1710.34	66.58	-1219.32	1678.66	-473.85
Oilseeds	-86.11	456.72	70.54	32.52	36.25	1304.02	-16.01	-1190.32	-385.14	78.02	-80.32	289.75	-1304.02
Vegetables and fruits	117.71	-15.42	356.97	279.34	-23.59	555.05	-34.99	-287.65	18.84	-82.69	-42.35	-126.21	-555.05
Other crops	65.52	-18.87	-100.57	-148.32	-3.04	-966.2	-98.56	-174.71	1265.22	-104.5	379.87	-301.11	966.2
Livestock	52.56	-15.89	-13.09	-11.75	21.23	-346.06	-91.95	66.32	549.95	52.27	120.56	-351.1	346.06
Meat and dairy products	75.2	183.64	426	9.28	67.09	4370.73	182.58	3698.15	-7819.53	783.76	-2692.71	1477.03	-4370.73
Sugar	-7.62	6.76	133.33	380.28	117.13	1105.79	0.64	-133.54	-809.27	-12.84	-313.88	163.1	-1105.79
Processed foods	-154.07	253.15	-22.76	-105.06	5.76	813.26	-105.62	1385.99	-934.84	-82.59	-1264	187.79	-813.26
Beverages and tobacco	18.16	2.32	13.48	-23.68	-17.36	-261.22	43.26	167.03	275.3	-56.69	-155.2	-12.49	261.22
Forestry and fishery	2.53	-0.01	10.86	2.38	14.01	6.62	-5.99	15.8	-77.64	9.92	-3.55	54.85	-6.62
Crude oil and natural gas	47.12	-18.79	60.11	27.37	-21.51	621.05	-219.41	-30.18	-324.54	34.4	-96.46	15.15	-621.05
Textiles	-311.45	-57.46	-88.5	269.72	-20.21	-915.95	2130.26	-1866.58	-113.08	-102.36	1116.09	-248.37	915.95
Apparel	-634.29	-38.17	-13.02	267.39	-30.76	6833.75	839.23	-3071.29	-2140.7	-369.18	-1528.93	-562.88	-6833.75
Leather and footwear	-173.84	-83.89	-85.22	-79.5	-102.64	1558.16	89.65	-765.77	-260.62	-141.83	-389.49	-90.09	-1558.16
Other manufactures	-82.17	-52.92	-73.49	-118.26	-16.26	-1484.4	622.15	2179.92	-716.64	-54.02	-130.61	-416.4	1484.4
Wood and paper products	77.17	-72.67	-15.62	-91.56	2.03	-1344.3	-8.61	414.68	1027.57	14	-136.83	33.48	1344.3
Petroleum, coal, and mineral products	-28.41	-34.04	23	-83.48	-32.12	-813.38	208.55	-0.44	815.97	-97.24	-25.71	-87.76	813.38
Chemical, rubber, and plastic products	27.13	-235.21	-272.8	-232.4	-92.31	-3681.23	375.9	677.13	2368.01	-156.73	894.76	-477.83	3681.23
Metals and metal products	-47.58	-22.72	77.04	-70.61	232.2	-255.9	-16.1	-413.34	380.16	158.17	507.12	-360.12	255.9
Motor vehicles and other transport equipment	13.94	62.73	-281.6	-133.42	-209.92	-3208.98	627.53	-3081.41	1776.54	-345.91	4966.55	-734.32	3208.98
Electronic equipment	717.74	-75.16	-88.46	15.48	-28.12	2529.58	-1826.63	-339.73	91.41	128.45	-507.29	-75.79	-2529.58
Other machinery	340.8	-197.28	-348.1	-132.43	-29.88	-4485.64	-277.82	70.88	3819.02	27.3	1305.58	-459.33	4485.64

Table 3.6. Percentage Change in Factor Returns under Sectoral and Hong Kong Scenarios

Factor	China	Indonesia	Vietnam	Rest of ASEAN	India	Bangladesh	Rest of South Asia	Russia and FSU	Middle East and North Africa	South Africa	East Africa	Rest of Sub-Saharan Africa	Brazil	Mexico
Doha Scenario for Agriculture (Scenario 1)														
Land	1.597	1.645	1.176	2.121	-1.611	0.817	-0.546	0.748	0.624	5.063	1.709	1.485	13.306	-3.381
Agricultural labor	0.095	0.118	0.395	0.449	-0.692	0.118	-0.414	0.02	0.075	0.112	0.883	0.53	0.282	-0.217
Unskilled labor	0	0	0	0	0	0	0	0.02	0	0	0	0	0	0
Skilled labor	-0.172	-0.226	-0.64	0.051	-0.228	-0.21	-0.272	-0.049	-0.026	0.027	-1.803	-0.211	-0.206	-0.165
Capital	-0.116	-0.159	0.111	-0.062	-0.211	-0.134	-0.274	0.012	0.007	0.009	-0.223	-0.033	-0.01	-0.119
Modest Scenario for Manufactures (Scenario 5)														
Land	0.863	-0.89	-1.851	-0.577	1.634	-0.206	0.686	0.61	0.262	0.227	0.206	0.29	1.897	0.627
Agricultural labor	1.482	0.717	2.06	0.673	1.18	-0.126	0.703	0.333	0.214	0.436	0.108	0.07	0.431	0.099
Unskilled labor	0	0	0	0	0	0	0	0.333	0	0	0	0	0	0
Skilled labor	1.718	1.617	9.918	1.397	0.943	-0.093	0.548	0.367	0.28	0.512	-0.376	-0.065	0.359	0.101
Capital	1.158	0.421	0.568	0.613	0.504	-0.075	0.403	0.358	0.191	0.333	-0.054	-0.057	0.223	0.052
Hong Kong Scenario (Scenario 6)														
Land	2.418	0.738	-0.679	1.494	-0.016	0.609	0.13	1.36	0.857	6.965	1.828	1.739	15.496	-2.707
Agricultural labor	1.573	0.831	2.462	1.117	0.478	-0.009	0.283	0.353	0.286	0.452	0.939	0.576	0.708	-0.125
Unskilled labor	0	0	0	0	0	0	0	0.353	0	0	0	0	0	0
Skilled labor	1.545	1.386	9.315	1.449	0.715	-0.305	0.272	0.319	0.254	0.445	-2.136	-0.288	0.141	-0.075
Capital	1.043	0.258	0.671	0.553	0.294	-0.21	0.12	0.369	0.198	0.202	-0.281	-0.097	0.209	-0.072

Factor	Argentina	Rest of Latin America	Central America and Caribbean	Rest of World	All Developing Countries	Asian NIEs	USA	EU 15	EU 10	Japan	Rest of OECD	All Developed Countries	World Total
Doha Scenario for Agriculture (Scenario 1)													
Land	7.675	3.595	3.72	1.311	0.92	2.59	-1.298	-26.004	2.051	-22.339	9.702	-9.475	-2.786
Agricultural labor	0.082	0.115	0.2	0.137	0.031	-0.023	-0.024	-0.01	0.089	-0.003	0.001	-0.007	0.018
Unskilled labor	0	0	0	0	0.001	-0.023	-0.024	-0.01	0.089	-0.003	0.001	-0.013	-0.011
Skilled labor	0.035	-0.076	-0.131	0.013	-0.115	-0.094	-0.019	0.092	0.058	0.194	0.006	0.045	0.027
Capital	-0.098	-0.095	-0.073	0.091	-0.074	-0.049	-0.005	0.022	0.002	0.102	0	0.018	-0.002
Modest Scenario for Manufactures (Scenario 5)													
Land	1.53	1.409	0.431	0.704	0.789	-0.984	0.66	-0.322	0.452	-1.095	1.233	0.083	0.537
Agricultural labor	0.243	0.254	0.492	0.541	0.804	0.292	0.004	0.079	0.148	0.104	0.042	0.08	0.554
Unskilled labor	0	0	0	0	0.022	0.292	0.004	0.079	0.148	0.104	0.042	0.056	0.05
Skilled labor	0.223	0.148	0.66	0.555	0.659	0.375	0.031	0.115	0.274	0.131	0.1	0.087	0.151
Capital	0.196	0.137	0.381	0.406	0.391	0.187	0.023	0.088	0.201	0.08	0.051	0.065	0.135
Hong Kong Scenario (Scenario 6)													
Land	9.397	5.258	4.195	2.022	1.714	1.591	-0.672	-26.359	2.509	-23.308	11.024	-9.4	-2.248
Agricultural labor	0.313	0.34	0.669	0.676	0.826	0.267	-0.019	0.069	0.236	0.1	0.041	0.072	0.566
Unskilled labor	0	0	0	0	0.024	0.267	-0.019	0.069	0.236	0.1	0.041	0.042	0.039
Skilled labor	0.242	0.03	0.541	0.564	0.536	0.278	0.012	0.206	0.329	0.325	0.104	0.132	0.177
Capital	0.087	0.004	0.282	0.495	0.31	0.137	0.019	0.11	0.201	0.182	0.051	0.083	0.132

Zealand, see strong gains in unskilled employment in processed foods but declines in all other manufacturing subsectors. In the Asian NIEs, unskilled employment increases in textiles, apparel, leather, other manufactures, motor vehicles, and chemical, rubber, and plastic products, while declining in other manufacturing subsectors.

Table 3.8 presents the changes in agricultural labor demand induced by the Hong Kong scenario. For developing countries as a group, agricultural employment barely increases (0.1 percent). Agricultural employment declines in Indonesia, India, the rest of South Asia, and Mexico.

In developed countries, the secular trend of declining agricultural employment continues for all countries except the ten newly acceded members of the EU; the Asian NIEs; and other high-income countries belonging to the Organization for Economic Cooperation and Development (OECD), such as Australia, Canada, and New Zealand, which see increases in agricultural exports, mainly to other high-income countries.

The Adjustment of Production Structures and the Redistribution of Value Added between Developed and Developing Countries

Table 3.9 presents the changes in production and value added induced by the Hong Kong scenario. In agriculture, the results show that the EU 15 and Japan reduce their agricultural and food production significantly across almost all subsectors. The United States expands production slightly in grains, livestock, meat and dairy products, and processed food while production of oilseeds, fruits, vegetables, nongrain crops, and sugar declines. High-income OECD countries, including Australia, Canada, and New Zealand, experience strong expansions in production of grains, oilseeds, and sugar, with smaller growth in meat, dairy products, and other processed foods. The Asian NIEs greatly expand production of oilseeds, with smaller increases in livestock and in meat and dairy products. Other subsectors shrink or hold steady.

Most developing countries (except Mexico) expand production of many agricultural goods. Oilseed production grows significantly in China, Vietnam, South Africa, Sub-Saharan Africa, Brazil, Argentina, and the rest of Latin America. Grain production holds roughly steady across the developing world, with only marginal expansions or contractions, except in South Africa, where production increases about 4 percent, and Mexico, where it declines by slightly more. Production of fruits, vegetables, and nongrain crops holds steady. Livestock production expands in Brazil, contracts in Vietnam, and holds steady elsewhere. Meat and dairy production expands in most developing countries, with significant increases in Sub-Saharan Africa and Brazil and a decline only in Vietnam. Sugar production expands for much of ASEAN, South Africa, East Africa, and the rest of Sub-Saharan Africa, Brazil, Central America, and some other Latin American countries, offset by contractions in China, Vietnam, and some South Asian countries. Food processing remains largely stable across the developing world, with some small losses in India and the rest of South Asia.

In manufacturing, labor-intensive production shrinks across the developed world, with the exception of the Asian NIEs. However, only a few developing countries, most notably China, ASEAN, India, some parts of South Asia, and Central America, increase their production. In other manufacturing subsectors, there is some shifting of production among developing countries. Most changes are fairly small (less than 2 percent). However in metals, motor vehicles,

Table 3.7. Percentage Change in Demand for Unskilled Labor by Sector under Hong Kong Scenario[a]

Sector	China	Indonesia	Vietnam	Rest of ASEAN	India	Bangladesh	Rest of South Asia	Russia and FSU	Middle East and North Africa	South Africa	East Africa	Rest of Sub-Saharan Africa	Brazil	Mexico
Meat and dairy products	1.688	3.014	0.736	1.613	1.252	2.442	2.155	2.917	3.931	3.295	2.043	11.804	10.596	0.048
Sugar	-2.856	-0.409	-3.083	6.173	0.783	0.158	-4.384	-2.775	0.255	8.581	11.902	7.444	4.501	-0.61
Processed foods	1.382	0.333	0.585	2.016	-1.95	-0.127	-1.465	-0.15	0.492	1.405	-0.427	-0.257	1.386	-0.553
Beverages and tobacco	0.819	0.207	-6.906	-0.51	0.118	-0.074	-0.706	-0.21	-1.672	0.699	0.442	0.341	0.141	0.063
Crude oil and natural gas	-0.302	-0.587	-0.154	-0.517	0.281	0.056	-0.046	0.045	0.234	-0.11	-0.268	-0.171	-0.302	0.193
Textiles	1.847	2.907	16.677	2.631	3.169	-0.717	2.624	-1.737	-3.364	-2.206	-2.495	-1.085	-1.907	-3.735
Apparel	5.819	7.102	29.483	4.139	9.824	-0.317	6.901	-2.282	-6.897	1.896	0.005	-1.343	-0.802	-4.775
Leather and footwear	4.241	7.365	23.179	1.141	2.561	-5.647	-0.736	-3.896	-2.994	-5.036	-2.269	-2.249	-2.836	-3.26
Other manufactures	0.109	-3.581	2.318	-0.938	0.574	0.287	0.886	-0.766	0.66	-0.05	-0.374	-2.06	-1.211	-1.596
Wood and paper products	0.287	0.212	2.994	-0.028	-0.228	0.062	-1.291	-0.778	-0.825	-2.705	-0.15	-0.47	-0.695	0.215
Petroleum, coal, and mineral products	0.634	-0.948	-1.618	-0.407	-0.796	0.751	-2.181	0.327	0.364	-1.937	-0.213	-0.351	-0.624	-0.123
Chemical, rubber, and plastic products	-0.501	-0.29	8.442	0.987	-0.731	-0.186	-1.687	-0.602	0.434	-1.818	-0.476	-0.6	-1.898	-0.527
Metals and metal products	0.216	-2	-0.046	-1.912	-1.651	-0.23	-2.424	0.489	0.479	2.229	-2.881	-1.799	-1.467	0.086
Motor vehicles and other transport equipment	-0.982	-2.172	-2.213	-2.878	-0.074	-0.277	-4.665	-0.971	-1.222	1.158	-1.388	-2.708	-0.172	-0.018
Electronic equipment	4.187	-0.704	0.543	0.625	0.429	-0.558	-1.118	-1.505	1.357	0.401	-1.799	-0.898	-3.296	2.257
Other machinery	0.032	-0.021	7.232	1.597	-0.557	-0.318	-1.996	-1.136	-0.384	0.561	-1.555	-1.172	-3.382	0.99
Trade and transportation	1.676	0.337	5.282	0.711	0.567	-0.194	0.35	0.242	0.487	0.502	-0.202	-0.132	0.118	-0.008
Financial services, banking, and insurance	1.649	0.417	0.408	0.968	1.047	-0.319	0.292	0.137	0.41	0.593	-0.516	-0.158	0.123	0.286
Communication, health, education, and public services	3.018	3.774	24.508	3.534	1.124	-0.987	0.442	-0.037	0.378	0.909	-6.809	-0.74	0.316	-0.239
Recreational and other services	1.865	0.211	5.592	0.296	1.75	-0.208	0.47	0.086	0.473	0.487	-2.055	-0.281	0.2	0.013
Housing, utilities, and construction	1.252	0.373	-0.922	0.719	0.526	-0.282	0.237	-0.05	0.155	0.407	-0.228	-0.148	0.177	-0.02
Total	1.451	0.87	4.498	0.977	0.662	-0.28	0.351	-0.051	0.2	0.255	-0.845	-0.154	-0.006	-0.097

Table 3.7 (continued). Percentage Change in Demand for Unskilled Labor by Sector under Hong Kong Scenario[a]

Sector	Argentina	Rest of Latin America	Central America and Caribbean	Rest of World	All Developing Countries	Asian NIEs	USA	EU 15	EU 10	Japan	Rest of OECD	All Developed Countries	World Total
Meat and dairy products	2.065	2.784	0.687	2.68	3.62	1.82	2.112	-4.982	4.356	-11.395	2.043	-0.904	2.211
Sugar	2.579	4.103	13.435	5.518	2.161	0.585	-0.727	-11.563	-0.247	-16.371	6.324	-5.311	1.236
Processed foods	1.555	0.168	-0.596	1.177	-0.156	-0.027	0.842	-1.13	-0.091	-1.824	0.438	-0.539	-0.215
Beverages and tobacco	0.124	0.177	-0.434	-0.006	0.209	0.078	0.199	0.071	-0.713	-0.347	-0.057	-0.193	0.145
Crude oil and natural gas	-0.279	0.234	-0.087	0.06	-0.001	-0.518	0.013	-0.01	0.535	-0.268	-0.065	0.01	0
Textiles	-4.267	-1.656	6.158	-0.846	1.725	5.479	-3.237	-0.889	-4.084	2.276	-5.558	-0.435	1.559
Apparel	-1.336	-0.364	2.704	-0.318	5.024	3.81	-4.163	-2.989	-5.436	-2.864	-5.997	-2.685	4.251
Leather and footwear	-3.472	-2.936	-4.737	-3.329	3.596	2.017	-6.424	-0.903	-4.532	-6.518	-4.366	-2.289	3.123
Other manufactures	-1.394	-2.619	-2.903	-0.959	-0.226	4.076	3.624	-0.281	-0.802	-0.068	-6.734	-0.044	-0.201
Wood and paper products	-0.925	-0.283	-1.323	-0.119	-0.114	-0.141	0.189	0.309	-0.186	-0.029	-0.214	0.122	-0.051
Petroleum, coal, and mineral products	-0.397	0.185	-1.051	0.328	0.271	0.039	0.028	0.36	-0.533	0.13	-0.267	0.02	0.244
Chemical, rubber, and plastic products	-2.237	-1.496	-1.516	-0.209	-0.515	0.64	0.013	0.268	-0.665	0.48	-0.738	0.148	-0.365
Metals and metal products	-1.589	0.04	-1.012	1.396	-0.095	-0.495	-0.13	0.292	0.462	0.6	-0.762	0.117	-0.041
Motor vehicles and other transport equipment	0.941	-2.616	0.635	-1.613	-1.011	0.684	-0.49	0.435	-1.003	2.309	-0.871	0.302	-0.594
Electronic equipment	-4.422	-3.233	0.766	0.079	2.037	-2.438	-0.103	0.267	0.794	-0.096	-0.3	-0.236	1.366
Other machinery	-4.184	-4.439	-0.678	0.267	-0.132	-0.98	0.042	0.719	0.146	0.52	-0.47	0.266	-0.024
Trade and transportation	0.079	0.183	0.278	0.88	0.704	-0.409	0.05	0.203	0.05	0.201	0.155	0.087	0.534
Financial services, banking, and insurance	0.213	0.237	0.401	0.748	0.63	-0.239	0.026	0.123	-0.018	0.15	0.071	0.034	0.431
Communication, health, education, and public services	0.615	0.072	1.12	0.898	1.457	0.48	0.091	0.244	0.377	0.625	0.431	0.306	1.033
Recreational and other services	0.154	0.192	0.346	0.716	0.809	-0.642	0.065	0.196	-0.097	0.22	0.114	0.062	0.518
Housing, utilities, and construction	0.152	0.05	0.053	0.497	0.578	0.051	0.038	0.093	-0.09	0.178	0.009	0.069	0.479
Total	0.021	-0.026	0.3	0.541	0.759	-0.027	0.026	0.114	-0.116	0.276	-0.051	0.076	0.583

a. Scenario 6.

Table 3.8. Percentage Change in Demand for Agricultural Labor by Sector under Hong Kong Scenario[a]

Sector	China	Indonesia	Vietnam	Rest of ASEAN	India	Bangladesh	Rest of South Asia	Russia and FSU	Middle East and North Africa	South Africa	East Africa	Rest of Sub-Saharan Africa	Brazil	Mexico
Grains	1.251	-0.016	-0.864	1.72	-0.292	0.119	-0.044	0.993	0.878	3.66	-0.137	0.36	1.044	-4.395
Oilseeds	7.535	2.898	45.015	3.008	-0.088	1.509	0.013	3.32	2.563	18.035	1.677	6.076	7.775	-18.241
Vegetables and fruits	-0.027	-0.141	-0.36	0.24	-0.913	0.011	-0.279	-0.18	-0.196	-0.233	0.109	-0.08	-2.479	1.472
Other crops	-0.542	-0.922	1.178	-2.472	0.281	0.713	0.04	-0.356	-1.48	1.162	0.39	-0.88	-1.493	0.386
Livestock	-0.036	1.138	-4.428	0.152	0.24	-0.63	0.243	0.237	0.625	1.41	0.393	1.925	7.089	0.824
Forestry and fishery	-0.222	-0.176	-1.592	-0.203	0.077	-0.038	-0.038	0.03	-0.024	0.177	0.166	-0.104	0.18	-0.067
Total	0.134	-0.037	-0.864	0.098	-0.101	0.136	-0.037	0.22	0.134	1.432	0.201	0.22	3.093	-0.096

Sector	Argentina	Rest of Latin America	Central America and Caribbean	Rest of World	All Developing Countries	Asian NIEs	USA	EU 15	EU 10	Japan	Rest of OECD	All Developed Countries	World Total
Grains	1.047	0.405	0.115	0.945	0.325	0.798	2.488	-12.326	3.176	-18.39	13.688	-3.22	0.265
Oilseeds	8.158	5.693	3.751	3.959	1.75	8.668	-11.749	-6.607	12.423	-10.942	12.164	-4.644	1.661
Vegetables and fruits	-1.034	2.437	3.729	-0.245	-0.121	-0.194	-1.191	-0.637	-1.626	-0.429	-2.591	-0.905	-0.135
Other crops	-1.771	-1.387	-2.157	0.13	-0.417	-0.966	-0.724	1.815	-2.805	-0.986	-4.44	-0.327	-0.415
Livestock	0.82	1.107	0.128	0.265	0.419	0.965	1.832	-2.871	1.853	-6.677	-0.768	-0.641	0.395
Forestry and fishery	-0.132	0.266	-0.316	0.139	-0.153	-0.068	0.188	-0.358	0.166	-0.328	0.241	-0.105	-0.152
Total	2.033	1.083	0.763	0.318	0.108	0.279	-0.812	-1.917	0.476	-5.738	0.912	-1.151	0.084

a. Scenario 6.

Table 3.9. Percentage Changes in Production and Value Added by Sector under Hong Kong Scenario[a]

Sector	China	Indonesia	Vietnam	Rest of ASEAN	India	Bangladesh	Rest of South Asia	Russia and FSU	Middle East and North Africa	South Africa	East Africa	Rest of Sub-Saharan Africa	Brazil	Mexico
Percentage Change in Production														
Grains	1.713	0.106	-0.051	1.847	-0.191	0.094	0.07	1.229	0.967	3.97	0.004	0.453	1.272	-4.319
Oilseeds	7.857	2.8	45.892	3.264	0.015	1.524	0.072	3.544	2.627	18.287	1.749	6.134	8.171	-18.134
Vegetables and fruits	0.346	0.01	0.319	0.421	-0.809	0.008	-0.189	-0.066	-0.138	-0.03	0.164	-0.024	-2.292	1.608
Other crops	0.079	-0.791	1.859	-2.27	0.395	0.705	0.127	-0.126	-1.325	1.372	0.661	-0.733	-1.379	0.505
Livestock	0.171	1.321	-3.771	0.596	0.202	-0.646	0.247	0.472	0.737	1.765	0.471	2.069	7.121	0.686
Meat and dairy products	0.736	2.746	0.131	1.161	1.146	2.451	2.006	2.929	3.807	3.021	2.327	11.656	9.69	0.158
Sugar	-3.417	-0.654	-3.328	6.069	0.316	0.117	-4.531	-2.381	0.171	8.34	12.12	7.412	4.107	-0.448
Processed foods	0.519	0.037	-0.072	1.64	-2.268	-0.13	-1.673	0.062	0.374	1.275	-0.335	-0.347	1.049	-0.833
Beverages and tobacco	0.205	0.026	-7.037	-0.665	0.013	-0.001	-0.688	0.164	-1.65	0.582	0.604	0.329	-0.044	0.111
Forestry and fishery	0.232	0.052	-0.842	0.226	0.179	-0.093	0.129	0.284	0.155	0.416	0.316	0.055	0.358	-0.082
Crude oil and natural gas	-0.11	-0.503	-0.223	-0.41	0.377	0.08	0.063	0.278	0.616	-0.039	-0.214	-0.173	-0.341	0.211
Textiles	1.627	2.978	17.546	2.645	3.211	-0.706	2.785	-1.301	-3.094	-2.029	-2.244	-0.996	-1.766	-3.593
Apparel	5.691	7.235	30.836	4.193	9.893	-0.264	7.04	-1.838	-6.418	2.315	0.396	-1.215	-0.605	-4.615
Leather and footwear	3.84	7.269	23.316	0.961	2.674	-5.59	-0.613	-3.359	-2.865	-4.846	-2.057	-2.148	-2.762	-3.098
Other manufactures	-0.338	-3.586	2.248	-0.946	0.965	0.39	1.095	-0.455	0.632	-0.107	0.029	-2.039	-1.165	-1.466
Wood and paper products	0.154	0.151	3.379	-0.024	-0.028	0.118	-1	-0.264	-0.743	-2.693	0.128	-0.363	-0.517	0.333
Petroleum, coal, and mineral products	0.819	-0.719	-1.207	-0.117	-0.753	0.81	-1.873	0.687	0.302	-1.883	0.11	-0.214	-0.308	-0.09
Chemical, rubber, and plastic products	-0.287	-0.016	8.464	1.211	0.064	-0.091	-1.048	-0.179	0.578	-1.754	-0.049	-0.47	-1.552	-0.406
Metals and metal products	0.402	-1.716	-0.228	-1.54	-0.786	-0.167	-1.824	0.908	0.809	2.249	-2.408	-1.628	-1.072	0.289
Motor vehicles and other transport equipment	-0.678	-1.875	-0.567	-2.416	0.453	-0.119	-4.055	-0.525	-0.909	1.627	-0.955	-2.526	0.419	0.218
Electronic equipment	5.128	-0.486	0.368	1.07	1.111	-0.403	-0.512	-0.992	1.538	0.286	-1.336	-0.74	-2.695	2.466
Other machinery	0.434	0.383	7.003	1.99	0.274	-0.175	-1.432	-0.712	-0.199	0.593	-1.102	-1.009	-3.027	1.166
Percentage Change in Value Added														
Grains	2.979	0.746	0.267	2.972	-0.012	0.329	0.16	1.563	1.197	4.95	0.675	0.992	3.392	-5.037
Oilseeds	9.371	3.683	46.669	4.282	0.192	1.721	0.218	3.903	2.887	19.504	2.506	6.743	10.279	-18.79
Vegetables and fruits	1.68	0.62	0.777	1.475	-0.634	0.22	-0.076	0.384	0.119	1.009	0.957	0.547	-0.213	0.791
Other crops	1.156	-0.167	2.332	-1.268	0.563	0.924	0.244	0.206	-1.169	2.421	1.205	-0.257	0.797	-0.288
Livestock	1.671	1.909	-3.338	1.383	0.522	-0.422	0.448	0.803	0.943	2.671	1.23	2.562	9.577	0.147
Meat and dairy products	1.61	2.986	0.593	1.556	1.225	2.455	2.142	3.279	3.913	3.279	2.082	11.813	10.578	0.056
Sugar	-2.941	-0.436	-3.191	6.112	0.756	0.165	-4.394	-2.433	0.241	8.564	11.948	7.453	4.491	-0.603
Processed foods	1.292	0.305	0.431	1.957	-1.97	-0.105	-1.475	0.202	0.474	1.389	-0.388	-0.248	1.371	-0.545
Beverages and tobacco	0.739	0.179	-6.999	-0.566	0.093	-0.054	-0.717	0.141	-1.688	0.679	0.476	0.349	0.128	0.07
Forestry and fishery	1.046	0.207	-1.568	0.469	0.547	-0.196	0.145	0.419	0.203	0.628	1.015	0.117	0.814	-0.216
Crude oil and natural gas	-0.194	-1.135	-0.05	-0.904	0.754	0.056	-0.051	0.47	0.713	-0.2	-0.799	-0.462	-0.749	0.394
Textiles	1.677	2.842	16.393	2.518	3.131	-0.692	2.606	-1.391	-3.4	-2.23	-2.421	-1.067	-1.942	-3.722
Apparel	5.681	7.043	29.162	4.03	9.785	-0.285	6.877	-1.939	-6.925	1.87	0.077	-1.327	-0.811	-4.761
Leather and footwear	4.104	7.299	22.836	1.022	2.506	-5.608	-0.76	-3.558	-3.023	-5.064	-2.196	-2.232	-2.859	-3.247
Other manufactures	-0.083	-3.632	2.097	-1.041	0.525	0.32	0.863	-0.418	0.626	-0.081	-0.304	-2.043	-1.237	-1.581
Wood and paper products	0.141	0.146	2.749	-0.137	-0.274	0.085	-1.31	-0.429	-0.859	-2.737	-0.078	-0.452	-0.713	0.23
Petroleum, coal, and mineral products	0.677	-0.926	-1.552	-0.373	-0.779	0.738	-2.174	0.681	0.374	-1.927	-0.234	-0.357	-0.615	-0.127
Chemical, rubber, and plastic products	-0.671	-0.364	8.118	0.869	-0.797	-0.145	-1.712	-0.253	0.399	-1.854	-0.399	-0.58	-1.932	-0.512
Metals and metal products	0.074	-2.072	-0.333	-2.024	-1.714	-0.212	-2.449	0.843	0.45	2.192	-2.806	-1.781	-1.492	0.101
Motor vehicles and other transport equipment	-1.145	-2.244	-2.512	-2.987	-0.122	-0.23	-4.683	-0.622	-1.253	1.121	-1.313	-2.691	-0.202	-0.003
Electronic equipment	4.002	-0.775	0.232	0.512	0.368	-0.511	-1.142	-1.158	1.319	0.37	-1.724	-0.878	-3.335	2.272
Other machinery	-0.133	-0.097	6.881	1.479	-0.622	-0.272	-2.022	-0.787	-0.421	0.531	-1.479	-1.154	-3.412	1.004

Table 3.9 (continued). Percentage Changes in Production and Value Added by Sector under Hong Kong Scenario[a]

Sector	Argentina	Rest of Latin America	Central America and Caribbean	Rest of World	All Developing Countries	Asian NIEs	USA	EU 15	EU 10	Japan	Rest of OECD	All Developed Countries	World Total
Percentage Change in Production													
Grains	1.219	0.44	0.233	1.28	0.809	0.819	2.475	-12.481	3.29	-18.172	13.889	-3.93	-0.66
Oilseeds	8.354	5.68	3.862	4.266	3.642	8.507	-11.853	-6.918	12.646	-10.864	12.464	-7.738	-0.013
Vegetables and fruits	-0.995	2.423	3.87	-0.063	0.263	-0.151	-1.202	-0.536	-1.551	-0.198	-2.499	-0.769	-0.022
Other crops	-1.765	-1.424	-2.072	0.547	-0.387	-0.926	-0.729	1.839	-2.636	-0.944	-4.385	-0.003	-0.228
Livestock	0.744	1.097	0.21	0.667	0.74	1.049	1.575	-3.149	2.068	-6.753	-0.486	-1.058	-0.025
Meat and dairy products	1.353	2.411	0.244	2.3	2.782	1.843	1.955	-4.62	4.478	-10.754	1.785	-1.53	-0.399
Sugar	1.977	3.83	13.099	5.373	1.876	0.741	-0.736	-11.211	-0.012	-15.257	6.342	-5.559	-2.01
Processed foods	1.289	0.123	-0.865	0.935	0.15	-0.147	0.65	-1.014	0.068	-1.058	0.542	-0.299	-0.14
Beverages and tobacco	0.048	0.165	-0.55	-0.051	-0.061	0.247	0.135	0.193	-0.535	-0.121	0.008	0.075	0.031
Forestry and fishery	0.05	0.434	-0.011	0.609	0.178	0.063	0.222	-0.413	0.48	-0.302	0.429	-0.098	0.05
Crude oil and natural gas	-0.242	0.358	-0.014	0.219	0.304	-0.497	0.021	0.016	2.239	-0.33	-0.033	0.022	0.227
Textiles	-4.147	-1.545	6.385	-0.698	0.882	5.764	-3.098	-0.716	-3.696	2.483	-5.296	-0.577	0.216
Apparel	-1.181	-0.178	2.978	-0.231	2.855	4.085	-3.84	-2.788	-5.089	-2.702	-5.603	-2.801	-0.365
Leather and footwear	-3.451	-2.773	-4.641	-3.204	1.249	2.217	-6.035	-0.726	-4.215	-6.033	-4.108	-2.178	-0.224
Other manufactures	-0.901	-2.473	-2.788	-0.951	-0.45	4.373	3.635	-0.265	-0.553	-0.058	-6.525	0.231	-0.008
Wood and paper products	-0.68	-0.076	-1.178	-0.033	-0.199	0.155	0.189	0.299	0.128	-0.038	-0.13	0.167	0.094
Petroleum, coal, and mineral products	-0.15	0.224	-0.915	0.448	0.281	0.679	0.027	0.394	-0.293	0.223	-0.167	0.194	0.23
Chemical, rubber, and plastic products	-1.659	-1.155	-1.284	-0.179	-0.284	1.075	0.032	0.35	-0.287	0.547	-0.591	0.252	0.119
Metals and metal products	-1.178	0.318	-0.743	1.512	0.216	-0.051	-0.108	0.366	0.865	0.624	-0.64	0.183	0.192
Motor vehicles and other transport equipment	1.544	-2.151	1.437	-1.37	-0.463	1.088	-0.436	0.537	-0.456	2.317	-0.583	0.451	0.308
Electronic equipment	-3.816	-2.923	1.038	0.105	2.143	-1.855	-0.095	0.307	1.182	-0.03	-0.186	-0.204	0.301
Other machinery	-3.641	-4.205	-0.511	0.375	0.188	-0.597	0.053	0.777	0.571	0.539	-0.353	0.318	0.292
Percentage Change in Value Added													
Grains	3.598	1.803	1.546	2.016	1.292	1.56	2.338	-14.53	4.025	-20.946	15.565	-5.063	-0.763
Oilseeds	10.89	7.165	5.235	5.083	3.885	9.502	-11.878	-8.755	13.345	-13.731	13.889	-9.005	-0.626
Vegetables and fruits	1.466	3.864	5.212	0.843	1.066	0.534	-1.336	-2.967	-0.831	-3.548	-0.987	-2.117	0.239
Other crops	0.71	-0.013	-0.758	1.182	0.14	-0.227	-0.869	-0.657	-2.009	-4.088	-2.838	-1.272	-0.478
Livestock	3.366	2.516	1.559	1.349	1.742	1.66	1.683	-5.311	2.675	-9.6	0.871	-2.251	0.328
Meat and dairy products	2.059	2.784	0.665	2.631	2.957	2.1	2.09	-4.92	4.603	-11.314	2.083	-1.51	-0.481
Sugar	2.571	4.102	13.404	5.474	2.588	0.863	-0.748	-11.506	-0.011	-16.295	6.366	-6.447	-2.748
Processed foods	1.547	0.167	-0.621	1.135	0.262	0.248	0.819	-1.067	0.145	-1.734	0.477	-0.276	-0.118
Beverages and tobacco	0.117	0.177	-0.46	-0.055	0.04	0.356	0.175	0.135	-0.477	-0.257	-0.018	0.08	0.07
Forestry and fishery	-0.017	0.825	-0.172	0.948	0.506	0.065	0.333	-0.671	0.539	-0.656	0.518	-0.295	0.169
Crude oil and natural gas	-0.661	0.552	-0.115	0.362	0.28	-1.096	0.028	0.07	1.851	-0.508	-0.122	-0.013	0.201
Textiles	-4.283	-1.657	6.1	-0.917	0.754	5.777	-3.26	-0.829	-3.857	2.361	-5.522	-0.991	-0.158
Apparel	-1.354	-0.365	2.646	-0.391	2.527	4.096	-4.184	-2.929	-5.212	-2.779	-5.961	-3.053	-0.755
Leather and footwear	-3.487	-2.937	-4.783	-3.384	0.673	2.298	-6.446	-0.842	-4.306	-6.436	-4.33	-2.643	-0.909
Other manufactures	-1.41	-2.62	-2.952	-1.03	-0.376	4.368	3.599	-0.222	-0.565	0.011	-6.7	0.191	-0.014
Wood and paper products	-0.941	-0.284	-1.376	-0.195	-0.374	0.139	0.164	0.368	0.053	0.049	-0.177	0.179	0.087
Petroleum, coal, and mineral products	-0.392	0.186	-1.037	0.348	0.101	0.301	0.01	0.432	-0.299	0.237	-0.226	0.163	0.14
Chemical, rubber, and plastic products	-2.255	-1.497	-1.568	-0.283	-0.677	0.927	-0.013	0.325	-0.428	0.56	-0.702	0.174	0.004
Metals and metal products	-1.603	0.039	-1.058	1.333	-0.213	-0.212	-0.153	0.351	0.699	0.68	-0.725	0.131	0.065
Motor vehicles and other transport equipment	0.924	-2.617	0.588	-1.68	-0.874	0.966	-0.514	0.494	-0.767	2.389	-0.835	0.334	0.155
Electronic equipment	-4.439	-3.235	0.711	-0.008	1.383	-2.158	-0.128	0.324	1.034	-0.018	-0.264	-0.119	0.131
Other machinery	-4.201	-4.44	-0.733	0.208	-0.349	-0.699	0.016	0.775	0.383	0.599	-0.435	0.266	0.174

a. Scenario 6.

electronics, and machinery, there is more significant redistribution of production.

It is interesting to note the different adjustment pattern in the textile and apparel sectors among Japan, the Asian NIEs, and other developed countries in response to the expansion of apparel production in developing countries. In most high-income countries, both textile and apparel industries decline, while in Japan apparel production declines but textile production increases. In the Asian NIEs both sectors increase. This disparity in adjustment reflects continuing trends in Asia to integrate production across the region based on changing comparative advantage. A reduction of trade barriers will accelerate this trend and enable even greater vertical integration between developed and developing Asian countries in manufacturing production. Similar attempts at vertical integration between the United States, Mexico, and Central America appear not to be sufficient to sustain the U.S. textile sector, based on the simulation results.

The structural adjustment induced by Doha liberalization in some developing countries seems opposite to their comparative advantage in the production of labor-intensive products. Plausible explanations have already been discussed. Liberalization in some world manufactures markets increases competition and pushes down world prices. Labor-intensive sectors in some developing countries cannot attract capital under conditions of reduced profitability from lower world prices. This leads labor and capital to remain in (or return to) agricultural activities in those countries. This is reinforced to some extent by the rise in world food prices, driven by the elimination of agricultural export subsidies, domestic support, and border protection in developed countries.

Adjustments in production structures redistribute value added among different sectors within countries and among countries. The gains and losses produce overall small net gains for both developed countries and developing countries as groups, with developing countries gaining slightly more in percentage terms, although from a much lower base. Most individual developing countries and regions gain value added in labor-intensive manufactures and agriculture. Two developing countries suffer very small losses in value added (Bangladesh and Mexico), while East African and Sub-Saharan African countries see no change. The EU 15 and Japan experience small net gains, mainly from capital-intensive manufacturing. The United States experiences no change. Value added increases in agriculture and food processing in high-income OECD countries, such as Australia, Canada, and New Zealand, while they experience declines in value added in their manufacturing sectors.

Adjustment Costs

Global trade models do not capture the costs incurred as economies adjust to trade reform. Most models assume that all resources are fully employed throughout the adjustment process. The Carnegie model does take account of preexisting and continuing unemployment of unskilled labor, but otherwise it shares the shortcomings of other models in this regard.

In reality, structural adjustment to trade-induced changes does not occur instantaneously or without cost. Some labor or capital will be idled temporarily by changes in trade patterns, which will subtract from overall GDP and have a negative impact on the individuals and households affected. The effects are likely to be relatively greater in developing countries, which typically have less diversified economies and therefore fewer employment alternatives, than in developed countries. For agricultural labor, adjustment costs may be very high because alternative employment in rural areas may be

almost nonexistent. As a result, relocation will be required to find alternative employment, increasing the time required and other costs to find new work. Adjustment costs may be severe and long lasting for the poorest households, due to low levels of education and skills, and limited savings that could be used to finance relocation or retraining. Most developing countries lack the unemployment insurance, job retraining, job placement, and other social safety nets that have been used, with varying success, in developed countries to facilitate adjustment to trade-related structural changes.

As a result of omitting these costs, applied general equilibrium models tend to systematically overstate the net gains from trade or understate the net losses. However, it is difficult to determine the scale of overstatement for developing countries, because the subject has received relatively little study in these countries. A limited number of case studies exist, but differences in methodologies and the difficulty of isolating trade policy effects from other causal factors limit their value in reaching broader conclusions.

One recent study of adjustment to unilateral trade opening by several developing countries does offer useful insights, including the conclusion that structural unemployment induced by trade policy changes is likely to be the major social cost of adjustment in developing countries.[26] Overall, the study reinforces the need for more systematic work. Further research on the patterns and duration of adjustment costs in developing countries would be needed to make comprehensive assessments of the net gains (or losses) from trade liberalization for these countries.

Implications for Global Equity and Poverty

The overall gains to the world are divided fairly evenly between developed and developing countries. As a percentage of current GDP, developing countries gain somewhat more under the main scenarios. However, this distribution of benefits among economies offers only a rough first approximation of the equity effects of trade. It is also important to look at the sizes of populations affected—positively and negatively—by trade policy changes. It is particularly important to assess, to the degree possible, whether the world's poor people are likely to be better or worse off, because the poor are less able to cope with adverse economic shocks, due to lower levels of education, savings, and mobility.

When the findings of the model are linked to data on the distribution of poverty, additional insight can be gained regarding the impact of trade policy changes on equity and poverty. Some models have been used to estimate specific numbers of poor people who would be lifted out of poverty based on trade scenarios. Using this approach, various modelers have projected net reductions in the number of poor people in the developing world ranging from 2.5 million to 686 million.[27] The difference in the order of magnitude of results illustrates the speculative nature of such calculations. This approach requires that a series of assumptions be employed, first about the impact of trade on economic growth and then about the impact of economic growth on poverty. However actual data on each of these linkages vary considerably, depending on the region studied and the historical period under review. The overall data are contested and cannot be considered robust.

We adopt a more modest approach, consistent with the limitations of AGE models and available data. Most of the world's poor people are concentrated in rural areas and depend on agriculture for their incomes. As discussed above, many developing countries experience negative

effects from agricultural liberalization, suggesting that their rural poor may experience a worsening of incomes. Poverty might deepen or become more widespread in the countryside. However, growing manufacturing exports could absorb some of these displaced farmers. Whether the net effect is positive or negative depends on the relative size of the agricultural and manufacturing sectors, the sequencing of liberalization, the rates of growth or contraction of each sector, the relative productivity levels, and other factors. Countries with high concentrations of their economically active population in agriculture will tend to have more difficulty absorbing these workers into other sectors. Table 3.10 presents the percentage of the economically active population in agriculture for selected countries.

Table 3.10. Percentage of Working Population Engaged in Agriculture, 2003

Country	Percentage	Country	Percentage
Kenya	74.1	Iran	25.2
Vietnam	66.1	Ecuador	23.9
Zimbabwe	60.9	Algeria	23.5
India	58.3	Tunisia	23.5
Ghana	56.1	Mexico	19.7
Cameroon	56.0	Colombia	18.8
Thailand	54.1	Malaysia	16.6
Indonesia	46.3	Brazil	15.0
Côte d'Ivoire	45.9	Chile	14.9
Pakistan	45.6	Argentina	9.1
Sri Lanka	44.6	South Africa	8.6
Guatemala	44.2	South Korea	8.2
Turkey	44.1	Venezuela	7.2
Bolivia	43.4	Spain	6.4
Philippines	37.7	Italy	4.6
Morocco	33.8	Australia	4.4
Egypt	31.5	Japan	3.4
Nigeria	30.6	France	2.9
Honduras	29.1	Germany	2.2
Peru	28.9	Canada	2.1
El Salvador	27.1	United States	1.9
Syria	26.6	United Kingdom	1.7

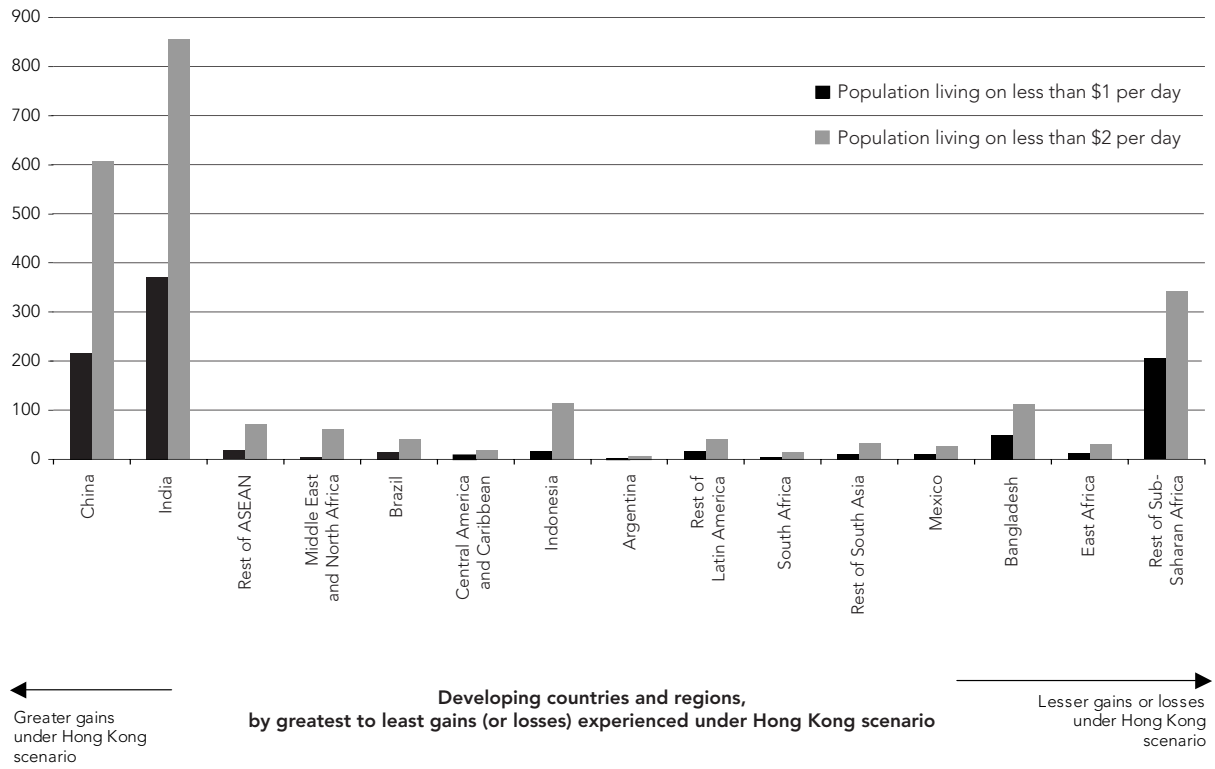
Source: The United Nations Food and Agriculture Organization Online Statistical Database, www.faostat.fao.org.

Note: Figures reported to FAO estimate the agricultural workforce for China at approximately 65 percent; this is overstated due to the household registration system, in which workers may still be counted in the agricultural sector when they have migrated to urban areas. Data from other Chinese sources suggest that about 45 to 50 percent of Chinese workers are engaged in agriculture.

Figure 3.23 combines data on the distribution of poverty in the developing world with the impact of the Hong Kong scenario on those countries and regions. The vertical bars show the number of poor and very poor in each country or region. The countries are arrayed from left to right in order of real income gains or losses under the Hong Kong scenario. China, which reaps the largest gains, is home to large numbers of poor people, with more than 200 million living on less than $1 a day and an additional 600 million living on less than $2 a day. A Doha pact that lowers barriers to exports of low-skilled manufactured products could present a boost to their incomes, if more jobs are created in that sector than are lost in agriculture. However, in the countries that lose under this plausible scenario for the Doha Round, including Bangladesh and many countries in Sub-Saharan Africa, there are even more desperately poor people (267 million) living on less than $1 a day and almost as many very poor people (486 million) living on $2 a day. These countries experience income losses from *both* agricultural and manufacturing liberalization and lose shares of world export markets in both sectors. As a result, there is little hope that displaced farmers would find work in the manufacturing export sector. It is likely that a Doha pact would result in poverty that is more widespread, deeper, or both in these countries.

India, the largest reservoir of poverty, loses slightly from agricultural liberalization and gains from manufacturing liberalization. Its gains in manufactures do not surpass losses in agriculture to the same extent as in China, and a higher proportion of India's workforce is in agriculture. Whether a pact would help or hurt India's poor population on a net basis depends heavily on the details of the outcome of the Doha Round. For example, it is likely that India will require significant latitude in shielding products produced by its subsistence farmers to avoid increases in poverty.

Figure 3.23. Population Living in Poverty in Developing Countries and Regions
(MILLIONS)



Source: *Human Development Report 2005* (New York: United Nations Development Program, 2005), calculated by the author from data in tables 3 and 5.

Other countries with high concentrations of the workforce in agriculture are likely to require similar measures to avoid worsening poverty. These include Indonesia; countries such as Kenya, Zimbabwe, Ghana, and Cameroon that are part of East Africa or the rest of Sub-Saharan Africa; and countries such as Pakistan and Sri Lanka that are part of the group including the rest of South Asia. It has already been agreed in the Doha Round that LDCs will not be required to reduce agricultural tariffs. However, many other developing countries will also need special treatment of their agricultural sectors.

It is essential that careful assessments of likely poverty effects for individual countries be prepared in advance of any final agreement. For those countries that do not have sufficient resources to make these assessments, international assistance should be provided. Other implications are discussed in chapter 5.

CHAPTER 4

A Comparison of Models and Simulation Results

Results from a number of new applied general equilibrium models have been reported in recent months. In this chapter, we provide a nontechnical explanation of some differentiating features of the models. The Carnegie results are compared with results from the newest World Bank model for agricultural and manufacturing liberalization scenarios. Models that focus on agricultural liberalization, constructed by the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) and the International Food Policy Research Institute (IFPRI), are compared with Carnegie and World Bank results for that sector.[28] A recent study by the United Nations Conference on Trade and Development (UNCTAD) that models manufacturing liberalization is compared with results for that sector from the Carnegie and World Bank models. We explore the main reasons for different findings among the models.

Most AGE models share common basic elements, including their assumptions about how economies operate.[29] These assumptions can be described as standard neoclassical economic assumptions, where markets are perfectly competitive, firms maximize their profits, and households obtain the greatest possible utility from their limited resources.[30] When modelers choose to make different assumptions, this will affect the findings of the model. Differences in certain key assumptions are discussed below. Models can also be distinguished based on the data they use, their scope, the type of trade policy scenarios they choose to simulate, and whether they are modeling what are termed static gains or dynamic gains from trade.

Data

Clearly, the quality of data used in a model is a key determinant of the reliability of the model's results. Differences in data inputs in different models will produce different findings. Many models use the same basic data about the global economy and trading patterns. Modelers may also incorporate additional data from other sources, as we have done. The most commonly used basic data set on global trade is the database built by the Global Trade Analysis Project (GTAP).[31] This evolving database was updated in late 2004 to incorporate newer economic data, generally for 2001. The updated version, GTAP 6, also incorporates changes in trade practices based on the results of the previous round of global trade negotiations, the Uruguay Round, and, for the first time, includes data about preferential trade arrangements that developed countries extend to developing countries.

The update of the GTAP database is a major factor explaining some large differences in results among different models that have been

Table 4.1. Income Gains from Full Free Trade in the World Bank Model with Different Data Sets

	Gains to World Economy	Gains to Developing Countries
World Bank 2002 LINKAGE Model with GTAP 5.4[a]	$385 billion	$196 billion
World Bank 2005 LINKAGE Model with GTAP 6.0[b]	$287 billion	$86 billion

a. Dominique van der Mensbrugghe and John C. Beghin, "Global Agricultural Reform: What Is at Stake?" in *Global Agricultural Trade and Developing Countries,* ed. M.A. Aksoy and John C. Beghin (Washington, D.C.: World Bank, 2005).
b. Kym Anderson, William J. Martin, and Dominique van der Mensbrugghe, "Global Impacts of the Doha Scenarios on Poverty," in *Poverty and the WTO: Impacts of the Doha Development Agenda*, ed. Thomas W. Hertel and L. Alan Winters (Washington, D.C.: World Bank, 2006).

used to simulate outcomes of the Doha Round since negotiations were launched in 2001. Models that use earlier versions of GTAP (GTAP 5 or earlier) overstate the gains that can be achieved from further trade liberalization in the Doha Round, for at least two reasons. First, they count as potential Doha Round gains many changes that already were secured through the Uruguay Round or through accession agreements for new WTO member countries. These changes include tariff reductions under the Uruguay Round, the end of the global apparel quota system, and the accession of China to the World Trade Organization (WTO)—all major changes in the international trading system.

Second, models based on earlier versions of GTAP do not take into account the preference programs that provide more favorable market access for goods exported by developing countries to developed country markets. Instead, they count these existing market access advantages as gains to be achieved from further trade liberalization in the Doha Round. In addition to overstating global gains from the Doha Round, models using older data will *understate* losses to countries that currently enjoy these preferences. For some countries, including many Sub-Saharan African and other least developed countries (LDCs), models based on GTAP 5 generate predictions that are likely to be directly contrary to what will actually happen to these countries if they lose their current preferential access. Because many of the countries involved also have high rates of poverty, these models also overstate the global gains in poverty reduction and ignore the possibility that poverty could increase in such countries.

Table 4.1 illustrates the magnitude of overstatement of gains from trade attributable to use of GTAP 5 or GTAP 6. It presents the global gains from full trade liberalization reported for the World Bank model in 2002 and 2005, with the major difference being the use of GTAP 5 for the 2002 report and GTAP 6 for the new report. The table also shows the gains for developing countries. What is noteworthy is that the World Bank model shows dramatically smaller gains for these countries based on the new data and inclusion of preference programs and other global changes since the Uruguay Round. Rather than capturing the majority of gains from liberalization (50.9 percent), as in the 2002 model, developing countries gain only 29.9 percent of the global benefits from full trade liberalization, with 70.1 percent of gains accruing to high-income countries. This comparison suggests that results from other studies using GTAP 5 data should be discounted to a similar degree.

Scope

General equilibrium models cover all major economic sectors while partial equilibrium models cover only selected sectors. Simulations conducted on general equilibrium models that include all sectors may nonetheless limit the scenarios of trade reform to certain sectors of particular interest. The Carnegie and World Bank general equilibrium

models include the agriculture, manufacturing, and service sectors but are not used to model service sector liberalization. The latter is excluded both because measuring liberalization in that sector is much more difficult and because the structure of negotiations on services at the WTO is more complex and difficult to simulate than negotiations for other sectors, as discussed in chapter 2. Some recent models do attempt to simulate liberalization of the service sector, but the modelers make widely different assumptions about the contribution to each economy's efficiency that service liberalization would make. In consequence, the results of these models vary dramatically and must be considered experimental or speculative.[32] When comparing gains from Doha Round trade liberalization under different models, it is important to note which sectors are included in the simulations.

Scenarios

The choice of trade policy scenarios that modelers simulate is also a source of major differences in results among models. Some simulate full trade liberalization, in which all countries cut all tariffs to zero, eliminate all nontariff barriers, and discontinue all trade-distorting domestic production and export subsidies. Others simulate more limited, and more realistic, trade policy changes. It should be noted that full trade liberalization is not a goal of the Doha Round and is not part of the WTO's July 2004 Framework Agreement, under which current negotiations are conducted. Many models, including the Carnegie model, simulate both full trade liberalization and other, more modest trade policy changes that have some chance of being realized in the Doha Development Round. Table 4.2 shows the difference between the gains from full liberalization of agricultural and manufactures trade and the gains from more modest Doha scenarios, as simulated in the Carnegie and World Bank models. Though the Doha scenarios that are modeled are not identical, they produce similar proportions of gains compared with full liberalization.

The main Doha scenario in the World Bank model (World Bank scenario 1) cannot be considered a realistic outcome of the negotiations. In that scenario, existing agricultural tariffs are divided into bands and then reduced by

Table 4.2. Income Gains from Full Free Trade Compared with Plausible Doha Scenarios, Carnegie and World Bank Models

Model	Full Liberalization	Plausible Doha Scenarios[b]
Current World Bank Model[a] (Dynamic gains)	$287 billion	$96 billion (No exceptions for sensitive or special agricultural products)
		$39 billion (2% sensitive and 4% special agricultural products are subject to lesser liberalization)
Carnegie Model (Comparative static gains)	$168 billion	$59 billion

a. Kym Anderson, William J. Martin, and Dominique van der Mensbrugghe, "Market and Welfare Implications of Doha Reform Scenarios," in *Agricultural Trade Reform and the Doha Development Agenda*, ed. Kym Anderson and William J. Martin (Washington, D.C.: World Bank, 2006).
b. In the World Bank model, scenario 7 is based on tariff reductions from bound rates based on a tiered formula. Resulting average agricultural tariff reductions are 44 percent by developed countries and 21 percent by developing countries. For manufactured goods, bound tariffs are reduced by 50 percent by developed countries and 33 percent by developing countries. Least developed countries do not make tariff reductions. Tiered reductions in domestic support of agriculture are made from bound aggregate measures of support. Export subsidies for agriculture are eliminated. In the Carnegie model scenario (scenario 3), reductions are made from trade-weighted ad valorem equivalent (AVE) applied border protection. Agricultural AVEs are reduced by 36 percent by developed countries and 24 percent by developing countries, whereas the corresponding reductions for manufactured goods are 50 percent and 33 percent. Least developed countries do not make AVE reductions. Export subsidies for agriculture are eliminated by all countries except least developed. Domestic subsidies for agriculture are reduced by a third by all countries except the least developed countries.

amounts that increase as the tariff bands increase, with reductions of 75 percent for the highest band. This is somewhat similar to the G-20 proposal at the Hong Kong ministerial and less than the highest tariff reductions in the U.S. proposal.[33] However, the scenario does not allow any exceptions for sensitive agricultural products or special products of developing countries.[34] Under the July 2004 Framework Agreement, it was agreed that there will be such exceptions, and every proposal that has been tabled includes such exceptions. For example, the United States proposes that 1 percent of agricultural tariff lines be excluded from cuts as sensitive products, while the European Union (EU) proposes 8 percent. The G-33 has proposed that 20 percent of developing country agricultural tariff lines be excluded from liberalization as special products.

On the basis of the current proposals, the two most realistic World Bank scenarios are those that allow for sensitive and special products (labeled World Bank scenarios 2 and 3). In scenario 2, 2 percent of developed country and 4 percent of developing country agricultural tariff lines can be subject to smaller tariff cuts. In scenario 3, the allowance for developed countries is 5 percent; and for developing countries, 10 percent. These scenarios produce global income gains of only $17.7 billion and $13.4 billion, respectively. For the purpose of comparison with Carnegie model results, we add $21.6 billion global income gains for manufacturing liberalization, the incremental amount above agricultural sector gains reported in the World Bank's combined scenario 7 (the only scenario that includes the manufacturing sector) to World Bank scenario 2.

Although the overall gains reported in the World Bank and Carnegie models are roughly similar, the sectoral sources of the gains are quite different. The Bank finds that three-fourths of all gains come from agriculture; while in the central Doha scenario used by Carnegie, less than 10 percent of the gains come from agriculture. Some of the difference is explained by differences in the Doha scenarios that are used in the two models. For example, the Bank's central scenario uses a tiered agricultural liberalization formula that generates average cuts of 44 percent in developed countries' agricultural tariffs and 21 percent cuts in tariffs by developing countries, while the corresponding figures in the Carnegie central scenario are 36 and 24 percent. When developed countries are allowed to exclude 2 percent of farm products from cuts based on their sensitive status, and developing countries exclude 4 percent as special products, the global gains reported in the Bank model drop dramatically from $74.5 billion to $17.7 billion, less than the gains from manufacturing liberalization ($21.6 billion). The Carnegie central Doha scenario is more ambitious than that of the World Bank with respect to manufacturing sector liberalization, which explains part of the difference. However, under the more modest manufacturing liberalization scenario, the Carnegie model still finds that more than 87 percent of overall gains arise in the manufacturing sector. The results from most models are closer to those from the Carnegie model than the Bank model with respect to the size of gains from agricultural liberalization, discussed further below.

The Structures and Assumptions of the Models

Some of the differences in results among models can be attributed to differences in structural features and the assumptions that are made. As noted above, most models have numerous similarities in structure and assumptions. However, in an effort to make the models more realistic, or to enable more detailed modeling of certain aspects of trade relationships,

modelers may adjust the parameters and assumptions of their models in various ways. These adaptations will affect the models' results.

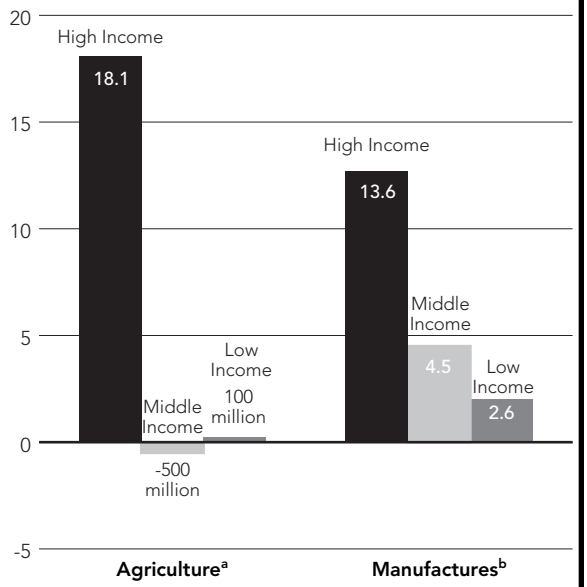
General equilibrium models calculate the gains or losses to economies based on the effects of trade policy changes on both producers and consumers. Most empirical studies show that the effects of such policy changes, especially at the household level, are dominated by earnings effects (that is, the impact on producers and workers) rather than by consumption effects, as discussed in chapter 2. In developing countries, the main source of household income for the majority of the population consists of wages for unskilled labor or income from the agricultural sector, either as wages for farm labor or self-employment on small-scale farms. Therefore, the impact of trade policies on demand for agricultural and unskilled labor in each country will significantly affect the welfare results for the overall economies, and for a large proportion of the households.

Because an important objective of the Carnegie model was to explore the impact of different potential trade policy changes on developing countries, particular attention was paid to the assumptions made about labor markets in those countries. The model incorporates two major innovations compared with most other models. First, the Carnegie model disaggregates labor into three types for developing countries: agricultural labor, urban unskilled labor, and urban skilled labor. Most models incorporate only two types of labor, skilled and unskilled, thereby blurring the different characteristics of agricultural and urban unskilled labor.

Second, the Carnegie model recognizes the existence of unemployment of urban unskilled labor in developing countries. By contrast, most models adopt the assumption of full employment for all economies, whether developed or developing. Unemployment is not taken into account, and any increases (or decreases) in demand for labor will be shown by the model as rising or declining wages. The assumption of full employment, though not accurate for developed countries, is nevertheless close enough to the actual functioning of labor markets in such countries that it is an acceptable simplification. In most developing countries, however, the assumption of full employment is so far from the reality that it is likely to significantly distort a model's results. The reality in such countries is a combination of very significant underemployment (also called hidden unemployment) in the countryside and open unemployment in urban areas. As noted in the sensitivity analysis (appendix B), the incorporation of unemployment into the Carnegie model *doubled* returns to developing countries as a group compared with an exercise in which the model was run with the assumption of full employment in these countries. This suggests that models that do not take unemployment into account will be much less accurate and less useful in examining the impact of potential policy changes on developing countries.

Several other recent modeling exercises attempt to more accurately represent the reality of labor markets in developing countries. Modelers at CEPII and UNCTAD also adapted the architecture of their models to try to capture the impact of trade policy changes in the presence of dual labor markets (CEPII) and unemployment (UNCTAD). In each case the modelers adopted a somewhat different approach to this challenge. The modelers at CEPII show the manufacturing and service sectors as paying a wage to unskilled workers that is above their marginal productivity. This attracts an effectively unlimited supply of workers, so that the expansion of these sectors faces no labor supply constraint. By contrast, the agricultural sector pays a competitive wage (determined by supply and demand). The

Figure 4.1. Sectoral Gains (Losses) for Developed and Developing Countries under World Bank Scenarios for Agriculture and Manufactures
(CHANGE IN REAL INCOME, BILLIONS OF DOLLARS)



Source: Kym Anderson, William J. Martin, and Dominique van der Mensbrugghe, "Market and Welfare Implications of Doha Reform Scenarios," in *Agricultural Trade Reform and the Doha Development Agenda*, ed. Kym Anderson and William J. Martin (Washington, D.C.: World Bank, 2006). Agriculture data from table 12.14. Manufactures data calculated by the author from the data in table 12.14.

a. World Bank scenario 2 for agriculture with two percent "sensitive" products and four percent "special" products.
b. World Bank scenario 7 (scenario 1 for agriculture plus manufacturing liberalization) minus World Bank scenario 1.

supply of labor to the agricultural sector is set as a residual; that is, once the better-paying manufacturing and service sectors have employed the number of unskilled workers needed, the remaining jobless are available to agriculture. The UNCTAD study addresses the unemployment issue in a straightforward way. Real wages for unskilled workers in developing countries are fixed, and the supply of labor adjusts to clear the market. The Carnegie approach is described in chapter 2 and appendix A.

The Results from the Models

All the newer models discussed here show potential gains from the Doha Round that are much lower than forecasts from earlier models. Many of the patterns of gains and losses found in the Carnegie simulations, reported above, are echoed in the findings of these models. However, there are a few significant differences between the models' findings at the sectoral level, noted below.

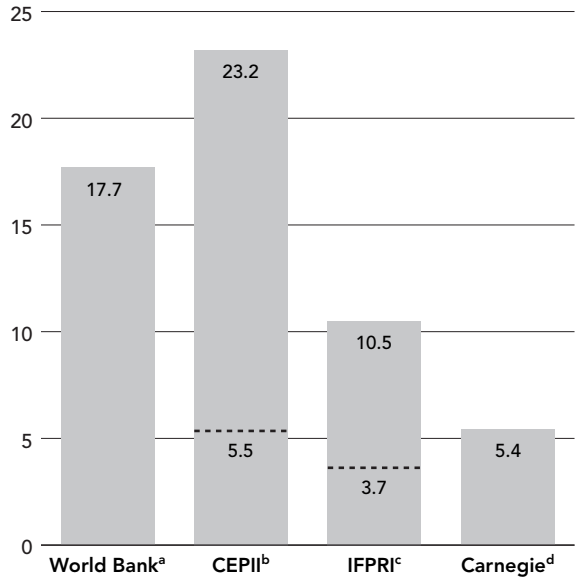
The results from the World Bank show that under the most realistic agricultural scenario modeled, all the income gains go to high-income countries (figure 4.1). In the manufacturing sector, the gains are somewhat more equally distributed among countries, although more than half the gains accrue to high-income countries. These results follow the same general pattern as the Carnegie results, which also show all gains from the Doha agricultural scenario accruing to developed countries, with manufacturing liberalization gains distributed more broadly (see figures 3.2 and 3.3). However, the overall gains for agriculture are much higher in the World Bank results.

Most recent models show lower gains from agricultural liberalization under plausible Doha scenarios than those found in the World Bank study. When scenarios are adjusted to be comparable, the results for the CEPII and IFPRI models are quite similar to the findings of the Carnegie model, as seen in figure 4.2.

The CEPII modelers appear to find higher gains. However, their scenario does not allow for any exceptions for sensitive or special products. If the same margin of reduction found in the World Bank's results after allowing for these exceptions is applied to the CEPII figure, the result with 2 percent sensitive and 4 percent special products would be a global welfare gain of $5.5 billion, virtually identical to the Carnegie finding.

The IFPRI model uses the scenario of full liberalization. In a more realistic Doha scenario, we should expect these gains to shrink, as they do

Figure 4.2. Global Real Income Gains from Agricultural Liberalization: Comparison of Major Models
(CHANGE IN REAL INCOME, BILLIONS OF DOLLARS)



a. Kym Anderson, William J. Martin, and Dominique van der Mensbrugghe, "Market and Welfare Implications of Doha Reform Scenarios," in *Agricultural Trade Reform and the Doha Development Agenda*, ed. Kym Anderson and William J. Martin (Washington, D.C.: World Bank, 2006), table 12.14.
b. Scenario includes tiered tariff reductions similar to World Bank, no "sensitive" products and a reduction of 55 percent in domestic subsidies. The Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) model uses GTAP 5 data; however, it does include trade preferences. Antoine Bouët, Jean-Christophe Bureau, Yvan Decreux, and Sebastien Jean, *Multilateral Agricultural Trade Liberalization: The Contrasting Fortunes of Developing Countries in the Doha Round*, CEPII Working Paper 2004-18 (Paris: Centre d'Etudes Prospectives et d'Informations Internationales, 2004). Calculated by author from data in table 6.
c. International Food Policy Research Institute (IFPRI) scenario is full liberalization; total gain would decline significantly in a more realistic Doha scenario. Xinshen Diao, Eugenio Diaz-Bonilla, Sherman Robinson, and David Orden, *Tell Me Where It Hurts, An' I'll Tell You Who to Call: Industrialized Countries' Agricultural Policies and Developing Countries*, MTID Discussion Paper 84 (Washington, D.C.: International Food Policy Research Institute, 2005), table 10.
d. Carnegie scenario 1.

in every other model. For example, the difference in the World Bank and Carnegie models between full liberalization and realistic Doha scenarios was on the order of three to one. By this rule of thumb, the IFPRI model would show gains of about $3.7 billion, the lowest of all the models.

Though showing larger overall gains, the World Bank simulations show similar results to those of the Carnegie model in the changes in trade patterns that are induced by agricultural liberalization, shown in table 4.3. Under the study's central Doha scenario (World Bank scenario 7), increases in agriculture and food exports from high-income countries go entirely to other high-income countries.[35] Their agricultural exports to developing countries do not increase at all. For developing countries, more than 75 percent of increased agricultural exports go to high-income countries.

This pattern of exports is consistent with the findings of the Carnegie model under the scenario in which special treatment is accorded to developing countries' agricultural sectors, based on livelihood security, food security, and rural development needs (Carnegie scenario 4). Carnegie found that the reduction in income gains caused by allowing this exception from agricultural liberalization rules was small both at the global level and for individual countries, including major agricultural exporters, as shown in figures 3.11 and 3.12.

The findings of the World Bank and CEPII simulations also follow the distributional patterns found in the Carnegie study. Figure 4.3 superimposes the results from the World Bank's scenario 2 (the most realistic agricultural scenario modeled by the Bank) on the results from Carnegie's main Doha agricultural scenario. The two scenarios are roughly comparable in levels of ambition. The World Bank central Doha scenario shows China, Mexico, the Middle East and North Africa, and most of Sub-Saharan Africa as net losers in terms of real income. The Bank's model shows much larger gains and much larger losses, but the pattern is strikingly similar to the Carnegie model's results. Note that the Carnegie results are measured in millions of dollars (on the left axis), whereas the World Bank results are measured in billions of dollars (on the right axis).

Similarly, the CEPII model simulation shows the countries of Sub-Saharan Africa and the

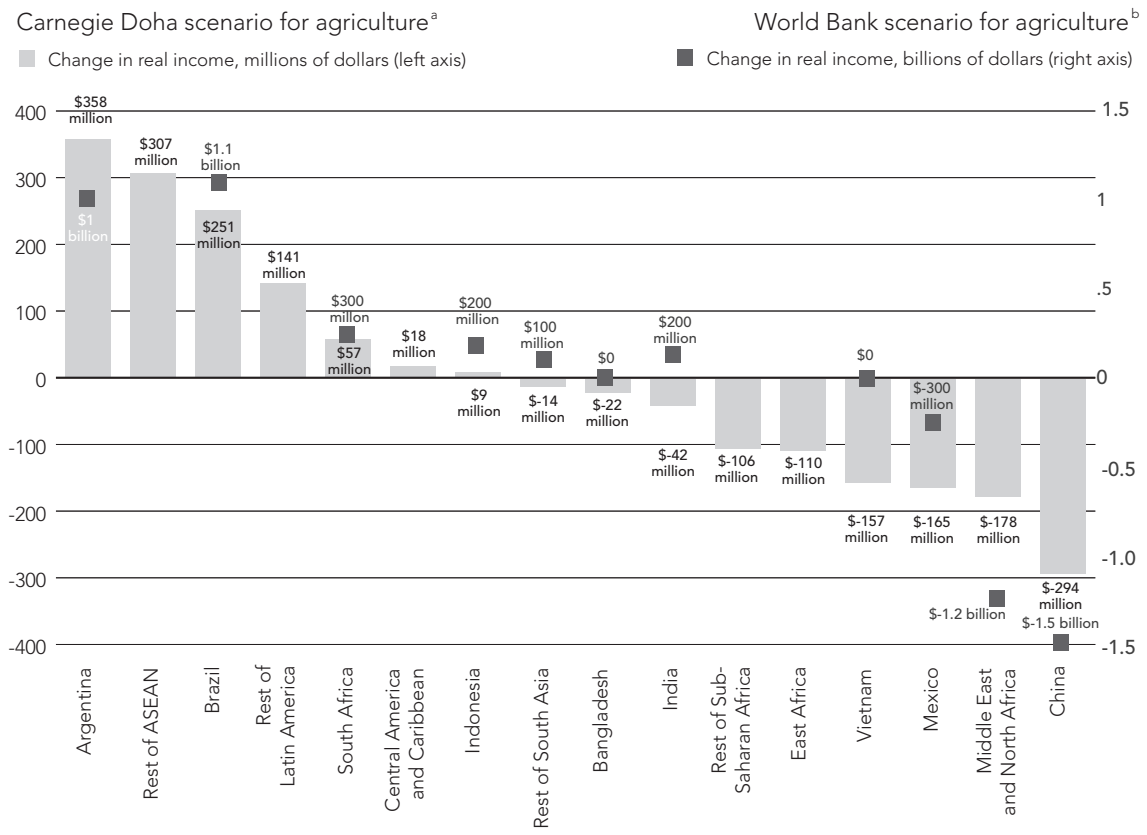
Table 4.3. Destination of Exports under Agricultural Liberalization in the World Bank Model
CHANGE FROM BASELINE IN BILATERAL TRADE FLOWS FROM WORLD BANK DOHA SCENARIO 7 (BILLIONS OF DOLLARS)

	Importer	
Exporter	**High-Income Countries**	**Developing Countries**
High-income countries	15	-0
Developing countries	31	10

Source: Kym Anderson, William J. Martin, and Dominique van der Mensbrugghe, "Market and Welfare Implications of Doha Reform Scenarios," in *Agricultural Trade Reform and the Doha Development Agenda*, ed. Kym Anderson and William J. Martin (Washington, D.C.: World Bank, 2006), table 2.16.

Note: World Bank Scenario 7 is based on tariff reductions from bound rates based on a tiered formula. Resulting average agricultural tariffs are reduced by 50 percent by developed countries and 21 percent by developing countries. Least developed countries do not make tariff reductions. Tiered reductions in domestic support of agriculture are made from bound aggregate measures of support. Export subsidies for agriculture are eliminated.

Figure 4.3. Agricultural Liberalization: Developing Country Winners and Losers under Carnegie Doha Scenario for Agriculture and World Bank Scenario 2



a. Carnegie Scenario 1.
b. World Bank Scenario 2 with two percent "sensitive" products and four percent "special" products. Kym Anderson, William J. Martin, and Dominique van der Mensbrugghe, "Market and Welfare Implications of Doha Reform Scenarios," in *Agricultural Trade Reform and the Doha Development Agenda*, ed. Kym Anderson and William J. Martin (Washington, D.C.: World Bank, 2006), table 12.14. Only World Bank regions that correspond exactly to the Carnegie model regions are included in this figure. The World Bank data for the Middle East and North Africa and for Turkey were used to calculate the data for the Middle East and North Africa region here, in order to correspond with the Carnegie model Middle East and North Africa region.

Mediterranean (North Africa, the Middle East, and Turkey) as net losers under the CEPII scenario for Doha liberalization of agriculture.

As noted above, the World Bank and CEPII models focus on agricultural trade. The one new model that focuses on the manufacturing sector, the UNCTAD model, shows higher gains from manufacturing liberalization than either the Carnegie or World Bank model. Under a range of scenarios, UNCTAD modelers find global income gains ranging from $94 billion to $137 billion. The majority of gains go to developing countries, ranging from 58 to 65 percent in different scenarios. One important explanation for the higher gains is that many of the scenarios modeled entail deep cuts in weighted-average applied tariffs. For example, the impact of various UNCTAD scenarios on the tariffs charged by developed countries on imports from developing countries ranges from reductions of applied tariffs of 46 percent under the most modest scenario to 94 percent under the most ambitious. These are very ambitious scenarios compared with those modeled by Carnegie and the World Bank, and they are more ambitions than current proposals. Another aspect of the model that may account in part for the high gains is that UNCTAD modelers did recognize the abundant supply of unskilled labor in developing countries. This will tend to increase the impact of manufacturing liberalization on developing countries with competitive manufacturing industries, as also found in the Carnegie study.

CHAPTER 5

Policy Implications and Recommendations

The main findings of the Carnegie model shed light on the challenges faced by World Trade Organization (WTO) members in concluding the Doha Round of multilateral trade negotiations. The negotiating rules of the WTO generally require that agreements be reached by consensus. Thus, negotiators must find a balance of terms that offer potential gains to all countries and regions, while fulfilling the commitment made at the launch of negotiations to conclude a "development round" that provides a better balance between the interests of rich and poor countries.

In the Uruguay and previous rounds of multilateral trade negotiations, the search for a consensus package was driven by the interests of the largest developed countries and blocs. The limits of that approach became apparent at the WTO ministerial meeting in Cancún in 2003, when the outline of an agricultural agreement, worked out in advance between the United States and European Union, was rejected by various groups of developing countries, leading to a breakdown of the negotiations. The coalitions formed at that time by developing countries have persisted and deepened. It is now clear that no new consensus—and thus no agreement—can be achieved without meeting their needs.

Finding the combination of measures that can achieve a balanced and mutually beneficial result from the Doha Round requires realistic estimates of the benefits to be achieved through different combinations of market access commitments and other liberalization measures, as well as reliable estimates of how those benefits are distributed among countries across the global economy. General equilibrium modeling is well suited for this purpose, and the Carnegie model has particular value because of its realism in modeling developing countries, the new majority in world trade negotiations, and its focus on issues and scenarios of interest to them.

The Carnegie model and a close analysis of most other recent models makes clear that trade is not a panacea for poverty alleviation or for development more generally. It is important not to overstate the possible gains from the Doha Round, as has been done by many political leaders, commentators, and activists. For example, it has been fashionable to state that trade can do more than development aid to lift people out of poverty in developing countries. Though this may be theoretically true, it is clear that trade has a modest contribution to make and is only one policy mechanism among many that must be pursued to achieve economic growth and rising incomes.

An unrealistic expectation of gains is not harmless. It can lead to pressure for inappropriate policies and could create a bandwagon effect where the very legitimate defensive concerns of developing countries are ignored to achieve illusory gains. Errors in analysis can lead to increases in poverty, not the hoped-for reductions, in developing countries. For the poorest countries, where there is little margin for error, the risks are particularly acute.

The various scenarios tested with the Carnegie model, together with actual negotiating stances in the Doha Round, suggest several conclusions about the dynamics of the negotiations and what will be required to achieve a successful outcome. These implications are discussed below, followed by recommendations of policies that would contribute to a successful outcome of the round.

Overall Gains in the Doha Round and Implications for Negotiating Stances

The first main conclusion arises from findings on the overall gains from plausible Doha scenarios. The scale of gains to be achieved at the global level, and by any country or region, is rather modest, measured as a percentage of the current economy. On the basis of new trade data that became available in late 2004, both the Carnegie and World Bank models show global income gains of less than $60 billion under any realistic Doha scenario.[36] That is 0.146 percent (about one-seventh of one percent) of current global gross domestic product (GDP). Higher figures that have been widely cited refer to full free trade or to scenarios that include levels of ambition that have already been ruled out in the Doha Framework Agreement and that exceed even the most ambitious proposals currently tabled.

The gains for individual economies are also small, with only China gaining more than 1 percent in real income (as a share of current GDP) from any of the plausible scenarios that were modeled.[37] Developing countries as a group gain from 0.33 to 0.50 percent under the main scenarios, while developed countries gain about 0.10 percent under these scenarios. The limited nature of the gains goes far in explaining the overall lack of urgency demonstrated by the members of the WTO and their negotiators.

An important political-economic corollary emerges from the finding that each country can expect only relatively small overall gains from the Doha Round: Given relatively low gains, the adjustment costs to which countries expose themselves when they change trade policies may loom larger than in the past. It could be more difficult for countries to make concessions in noncompetitive sectors if these concessions impose high or concentrated adjustment costs and the gains in other sectors are modest. Consequently, any agreement is likely to be shaped to accommodate the main defensive interests of all major countries.

This corollary provides insight into the negotiating stances of the major countries, which have sought liberalizing measures from others for their competitive sectors but have been largely unwilling to make offsetting concessions in their noncompetitive sectors. The stances of the EU and Brazil illustrate the point. The EU aggressively seeks liberalization of manufacturing and services, but it has not been prepared to go beyond modest agricultural liberalization measures that had already been adopted internally in earlier EU policy decisions. Similarly, Brazil has aggressively sought agricultural liberalization, but it appears unwilling to make significant cuts in either manufacturing or service sectors to achieve that end. In previous rounds, defensive interests in the agriculture, textile, and apparel sectors in the major developed countries were able to limit liberalizing concessions in these areas despite what were seen to be

large potential gains from liberalization in other sectors. With smaller overall gains, the losing sectors may be even more successful in blocking concessions that affect them.

Similar domestic calculations prevail in every major country. Taken together, they reinforce the likelihood that any Doha agreement will entail only modest levels of ambition in any sector.

The Imperative of Making Doha a "Development Round"

The WTO members agreed to make Doha a "development round" as a necessary condition for launching a new effort at global trade liberalization. The new weight of developing countries in the WTO means that their interests, both offensive and defensive, must be addressed if an agreement is to be reached. They have the power to veto any proposed deal that fails to deliver benefits to them that exceed their costs of adjustment. Recent ministerial meetings have demonstrated that the major developing countries, and some smaller ones as well, are fully aware of their own negotiating power, particularly when they combine into bargaining coalitions. Because the developing world now constitutes the majority of WTO members and a rapidly growing share of the world economy, the Doha Round can be seen as the first round in which the global community must learn to negotiate under this new global distribution of economic and bargaining power.

Beyond the realpolitik that will require concessions by high-income countries to developing countries in order to reach a new agreement, there are considerations of equity, justice, and even global economic and political stability that should inform the negotiations. If the global trading system extends opportunities to the global majority (that is, those who live in developing countries and depend on agriculture or unskilled urban occupations for their livelihood), the result will be increased global economic activity, growth, and stability. If large numbers of these individuals and households do not benefit, or if they face worse economic circumstances as a result of global trade rules, the impact of trade will be to concentrate wealth in a relatively small number of countries, firms, and households. This would call into question both the legitimacy and the economic sustainability of an open global trade regime, with potential harm to high-income countries, households, and firms as well as to the poor.

The scenarios we modeled make clear that some low-income countries are likely to be harmed by trade policies under consideration in the Doha Round. Poor people in middle income developing countries are also at risk of negative impacts from the negotiations.

We suggest two principles that should be used to evaluate—and adjust—trade policies in light of possible adverse effects on poverty and equity. First, if a proposed trade policy change is likely to worsen poverty, it should be rejected or offset by changes that have a high probability of offering better opportunities to groups likely to be affected. Second, the international community should agree to apply the principle that trade policy changes that produce benefits that are likely to accrue to only small numbers of firms and households while inflicting economic harm on larger numbers of firms, individuals, or households will not be adopted.

The Challenge of Finding Gains for All Developing Countries

The developing countries have very different types of economies and economic potential. For example, the often-cited proposition that agricultural liberalization offers major benefits for most developing countries is simply not true, as demonstrated by the findings of the Carnegie model and other major models. Many

developing countries are net losers if only agriculture is liberalized. The gains accrue mainly to high-income countries that liberalize their own agricultural sectors and shed the burden of maintaining expensive and inefficient subsidies. In terms of agricultural trade, there are some shifts in market share but little overall growth in agricultural export markets. Most developing countries gain more from liberalization of manufactured goods than from freer trade in agriculture. Even Brazil, a strong agricultural exporter and demandeur in the negotiations on agriculture, gains more from manufacturing than from agricultural liberalization.

However, liberalization of manufactured goods poses its own difficult challenges. The current overabundance of labor in developing countries—relative to both capital and the capacity of national and global markets to absorb output—will make achieving all-around gains from trade even more complicated. The Carnegie model's innovative use of realistic assumptions about developing country labor markets makes this particularly evident.

The current surplus of labor in developing countries affects both agriculture and manufacturing. Many developing countries have noncompetitive agricultural sectors based on low-productivity, small-scale farming. Though they would benefit from lower food costs by importing from more efficient producers abroad, they would lose a disproportionate share of employment in their own agricultural sectors. In the absence of sufficient alternative employment, their economies would be worse off, at least in the short and medium terms.

In the manufacturing sector, export demand generated by lower trade barriers would allow developing countries to use unemployed unskilled labor and increase production without increasing labor costs. This would benefit the most competitive producers among developing countries but drive out marginal producers. This has already happened in the apparel sector after partial liberalization under the Uruguay Round. Further ambitious liberalization of manufacturing trade would benefit China, which has a concentration of efficient producers, and other developing countries to a lesser extent, but would harm Bangladesh and some Sub-Saharan African countries. As China, India, and other developing countries climb the technology ladder, it is likely that downward pressures on prices and intense global competition will extend up the value-added chain to other manufacturing industries.

The concerns of many low-income developing countries about the Doha Round are especially justified. Many fare poorly under the types of liberalization currently proposed. Some experience actual losses in real income or in their export share in world markets.

Finding a balance of measures that benefits all developing countries will be a daunting challenge. It may take more time and effort than in earlier rounds to succeed in this more complex global economic matrix. An overall balance has not yet been found. However, several components can be identified that should be included in any package to address the challenges identified through this report's simulations. These recommended measures are presented in box 5.1.

Our analysis suggests that for Doha to succeed as a development round, significant differentiation must be built into the basic structure of the global trading regime to accommodate the wide differences in the offensive and defensive interests of developing countries. Even with a carefully calibrated treatment of developing countries in the main architecture of any agreement, special measures will also be required to ensure that the least developed and most vulnerable countries are able to join the winners' circle of trade.

Box 5.1. Recommendations

Careful Sequencing of Liberalization and Much Longer Phase-In Periods for Developing Countries

Because developing countries have less differentiated economies than more industrialized countries and, in many cases, have high concentrations of their labor forces in agriculture, it is essential that their manufacturing sectors be allowed to develop and grow *before* they expose uncompetitive agricultural sectors to the full force of global agricultural trade. Otherwise, they are likely to experience higher levels of unemployment and poverty as their economies adjust to trade liberalization. These short- to medium-term outcomes are undesirable in themselves and would put downward pressure on domestic consumption, which could create a long-term cycle of stagnation.

In the context of a current global capacity glut in many low-skilled manufacturing sectors, it is unrealistic to expect that these sectors will quickly absorb displaced agricultural labor. Therefore, developing countries with very high concentrations of agricultural labor will require special agricultural consideration throughout the Doha implementation period, and probably beyond.

Special and Differential Treatment for Developing Country Agriculture

The WTO's July Framework Agreement from 2004 acknowledges that developing countries will need to designate some products as special products based on livelihood security, food security, and rural development concerns. The number of such products and the terms for selecting them have yet to be agreed. Given their high levels of employment in agriculture and the need to maintain those livelihoods until alternative employment can be generated in other sectors, developing countries should be allowed to designate a substantial portion of their agricultural tariff lines as special products. The G-33 group of developing countries with high concentrations of employment in agriculture, has proposed that 20 percent of tariff lines be eligible for such designation. For countries with the highest concentrations of workers in agriculture, this would be a minimum necessary accommodation.

The right to designate special products should be open-ended. Raising productivity levels and developing new skills among large numbers of subsistence farmers will be a difficult process that in many countries will require much longer than any anticipated implementation period for the Doha Round. In addition, beneficiary countries should be allowed to change the products in this category as circumstances warrant. Cumbersome or restrictive rules on the designation of special products are not appropriate and are not warranted in light of the minimal impact on other countries.

Agreement in principle has also been reached that developing countries will be allowed to establish a special safeguard mechanism, under which they could introduce tariffs or other protection for agricultural products in the future. Detailed provisions have yet to be negotiated but should include the right to launch such protective measures when prices decline or when volumes surge.

In some cases, the interests of exporters in other countries may run counter to the critical defensive interests of developing countries with large numbers of subsistence farmers. For example, some basic grains may pose this conflict of inter-

ests. A Doha agreement should reflect the basic principle that new trade measures should not benefit a limited number of large firms and wealthy households at the expense of much larger numbers of very poor farmers and households in the developing world.

Development Assistance for Agriculture

Allowing extensive special and differential treatment for products cultivated by subsistence farmers is not intended to keep farmers in low-productivity, low-income occupations. It is meant to allow sufficient time for them to become more productive in farming or to find other occupations. These transitions will take time and require targeted development assistance to raise farm incomes and to prepare farmers to cope with changes in global agricultural trade.

The Doha Round should include negotiations over additional development assistance for agriculture because the transition to more modern sectors will require resources beyond what is domestically available in poor countries.[38] New aid commitments by multilateral development agencies and bilateral donors are needed to upgrade farming techniques and inputs, extend irrigation systems, and build roads to markets. Specific amounts of aid from donors with bound timetables for delivery should be part of the final Doha agreement.

Policies for Least Developed Countries

Additional affirmative actions will be needed for low-income countries that otherwise would come out as net losers from the Doha Round. The WTO took an important step on this issue at the Hong Kong ministerial, where developed countries agreed to extend duty-free and quota-free market access for most exports of least developed countries (LDCs). This agreement is likely to mean additional market opening by the United States and some other developed countries when it takes effect after all other provisions of the round are settled. However, the agreement covers only 97 percent of LDC exports, which may exclude their most competitive products. The agreement should be extended to include all products of LDCs by a firm future date. The final plan should also eliminate cumbersome rules of origin that block some exports of LDCs and reduce their opportunity to achieve economies of scale.

Ideally, middle-income developing countries should also extend this access to the LDCs. China established a positive precedent by offering preferential access to many products of the least developed members of the Association of Southeast Asian Nations as part of a regional free trade agreement, although there are many exceptions. Preferential access should be extended to LDCs by other middle-income developing countries and by China to LDCs in other regions.

Policies for Other Low-Income Countries

A solution must also be found for the group of low-income countries that are just above the threshold for LDC status, because they may be made worse off by the effort to help the poorest nations. Some access to special benefits should be extended to these countries as well. Criteria should be developed to identify sectors in which these very-low-income countries outside the LDC group share similar risks. On the basis of these criteria, sectoral benefits available to the LDCs should be extended to this group.

Trade Adjustment Assistance Programs for the Poor in Developing Countries

Trade by its nature creates winners and losers, as economies adjust to changes in export and import prices and other trade-induced changes. In theory, the winners can compensate the losers with transfer payments, or governments can tax the winners to pay for unemployment compensation, training programs, and job searches by the losers. In practice, such policies and programs have never been created between countries where one is the winner and the other the loser from trade.

In low-income countries, resources are not available for such trade adjustment programs. If the members of the WTO agree on trade policy changes that inflict losses on poor people in low-income countries, they should recognize a responsibility to assist in constructing and funding trade adjustment programs there. This can be done through multilateral development agencies, such as the World Bank, or through bilateral assistance. To date, such programs have not been adopted or even discussed. They should be added to the Doha agenda.

APPENDIX A

Technical Specifications of the Model

I. The Structure of the Model

The model is an update and extension of the applied general equilibrium (AGE) models used in the study of China's accession to the World Trade Organization (WTO) by Zhi Wang, with endogenous unskilled labor unemployment in developing countries.[39] It is part of a family of models used widely to analyze the impact of global trade liberalization and structural adjustment programs. It focuses on the real side of the world economy and incorporates considerable detail on sectoral output and real trade flows, both bilateral and global. However, this structural detail is obtained at the cost of not explicitly modeling financial markets, interest rates, and inflation.

Given a world equilibrium in the base year, the model generates the pattern of production and trade changes from the base that result from world economic adjustment to the shocks specified in various alternative scenarios of trade liberalization. The model has a focus on developing countries, with twenty-four fully endogenized regions and twenty-seven production sectors in each region to represent the world economy. Details of the regions and sectors and their correspondence to the GTAP database are provided in table A.1 and table A.2.

There are six primary factors of production: agricultural land, natural resources, capital, agricultural labor, unskilled labor, and skilled labor. Skilled and unskilled labor have basic education in common, with skilled labor also having more advanced training. Agricultural labor has little or no education. Natural resources are sector specific. Land and agricultural labor are employed only in agricultural sectors. Agricultural laborers may migrate in response to increased demand in urban unskilled labor markets, depending on the level of unemployment in these markets and rural/urban wage differentials. The elasticity of substitution is 1. Other primary factors are assumed to be mobile across sectors but immobile across regions. All commodity and factor markets, except unskilled labor, are assumed to clear through market prices. For unskilled labor, the market equilibrium specification of Harris and Todaro is adopted for all developing countries in the model,[40] in which the wage is assumed fixed to a price index. This reflects the abundant supply of unskilled labor and the presence of unemployment in most developing countries. Unskilled labor employment is endogenous, adjusting to clear the unskilled labor market in developing countries. Full employment is assumed in developed country labor markets.

Table A.1. Countries and Regions in the Model and Correspondence to GTAP Database

Region	Country	Corresponding GTAP Codes
China	China	CHN
Indonesia	Indonesia	IDN
Vietnam	Vietnam	VNM
Rest of ASEAN	Brunei	XSE
	Cambodia	
	Laos	
	Myanmar	
	Timor-Leste	
	Philippines	PHL
	Thailand	THA
India	India	IND
Bangladesh	Bangladesh	BGD
Rest of South Asia	Afghanistan	XSA
	Bhutan	
	Maldives	
	Nepal	
	Pakistan	
	Sri Lanka	LKA
Russia and Former	Russia	RUS
Soviet Union	Armenia	XSU
	Azerbaijan	
	Belarus	
	Estonia	
	Georgia	
	Kazakhstan	
	Kyrgyzstan	
	Latvia	
	Lithuania	
	Moldova	
	Tajikistan	
	Turkmenistan	
	Ukraine	
	Uzbekistan	
Middle East and	Turkey	TUR
North Africa	Morocco	MAR
	Tunisia	TUN
	Israel	XME
	Jordan	
	Syria	
	Lebanon	
	Bahrain	
	Iraq	
	Iran	
	Kuwait	
	Yemen	
	United Arab Emirates	
	Saudi Arabia	
	Qatar	
	Oman	
	Palestinian Territory	
	Algeria	XNF
	Libya	
	Tunisia	
	Egypt	
South Africa	South Africa	ZAF
East Africa	Malawi	MWI
	Tanzania	TZA
	Uganda	UGA

Region	Country	Corresponding GTAP Codes
Rest of Sub-	Botswana	BWA
Saharan Africa	Lesotho	XSC
	Namibia	
	Swaziland	
	Mozambique	MOZ
	Zambia	ZMB
	Zimbabwe	ZWE
	Madagascar	MDG
	Angola	XSD
	Democratic Republic of Congo	
	Mauritius	
	Seychelles	
	Benin	XSS
	Burkina Faso	
	Burundi	
	Cameroon	
	Cape Verde	
	Central African Republic	
	Chad	
	Comoros	
	Côte d'Ivoire	
	Congo	
	Djibouti	
	Equatorial Guinea	
	Eritrea	
	Ethiopia	
	Gabon	
	Gambia	
	Ghana	
	Guinea	
	Guinea Bissau	
	Kenya	
	Liberia	
	Mali	
	Mauritania	
	Niger	
	Nigeria	
	Rwanda	
	São Tomé and Príncipe	
	Senegal	
	Sierra Leone	
	Somalia	
	Sudan	
	Togo	
Brazil	Brazil	BRA
Mexico	Mexico	MEX
Argentina	Argentina	ARG
Rest of Latin America	Colombia	COL
	Peru	PER
	Venezuela	VEN
	Bolivia	XAP
	Ecuador	
	Chile	CHL
	Uruguay	URY
	Paraguay	XSM
	Falkland Islands (Malvinas)	
	French Guiana	
	Guyana	
	Suriname	

Table A.1. (continued) Countries and Regions in the Model and Correspondence to GTAP Database

Region	Country	Corresponding GTAP Codes
Central America and Caribbean	Belize	XCA
	Costa Rica	
	Guatemala	
	Honduras	
	El Salvador	
	Nicaragua	
	Panama	
	Antigua and Barbuda	XFA
	Bahamas	
	Barbados	
	Dominica	
	Dominican Republic	
	Grenada	
	Haiti	
	Jamaica	
	Puerto Rico	
	Saint Kitts and Nevis	
	Saint Lucia	
	Saint Vincent and the Grenadines	
	Trinidad and Tobago	
	U.S. Virgin Islands	
	Anguilla	XCB
	Aruba	
	British Virgin Islands	
	Cayman Islands	
	Cuba	
	Guadeloupe	
	Martinique	
	Montserrat	
	Netherlands Antilles	
	Turks and Caicos	
Rest of the World	American Samoa	XOC
	Cook Islands	
	Fiji	
	French Polynesia	
	Guam	
	Kiribati	
	Marshall Islands	
	Micronesia, Federated States of	
	Nauru	
	New Caledonia	
	Norfolk Island	
	Northern Mariana Islands	
	Niue	
	Palau	
	Papua New Guinea	
	Samoa	
	Solomon Islands	
	Tokelau	
	Tonga	
	Tuvalu	
	Vanuatu	
	Wallis and Futuna	
	Macau	XEA
	Mongolia	
	North Korea	
	Bermuda	XNA
	Greenland	
	Saint Pierre and Miquelon	
	Andorra	XER
	Bosnia and Herzegovina	
	Faroe Islands	
	Gibraltar	
	Former Yugoslav Republic of Macedonia	
	Monaco	
	San Marino	
	Serbia and Montenegro	
	Albania	ALB
	Bulgaria	BGR
	Croatia	HRV
	Romania	ROM
Asian Newly Industrialized Economies	South Korea	KOR
	Malaysia	MYS
	Singapore	SGP
	Taiwan	TWN
	Hong Kong	HKG
United States	United States	USA
European Union 15	Austria	AUT
	Belgium	BEL
	Denmark	DNK
	Finland	FIN
	France	FRA
	Germany	DEU
	United Kingdom	GBR
	Greece	GRC
	Ireland	IRL
	Italy	ITA
	Luxembourg	LUX
	Netherlands	NLD
	Portugal	PRT
	Spain	ESP
	Sweden	SWE
European Union 10	Cyprus	CYP
	Czech Republic	CZE
	Hungary	HUN
	Malta	MLT
	Poland	POL
	Slovakia	SVK
	Slovenia	SVN
	Estonia	EST
	Latvia	LVA
	Lithuania	LTU
Japan	Japan	JPN
Rest of OECD	Australia	AUS
	New Zealand	NZL
	Canada	CAN
	Switzerland	CHE
	Iceland	XEF
	Norway	
	Lichtenstein	

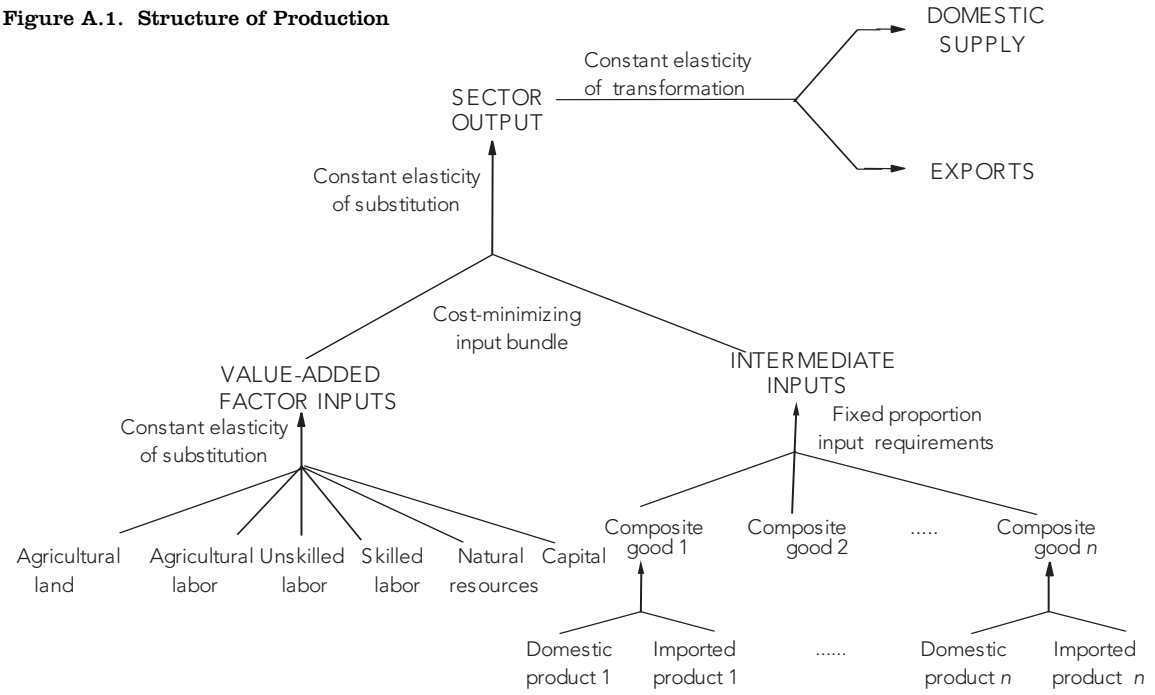
Source: Betina V. Dimaranan and Robert A. McDougall, eds., *Global Trade, Assistance, and Production: The GTAP 6 Data Base* (West Lafayette, Ind.: Center for Global Trade Analysis, Purdue University, 2006).

Table A.2. Sectors in the Model, with Corresponding GTAP and ISIC Codes

Sectors in the Carnegie Model	Global Trade Analysis Project Database Version 6.0 Sector Number and Description	International Standard Industry Classification Revision 3 Code
1. Grains	1. Paddy rice 2. Wheat 3. Cereal grains, not elsewhere classified	01111, 01301, 01401, 01112, 01302, 01402, 01113, 01303, 01403
2. Oilseeds	5. Oil seeds	01116, 01307, 01407
3. Vegetables and fruits	4. Vegetables, fruit, and nuts	01121, 01112, 01114
4. Other crops	6. Sugar cane, sugar beet; 7. Plant-based fibers; 8. Crops not elsewhere classified	01305, 01405, 01204, 01404, 01117, 01115, 01306, 01406, 01122, 01132
5. Livestock	9. Bovine cattle, sheep and goats, horses; 10. Animal products, not elsewhere classified; 11. Raw milk; 12. Wool, silk-worm cocoons	01308, 01408, 01211, 01212, 013012, 01213,0122, 01309, 013010, 013011, 01409, 014010, 014011, 014012 , 15311
6. Meat and dairy products	19. Meat of cattle, sheep, goats, and horses; 20. Meat products, not elsewhere classified; 22. Dairy products	1511, 1514, 1520
7. Sugar	24. Sugar	1542
8. Processed foods	23. Processed rice; 21. Vegetable oils and fats; 25. Food products not elsewhere classified	1500 excluding 1511, 1514, 1520, 1542, 1551,1552, 1553, and 1554
9. Beverages and tobacco	26. Beverages and tobacco	1551, 1552, 1553, 1554, 1600
10. Forestry and fishery	13. Forestry; 14. Fishing	02, 015, 05
11. Crude oil and natural gas	16. Oil; 17. Gas	111, 112
12. Textiles	27. Textiles	17, 243
13. Apparel	28. Wearing apparel	18
14. Leather and footwear	29. Leather products	19
15. Other manufactures	42. Manufactures not elsewhere classified	36
16. Wood and paper products	30. Wood products; 31. paper products, publishing	20, 361, 21, 2211, 2212, 2219, 222
17. Petroleum, coal, and mineral products	15. Coal; 18. Minerals not elsewhere classified; 34. Mineral products, not elsewhere classified; 32. Petroleum, coal products	101, 102, 103, 12, 13, 14, 231, 232, 26
18. Chemical, rubber, and plastic products	33. Chemical, rubber, and plastic products	233, 241, 242, 23
19. Metals and metal products	35. Ferrous metals; 36. Metals not elsewhere classified; 37. Metal products	271, 2731, 272, 2732, 28
20. Motor vehicles and other transport equipment	38. Motor vehicles and parts; 39. Transport equipment not elsewhere classified	34, 35
21. Electronic equipment	40. Electronic equipment	30, 32
22. Other machinery	41. Machinery and equipment not elsewhere classified	2213, 223, 29, 31, 33
23. Trade and transportation	47. Trade; 48. Other transportation; 49. Water transportation; 50. Air transportation	521, 522, 523, 524, 523, 60, 61, 62, 51
24. Financial services, banking, and insurance	52. Financial services; 53. Insurance; 54. Business services not elsewhere classified	65, 66, 67, 70
25. Communication, health, education, and public services	51. Communication; 56. Defense, education, health	37, 64, 73, 75, 80, 85, 91, 99
26. Recreational and other services	55. Recreational and other services	55, 63, 92, 93, 95
27. Housing, utilities, and construction	43. Electricity; 44. Gas manufacture and distribution; 45. Water; 46. Construction; 57. Dwellings	401, 402, 403, 41, 45, 90

Source: Betina V. Dimaranan and Robert A. McDougall, eds., *Global Trade, Assistance, and Production: The GTAP 6 Data Base* (West Lafayette, Ind.: Center for Global Trade Analysis, Purdue University, 2006).

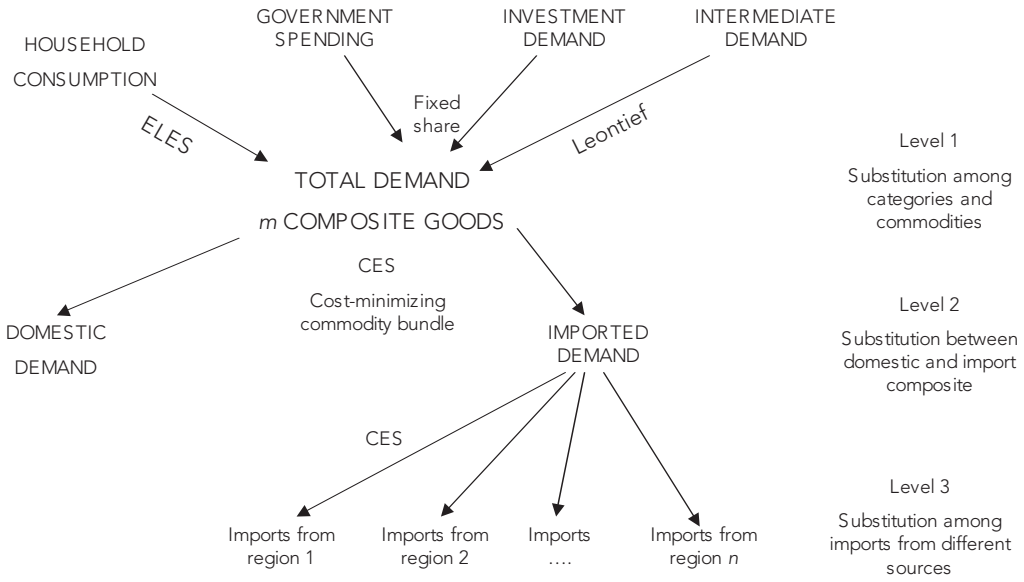
Figure A.1. Structure of Production



On the macroeconomic side, household savings, government surplus (deficit), and foreign capital inflows (foreign savings) are assumed to be perfect substitutes and collectively constitute the source of gross investment in each region. Because balance of trade and government surplus (deficit) are fixed at the base year level during simulation, domestic private savings is assumed to adjust to achieve saving–investment balance after a trade policy change.

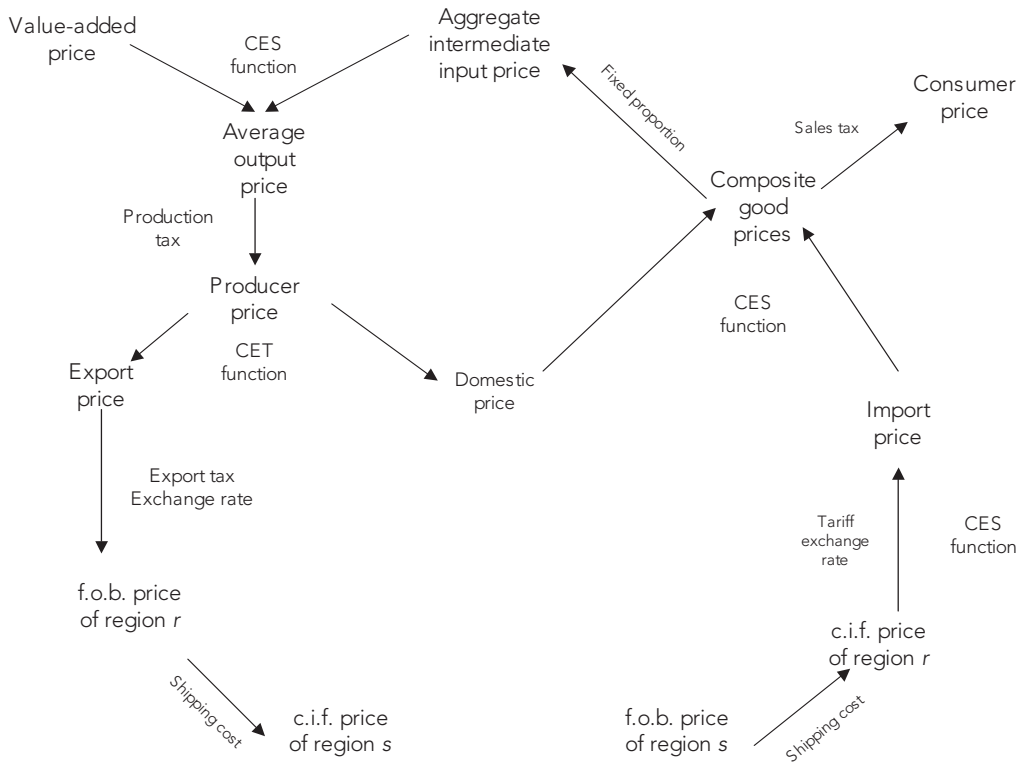
The structure of production in the model is shown in figure A.1 and the structure of demand in figure A.2. The price system in the model is shown in figure A.3.

Figure A.2. Structure of Demand



Notes: CES = constant elasticity of substitution. ELES = extended linear expenditure system.

Figure A.3. Price System in the Model



Note: CES = constant elasticity of substitution. CET = constant elasticity of transformation. f.o.b. = free on board. c.i.f. = cost, insurance, freight.

In addition to changes in terms of trade and trade volumes, the model captures two additional types of gains from trade liberalization. The first is gains from more efficient utilization of resources, which lead to a one-time permanent increase in gross domestic product (GDP) and social welfare. The second stems from the fact that empirical evidence suggests that there is positive feedback between trade expansion and productivity growth. The model incorporates a capital- and intermediate-goods import-embodied technology transfer among regions, which links sector-specific total factor productivity (TFP) growth with each region's imports of capital- and technology-intensive products. The technology transfer is assumed to flow in one direction—from more developed regions to less developed regions. Trade liberalization increases the prevalence of technology transfer as trade barriers are reduced. Firms in the liberalized regions will import more capital- and technology-intensive goods as both investment and intermediate inputs from abroad at cheaper prices. Those goods are usually embodied with advanced technology from other countries, thus stimulating productivity growth for all production factors.

II. Algebraic Specification of the Model

This section provides a detailed mathematical specification of the model. Definitions of variables are found in table A.3 and definitions of parameters in table A.4. Equations are shown in box A.1. The model is implemented by the General Algebraic Modeling System (GAMS) and solved in levels.[41]

Notation:

- Regions are defined in set *R* and indexed by *r* or *s*;

Table A.3. Definitions of Variables

Variable	Definition	No. of Variables
PWE_{isr}	World f.o.b. price for goods from region s to region *r*	$I \times R(R\text{-}1)$ (13,662)
PWM_{isr}	World c.i.f. price for goods from region s to region *r*	$I \times R(R\text{-}1)$ (13,662)
PM_{ir}	Price of aggregate imported goods in region *r*	$I \times R$ (621)
PX_{ir}	Price of composite goods in region *r*	$I \times R$ (621)
PD_{ir}	Price of domestic products sold at domestic market in region *r*	$I \times R$ (621)
PE_{ir}	Price of domestic goods for export in region *r*	$I \times R$ (621)
PC_{ir}	Domestic consumer price in region *r*	$I \times R$ (621)
PP_{ir}	Average output price before production tax in region *r*	$I \times R$ (621)
P_{ir}	Average output price after production tax in region *r*	$I \times R$ (621)
PF_{fr}	Factor price in region *r*	$F \times R$ (138)
PV_{ir}	Price of value added in region *r*	$I \times R$ (621)
PN_{ir}	Price of aggregate intermediate inputs in region *r*	$I \times R$ (621)
CPI_r	Price of savings in region *r* (consumer price index)	R (23)
ER_r	Exchange rate of region *r*	R (23)
PID_r	Price index in region *r*	R (23)
Q_{ir}	Sector output in region *r*	$I \times R$ (621)
VA_{ir}	Variable sector production cost in region *r*	$I \times R$ (621)
NX_{ir}	Aggregate sector intermediate input in region *r*	$I \times R$ (621)
DF_{fir}	Sector factor demand in region *r*	$(F\text{-}3) \times I \times R + (IAG + RES) \times R$ (2,024)
DX_{ir}	Sector domestic sales in region *r*	$I \times R$ (621)
EX_{ir}	Domestic goods for export in region *r*	$I \times R$ (621)
C_{ir}	Household consumption in region *r*	$I \times R$ (621)
GC_{ir}	Government spending in region *r*	$I \times R$ (621)
ID_{ir}	Investment demand in region *r*	$I \times R$ (621)
TX_{ir}	Composite goods demand (supply) in region *r*	$I \times R$ (621)
MX_{ir}	Sector composite goods imports in region *r*	$I \times R$ (621)
X_{isr}	Trade flows from region *s* to region *r*	$I \times R(R\text{-}1)$ (13,662)
TRQ	Total international transportation supply	1
PTR	Price of international shipping service	1
$TRQD_{ir}$	International shipping demand by region *r*	$I \times R$ (621)
$TRQS_r$	International shipping service supply by region *r*	R (23)
HDI_r	Household disposable income in region *r*	R (23)
SY_r	Household supernumerary income in region *r*	R (23)
GR_r	Total government revenue in region *r*	R (23)
GSP_r	Total government spending in region *r*	R (23)
$TARIFF_r$	Total tariff revenue in region *r*	R (23)
$ETAX_r$	Total export tax revenue (subsidy expenditure) in region *r*	R (23)
$PTAX_r$	Total production tax revenue in region *r*	R (23)
$CTAX_r$	Total consumer sales tax in region *r*	R (23)
SAV_r	Household savings in region *r*	R (23)
$GSAV_r$	Government saving (deficit) in region *r*	R (23)
$GTRNS_r$	Government transfer in region *r*	R (23)
BOT_r	Balance of trade in region *r* (net capital inflow)	R (23)
INV_r	Gross investment by region *r*	R (23)
$ITFP_{ir}$	Import embodied TFP shifter by sector in region *r*	$I \times R$ (621)
FS_{fr}	Factor endowment by region *r*	$F \times R$ (138)
	Total number of variables: $17 \times R + (2 \times F + IAG + RES) \times R + 21 \times I \times R + 3 \times I \times R(R - 1) + (F - 3) \times I \times R + 2$ (56,720)	

Note: f.o.b. = free on board. c.i.f. = cost, insurance, freight. TFP = total factor productivity.

- Sectors are defined in set *I* and indexed by *i* or *j*;
- Agricultural sectors are defined as a subset of *I*: *IAG*(*I*);
- Natural resource based sectors are defined as a subset of *I*: *RES*(*I*);
- Primary factors are defined in set *F* and indexed by *f*.

Conventions:

Uppercase English letters indicate variables. Those marked with a bar on top are set exoge-

Table A.4. Definitions of Parameters

Parameter	Definition
te_{isr}	Sector export tax (subsidy) rate for goods to region *r* from region *s*
tm_{isr}	Sector tariff rate for goods from region *s* in region *r*
tn_{isr}	Sector NTB for goods from region *s* in region *r*
tp_{ir}	Sector indirect tax rate in region *r*
tc_{ir}	Consumer sales tax rate in region *r*
trc_{isr}	International transportation cost margin as percent value of f.o.b.
io_{ijr}	Input/output coefficients for region *r*
kio_{ir}	Sector share of total investment in region *r*
dk_r	Depreciation rate of capital stock in region *r*
τ_r	Regional share of international shipping service supply
Γ_{ir}	Unit coefficients in first level Armington aggregation function of region *r*
∞_{ir}	Unit coefficients in second level Armington aggregation function of region *r*
α_{ir}	Share parameters in the first level Armington aggregation function of region *r*
ξ_{ir}	Share parameters in the second level Armington aggregation function of region *r*
σm_i	Substitution elasticities between domestic and imported goods
σt_i	Substitution elasticities among import goods from different regions
χ_{ir}	Unit coefficients in CET function of region *r*
κ_{lr}	Share parameters in CET function of region *r*
σe_i	Elasticities of transformation between domestic sales and exports
A_{ir}	Unit parameter in aggregate cost function
λ_{lr}	Intermediate input share in aggregate cost function
σp_{ir}	Elasticities of substitution between aggregate factor and intermediate input
Λ_{ir}	Unit parameter in value added function
δ_{fir}	Factor share in value added function
σv_{ir}	Elasticities of substitution among primary factors in value added
γ_{ir}	Sector minimum subsistence requirements for private households in region *r*
β_{ir}	Marginal propensity to consume for private households in region *r*
Mps_r	Marginal propensity to save for private households in region *r*
θ_{ir}	Sector share of government spending in region *r*
Tfp_r	General TFP shifter in region *r*
Ims_{ir}	The share of intermediate inputs in sector's total imports
σip_{ir}	Elasticity between intermediate goods import growth with TFP growth
dl_r	Land depletion rate in region *r*
Ds_r	Share of additional tertiary education stock to skilled labor force at each period
$t\varphi_r$	Parameter that controls the speed of wage convergence between agricultural and unskilled labor
N_{rt}	Population growth rate in region *r* at period *t*
Wdf_r	Wage ratio of agricultural labor and unskilled labor in region *r* at base year

Note: NTB = nontariff barrier. CET = constant elasticity of transformation. TFP = total factor productivity.

nously. Greek letters or lowercase English letters refer to parameters, which need to be calibrated or supplied from exogenous sources. When multiple subscripts of a variable or parameter come from the same set, the first one represents the region or sector supplying goods; the next one represents the region or sector purchasing goods.

Price Equations

Equations 1 through 11 are price equations in the model. Equations 1 and 2 define the relationship between border (world) prices and internal prices, while equations 3, 4, 6, 7, and 8 define price indices for aggregate imported goods, Armington goods, composite value added, and the firm's output with and without production taxes, respectively. In equations 3, 4, 6, and 7, the price indices are the unit cost functions, while in equation 8 they are unit revenue functions, all of which are dual to the corresponding unit quantity aggregator functions. For example, equation 7 is the result of cost minimization by the representative firm in each sector with respect to its aggregate factor

and inputs, subject to a constant elasticity of substitution (CES) production function. Since CES functions are used as the building blocks of the basic model, and this quantity aggregator function is homogeneous of degree one, the total costs can be written as total quantity multiplied by unit cost.[42] This implies that the average cost, under cost minimization, is independent of the number of units produced or purchased. Thus, the unit cost function also stands for the price of the composed commodity. Equation 5 defines the unit price for aggregate inputs, which is the input–output coefficient weighted sum of all the value of its contents. Equation 9 states the domestic consumer price is the Armington goods price plus sales taxes. Equation 10 specifies an economy-wide consumer price index, which is used as price of household savings. Equation 11 defines the numeraire in the model.

Factor Demand and Firms' Supply Equations

Equation 12 and 13 specify the demand functions for aggregate factor and intermediate inputs, while equation 14 gives demand functions of each primary factor. They equal unit demand function multiplied by the quantities of total output, and the unit demand functions are obtained by taking partial derivatives of the unit cost functions (equation 6 and 7) with respect to the relevant factor prices, according to Shephard's lemma.

Equations 15 through 18 are the domestic and export supply functions corresponding to the constant elasticity of transformation (CET) function commonly used in today's AGE models. They are derived from revenue maximization, subject to the CET function, in a way similar to the derivation of factor demand functions. Equation 19 aggregates exports by the representative firm in each region, which implies that producers only differentiate output sold in domestic and foreign markets but do not differentiate exports by destination (foreign markets are perfect substitutes). Equations 15 through 18 can be partially or entirely turned off in the model; in such case, $PD_{ir} = PE_{ir} = P_{ir}$ will be enforced and exports and domestic sales become perfect substitutes in the model.

Trade and Final Demand Equations

Trade and final demand equations are listed in equations 20 through 26. Equation 20 is the consumer demand function, which is the Extended Linear Expenditure System derived from maximizing a Stone-Geary utility function subject to household disposable income, which is specified in equation 31. Equation 21 defines household supernumerary income, which is disposable income less total expenditure on the subsistence minimum. Equations 22 and 23 give government and investment demand. Equations 24 through 26 are demand functions for domestic goods, for aggregate imported goods, and for imported goods by source, respectively. They describe the cost-minimizing choice of domestic and import purchases, as well as import sources. They are derived from corresponding cost functions according to Shephard's lemma in a way similar to the derivation of factor demand functions (taking partial derivatives of the cost function with respect to the relevant component prices). Because of the linear homogeneity of the CES function, the cost function that is dual to the commodity aggregator can be represented by its unit cost function (equations 3 and 4) multiplied by total quantity demanded.

International Shipping Equations

Equations 27 through 30 describe the international shipping industry in the model. Equations 27 and 28 describe the supply side of the international shipping industry. Equation 27 states that at equilibrium, the returns from shipping activity must cover its cost. Like other

industries in the model, it also earns zero profit. Equation 28 describes the demand for each region's service sector exports to the international shipping industry, which is generated by the assumed Cobb-Douglas technology in this industry. The next two equations (29 and 30) refer to the demand side of the international shipping industry. The demand for shipping services associated with commodity *i* in region *r* is generated by a fixed proportion input requirement (Leontief) coefficient trs_{isr}, which is routine/commodity specific (equation 29). In equilibrium, the total demand for shipping service must equal total supply (equation 30).

Income and Saving Equations

Equations 31 through 39 are income and saving equations in the model. Equations 31 and 32 define household disposable income and savings. Equations 33 through 37 determine government revenue from production taxes, consumption taxes, tariffs, and export taxes (a negative value indicates a subsidy), respectively, while equations 38 and 39 define government transfers to households and the balance of trade (foreign savings) in each region.

General Equilibrium Conditions

Equations 40 through 43 define general equilibrium conditions of the model, which are system constraints that the model economy must satisfy. For every sector in each region, the supply of the composite goods must equal total demand (equation 40), which is the sum of household consumption (C_{ir}), government purchases (GC_{ir}), investment (ID_{ir}), and the firm's intermediate demand. Similarly, the demand for each factor in every region must equal the exogenously fixed supply (equation 41). In this dual formulation, output in each region is determined by demand. Sectoral equilibrium is determined in equation 42, unit output price equals average cost, which is also the zero profit condition. Equation 43 describes the macroeconomic equilibrium identity in each region, which is also the budget constraint for the investor. Because all agents in each region (households, government, investor, and firms) satisfy their respective budget constraints, it is well known that the sum of the excess demand for all goods is zero; that is, Walras' law holds for each region. Therefore, there is a functional dependence among the equations of the model. One equation is redundant in each region and thus can be dropped.

There are 60,914 equations and 61,130 variables in the model. Since the 144 factor endowment variables (FS_r) are determined by base year data, three additional sets of variables (72) have to be set exogenously as macro closures to make the model fully determinate. They are chosen from the following variables for alternative closures: (1) gross investment or government transfer (INV_r or $GTRANS_r$), (2) balance of trade or exchange rate (BOT_r or ER_r), and (3) government spending or surplus (deficit) (GSP_r or $GSAV_r$).

Trade–Productivity Linkages

Equation 44 links import embodied technology transfer (via imports of capital goods and intermediate inputs) and total factor productivity. Where $X0_{isr}$ is the base year real trade flows, *IM* is a subset of *I*, including those products embodied with advanced technology. It operates through shared parameters and elasticities. An elasticity (ip_{ir}) of 0.1 implies that a 10 percent increase in real imports of capital and technology intensive goods would result in an increase of no more than 1 percent in TFP in that sector, depending on the share of intermediate inputs in the sector's total imports. As pointed out by Lewis, Robinson, and Wang,

while there is fairly widespread agreement that a linkage between imports of intermediate inputs and productivity gains does exist, there is less evidence of the size of the feedback.[43] In our simulation exercises, the elasticities used for developed countries are substantially lower than the values used for developing countries (less than half or lower).

Farm–Nonfarm Migration and Unemployment in Urban Unskilled Labor Markets

Urban unskilled labor and agricultural labor are linked though migration, in which individual workers leave their households and move temporarily or permanently to urban areas to obtain nonagricultural jobs. Such migration is determined by equation 45, the differential between the wage for agricultural labor and the relative expected wage in the urban unskilled labor market, which is defined as the product of wage and employment rate of unskilled labor. The employment rate of unskilled labor is defined by equation 46, while equations 47 and 48 give the numbers of agricultural labor and unskilled labor after accounting for rural and urban migration.

Unskilled Labor Market Equilibrium in Developing Countries

Equation 49 specifies the unskilled labor market equilibrium in developing countries as a complementarity-slack condition. In such a formulation, when there is unemployment in the economy the wage rate will be fixed at the baseline and the employment rate will adjust to clear the unskilled labor market. If labor demand in the economy reaches the level of full employment, the unemployment rate will be zero and the wage rate will adjust to clear the unskilled labor market.

Welfare Measure

We measure the change in welfare (equation 50) induced by trade liberalization by the Hicksian equivalent variation (*EV*), with changes in government consumption and investment spending valued according to the private household's preference and playing the same weight in the regional utility function. The regional spending represents future consumption for households and government in the region, which equal the sum of household, government, and foreign savings (balance of trade in current model).

Box A.1. Equations

$$PWM_{isr} = (1 + trs_{isr}) \times PWE_{isr} \quad (1)$$

$$PWE_{isr} = (1 + te_{isr}) \times \left(\frac{1}{ER_r}\right) \times PE_{ir} \quad (2)$$

$$PM_{ir} = \frac{1}{\mu_{ir}} \times \left\{\sum_{s \in R} \xi_{irs}^{\sigma t_i} \times [(1 + tm_{irs} + tn_{irs}) \times ER_r \times PWM_{irs}]^{1-\sigma t_i}\right\}^{\frac{1}{1-\sigma t_i}} \quad (3)$$

$$PX_{ir} = \frac{1}{\Gamma_{ir}} \times \left\{\sum \alpha_{ir}^{\sigma m_i} \times PD_{ir}^{1-\sigma m_i} + (1 - \alpha_{ir})^{\sigma m_i} \times PM_{ir}^{1-\sigma m_i}\right\}^{\frac{1}{1-\sigma m_i}} \quad (4)$$

$$PN_{jr} = \sum_{i \in I} io_{ijr} \times PX_{ir} \tag{5}$$

$$PV_{ir} = \frac{1}{\Lambda_{ir} \times tfp_r \times ITFP_{ir}} \times \{\sum_{f \in F} \delta_{fir}^{\sigma v_i} \times PF_{fr}^{1-\sigma v_i}\}^{\frac{1}{1-\sigma v_i}} \tag{6}$$

$$PP_{ir} = \frac{1}{A_{ir}} \times \{\lambda_{ir}^{\sigma p_i} \times PN_{ir}^{1-\sigma p_i} + (1-\lambda_{ir})^{\sigma p_i} \times PV_{ir}^{1-\sigma p_i}\}^{\frac{1}{1-\sigma p_i}} \tag{7}$$

$$P_{ir} = \frac{1}{\chi_{ir}} \times \{\kappa_{ir}^{\sigma e_{ir}} \times PD_{ir}^{1-\sigma e_i} + (1-\kappa_{ir})^{\sigma e_i} \times PE_{ir}^{1-\sigma e_i}\}^{\frac{1}{1-\sigma e_i}} \tag{8}$$

$$PC_{ir} = (1+tc_{ir}) \times PX_{ir} \tag{9}$$

$$CPI_r = \frac{\sum_{i \in I} PC_{ir} \times C_{ir}}{\sum_{i \in I} PCO_{ir} \times C_{ir}} \tag{10}$$

$$PID_r = \prod_{i \in I} PC_{ir}^{\beta_{ir}} \times CPI_r^{mps_r} \tag{11}$$

$$NX_{ir} = (\frac{1}{A_{ir}})^{1-\sigma p_i} \times (\lambda_{ir} \times \frac{PP_{ir}}{PN_{ir}})^{\sigma p_i} \times Q_{ir} \tag{12}$$

$$VA_{ir} = (\frac{1}{A_{ir}})^{1-\sigma p_i} \times [(1-\lambda_{ir}) \times \frac{PP_{ir}}{PV_{ir}}]^{\sigma p_i} \times Q_{ir} \tag{13}$$

$$DF_{fir} = (\frac{1}{\Lambda_{ir} \times tfp_r \times ITFP_{ir}})^{1-\sigma v_i} \times (\delta_{fir} \times \frac{PV_{ir}}{PF_{fr}})^{\sigma v_i} \times VA_{ir} \qquad \sum_{f \in F} \delta_{fir} = 1 \tag{14}$$

$$DX_{ir} = (\frac{1}{\chi_{ir}})^{1-\sigma e_i} \times (\kappa_{ir} \times \frac{P_{ir}}{PD_{ir}})^{\sigma e_{sv}} \times Q_{ir} \quad \text{for } s \neq sv \tag{15}$$

$$DX_{sv,r} = (\frac{1}{\chi_{sv,r}})^{1-\sigma e_{sv}} \times (\kappa_{sv,r} \times \frac{P_{sv,r}}{PD_{sv,r}})^{\sigma e_{sv}} \times (Q_{sv,r} - TRQS_r) \tag{16}$$

$$EX_{ir} = (\frac{1}{\chi_{ir}})^{1-\sigma e_i} \times \{(1-\kappa_{ir}) \times \frac{P_{ir}}{PE_{ir}}\}^{\sigma e_i} \times Q_{ir} \quad \text{for } s \neq sv \tag{17}$$

$$EX_{sv,r} = (\frac{1}{\chi_{sv,r}})^{1-\sigma e_{sv}} \times \{(1-\kappa_{sv,r}) \times \frac{P_{sv,r}}{PE_{sv,r}})^{\sigma e_{sv}} \times (Q_{sv,r} - TRQS_r) \tag{18}$$

$$EX_{ir} = \frac{1}{PE_{ir}} \times \sum_{s \in R} \frac{ER_r}{(1+te_{irs})} \times PWE_{irs} \times X_{irs} \tag{19}$$

$$C_{ir} = \gamma_{ir} + \frac{\beta_{ir}}{PC_{ir}} \times SY_r \tag{20}$$

$$SY_r = HDI_r - \sum_{j \in I} PC_{jr} \times \gamma_{jr} \tag{21}$$

$$GC_{ir} = \frac{\theta_{ir}}{PC_{ir}} \times GSP_r \tag{22}$$

$$ID_{ir} = \frac{kio_{ir}}{PC_{ir}} \times INV_r \tag{23}$$

$$DX_{ir} = (\frac{1}{\Gamma_{ir}})^{1-\sigma m_i} \times (\alpha_{ir} \times \frac{PX_{ir}}{PD_{ir}})^{\sigma m_i} \times TX_{ir} \tag{24}$$

$$MX_{ir} = (\frac{1}{\Gamma_{ir}})^{1-\sigma m_i} \times \{(1-\alpha_{ir}) \times \frac{PX_{ir}}{PM_{ir}}\}^{\sigma m_i} \times TX_{ir} \tag{25}$$

$$X_{isr} = (\frac{1}{\mu_{ir}})^{1-\sigma t_i} \times \{\xi_{isr} \times (\frac{PM_{ir}}{(1+tm_{isr}+tn_{irs}) \times ER_r \times PWM_{isr}})^{\sigma t_i} \times MX_{ir} \quad \sum_{s \in R} \xi_{isr} = 1 \text{ for } s \neq r \tag{26}$$

$$TRQ = \frac{1}{PTR} \times \sum_{r \in R} \frac{P_{sv,r}}{ER_r} \times TRQS_r \tag{27}$$

$$TRQ = \sum_{r \in R} \sum_{i \in I} TRQD_{ir} \tag{28}$$

$$TRQS_r = \frac{\tau_r \times ER_r}{P_{sv,r}} \times PTR \times TRQ \tag{29}$$

$$TRQD_{ir} = \frac{1}{PRT} \times (\sum_{s \in R} trs_{isr} \times PWE_{isr} \times X_{isr}) \tag{30}$$

$$HDI_r = \sum_{f \in F} PF_{fr} \times \overline{FS_{fr}} - dk_r \times \overline{FS_{KAr}} + GTRANS_r \tag{31}$$

$$GR_r = PTAX_r + CTAX_r + TARIFF_r + ETAX_r \tag{32}$$

$$SAV_r = \frac{HDI_r \times \sum_{i \in I} PC_{ir} \times C_{ir}}{CPI_r} \tag{33}$$

$$PTAX_r = \sum_{i \in I} tp_{ir} \times P_{ir} \times Q_{ir} \tag{34}$$

$$CTAX_r = \sum_{i \in I} tc_{ir} \times PX_{ir} (C_{ir} + GC_{ir} + ID_{ir}) \tag{35}$$

$$TARIFF_r = \sum_{s \in R} \sum_{i \in I} (tm_{isr} + tn_{irs}) \times ER_r \times PWM_{isr} \times X_{isr} \tag{36}$$

$$ETAX_s = \sum_{r \in R} \sum_{i \in I} te_{isr} \times PE_{is} \times X_{isr} \tag{37}$$

$$GTRANS_r = GR_r - GSP_r - GSVA_r \tag{38}$$

$$BOT_r = \sum_{s \in R} \sum_{i \in I} PWE_{irs} X_{irs} + \frac{P_{sv,r}}{ER_r} \times TRQS_r - \sum_{s \in R} \sum_{i \in I} PWM_{isr} \times X_{isr} \tag{39}$$

$$TX_{ir} = C_{ir} + GC_{ir} + ID_{ir} + \sum_{j \in I} io_{ijr} \times NX_{jr} \tag{40}$$

$$\sum_{i \in I} DF_{fir} = \overline{FS_{fr}} \tag{41}$$

$$P_{ir} = \frac{PN_{ir} \times NX_{ir} + PV_{ir} \times VA_{ir} + tp_{ir} \times P_{ir} \times Q_{ir}}{Q_{ir}} \tag{42}$$

$$INV_r = dr_r \times \overline{FS_{k,r}} + CPI_r \times (SAV_r + GSAV_r) - ER_r \times BOT_r \tag{43}$$

$$ITFP_{ir} = 1 + ims_{ir} \times \left\{ \frac{NX_{ir}}{NX_{ir} + VA_{ir}} \times \left[\frac{\sum_{j \in IM} \sum_{s \in R} x_{jsr}}{\sum_{j \in IM} \sum_{s \in R} xo_{jsr}} \right]^{\sigma ip_{ir}} + \frac{VX_{ir}}{NX_{ir} + VA_{ir}} - 1 \right\} \tag{44}$$

$$\frac{PF_{ALr,t}}{EMR_{r,t} \times PF_{ULr,t}} = wdf_r^{\exp^{-t\varphi_r}} \tag{45}$$

$$EMR_{ul,r,t} = \frac{FS_{ul,r,t} + MIG_{r,t} - UEM_{ul,r,t}}{FS_{ul,r,t} + MIG_{r,t}} \tag{46}$$

$$FS_{ULr,t} = FS_{ULr,t-1} + MIG_{rt} \tag{47}$$

$$FS_{RLr,t} = FS_{RLr,t-1} - MIG_{rt} \tag{48}$$

$$(1 - EMR_{ul,r}) = 0 \Rightarrow PF_{ul,r} = PF0_{ul,r}, \qquad (1 - EMR_{ul,r}) \times (PF_{ul,r} - PF0_{ul,r}) = 0 \tag{49}$$

$$\begin{aligned} EV_r = {} & (HDI_r - CPI_r \times SAV_r) \prod_{i \in I} \left(\frac{PC0_{ir}}{PC_{ir}} \right)^{\beta_{ir}} - (HDI0_r - SAV0_r) \\ & + GSP_r \prod_{i \in I} \left(\frac{PC0_{ir}}{PC_{ir}} \right)^{\theta_{ir}} - GSP0_r + INV_r \prod_{i \in I} \left(\frac{PC0_{ir}}{PC_{ir}} \right)^{kio_{ir}} - INV0_r \end{aligned} \tag{50}$$

III. Simulation Design

To estimate the impact of trade liberalization based on possible agreements in the Doha Round of WTO trade negotiations, comparative static counterfactual analysis is conducted. (The static counterfactual analysis is the empirical analogy of the comparative-static analysis that is common in theoretical work.) Such experiments begin by assuming that the world economy under study is in equilibrium (not necessarily Walrasian type) in the presence of currently existing policy regimes and for the data in the benchmark year. In the baseline simulation, the model will replicate this benchmark equilibrium through a model solution (called calibration). This "benchmark" or "observed" equilibrium data set serves as the point of comparison for counterfactual-equilibrium analysis of hypothetical policy changes. The nature of this numerical comparative-static approach enables us not only to capture both terms-of-trade effects and Stolper-Samuelson effects, but also to isolate economic growth effects from the impact due to changes in trade policy.

We start our simulation exercises with separate simulations of full liberalization of agriculture and of manufactures, first by developed countries and then by developing countries only. The purpose of conducting separate simulations is to better understand the relative importance of different sectoral and regional components in changes in trade patterns and welfare induced by trade policy. These simulations are then cumulated into a simulation of full worldwide trade liberalization of both agriculture and manufactures (all border protection and subsidies are reduced to zero for all countries in the model). This full liberalization scenario, while not a plausible outcome of the Doha Round negotiations, serves as another reference benchmark, both with our more modest scenarios and with other modeling exercises that present full liberalization scenarios. We then move to four more realistic scenarios that could be considered plausible outcomes of the actual WTO negotiation. Again, agricultural and manufacturing liberalization are modeled separately and then cumulated in each scenario. Our goal is to quantify the impact on developing countries of trade liberalization in agricultural and manufactured products based on plausible agreements from the Doha Round negotiations. A total of sixteen comparative-static simulations were conducted. A description of the main scenarios is presented in table 2.4.

Our AGE model generates results regarding the effects on GDP, real income (also referred to as welfare and technically, equivalent variation or EV), terms of trade, volume of trade, output, consumption, returns to each factor, and changes in prices and resource allocation. The differences in results generated by the alternative simulation scenarios with the baseline scenario provide estimates of the relative impact of different trade liberalization agreements on the world economy. However, those estimates should be regarded as outcomes from conditional projections rather than as forecasts. In reality, actual trade and output patterns are affected by many more factors than trade liberalization, such as domestic macroeconomic and income policy changes.

Table A.5. Economic Data, Factor Endowments, and Trade Dependence for Regions in the Model

Measure	China	Indonesia	Vietnam	Rest of ASEAN	India	Bangladesh	Rest of South Asia	Russia and FSU	Middle East and North Africa
GDP and trade flows (billions of dollars)									
GDP	1159	145	33	353	477	47	100	414	1028
Exports	383	70	15	237	60	8	21	109	276
Imports	278	46	25	177	58	10	21	91	286
Relative size in the world (percent)									
GDP	3.7	0.5	0.1	1.1	1.5	0.2	0.3	1.3	3.3
Exports	7.2	1.3	0.3	4.4	1.1	0.2	0.4	2.0	5.2
Imports	5.0	0.8	0.5	3.2	1.1	0.2	0.4	1.7	5.2
Trade dependence (percent)									
Exports/output	33.0	48.5	44.4	67.0	12.6	17.0	20.6	26.2	26.9
Imports/absorption	24.0	31.5	76.0	50.1	12.2	21.6	21.2	22.0	27.9
Share of factor endowment (percent)									
Land	10.2	1.5	0.5	2.7	11.5	0.6	2.4	14.0	5.7
Agricultural labor	28.5	4.4	2.5	5.3	23.4	3.4	4.1	1.8	3.8
Unskilled labor	24.6	3.4	0.9	3.0	10.8	2.0	2.0	6.0	5.0
Skilled labor	15.6	1.2	0.4	2.9	6.9	0.8	2.1	9.7	8.2
Total labor	25.0	3.5	1.4	3.9	15.2	2.4	2.8	4.9	4.9
Capital	3.2	0.4	0.1	1.2	1.2	0.1	0.3	1.6	3.2
Factor share in value-added (percent)									
Land	4.8	6.2	6.2	4.1	10.0	5.0	10.8	3.0	1.1
Agricultural labor	11.4	5.7	6.0	4.7	9.4	4.6	10.1	7.0	5.7
Unskilled labor	36.0	22.8	29.5	25.4	28.5	47.1	31.2	35.0	30.1
Skilled labor	10.5	7.1	7.9	10.0	10.3	9.6	10.4	13.7	13.3
Total labor	57.9	35.6	43.4	40.1	48.2	61.2	51.7	55.7	49.1
Capital	37.4	58.2	50.4	55.9	41.8	33.8	37.6	41.3	49.8
Skill distribution of labor force (percent)									
Agricultural labor	43.6	47.7	66.9	52.2	59.2	54.7	55.5	14.3	29.8
Unskilled labor	48.9	48.2	30.0	38.8	35.4	41.1	35.5	61.6	50.3
Skilled labor	7.5	4.1	3.1	9.0	5.4	4.2	9.0	24.0	19.9
Unemployment rate (percent)									
Urban unskilled labor	3.6	8.0	3.1	5.5	9.2	27.0	9.3	0.0	10.6
Capital and land intensity									
Capital/labor ($1000 per worker)	3.7	3.0	2.2	9.1	2.3	1.5	2.6	9.5	18.3
Land/labor (hectares per worker)	0.19	0.2	0.16	0.33	0.36	0.11	0.4	1.37	0.55
Relative factor price (ratio)									
Capital rent/wage	18.52	59.78	56.50	16.26	42.34	52.20	30.61	7.83	6.07
Land rent/wage	45.14	96.53	94.49	32.49	63.59	102.12	57.66	3.97	4.42
Capital rent/land rent	0.41	0.62	0.60	0.50	0.67	0.51	0.53	1.97	1.38

Table A.5. (continued) Economic Data, Factor Endowments, and Trade Dependence for Regions in the Model

Measure	South Africa	East Africa	Rest of Sub-Saharan Africa	Brazil	Mexico	Argentina	Rest of Latin America	Central America and Caribbean	All Developing Countries
GDP and trade flows (billions of dollars)									
GDP	113	17	192	503	618	269	382	226	7180
Exports	39	3	59	67	165	30	73	57	2193
Imports	28	4	70	75	149	27	71	78	2032
Relative size in the world (percent)									
GDP	0.4	0.1	0.6	1.6	2.0	0.9	1.2	0.7	23.0
Exports	0.7	0.1	1.1	1.3	3.1	0.6	1.4	1.1	41.2
Imports	0.5	0.1	1.3	1.4	2.7	0.5	1.3	1.4	36.8
Trade dependence (percent)									
Exports/output	34.0	16.5	31.0	13.4	26.8	11.2	19.2	25.1	30.6
Imports/absorption	25.1	26.1	36.3	14.9	24.1	10.1	18.6	34.7	28.3
Share of factor endowment (percent)									
Land	1.1	0.8	9.5	4.2	1.8	2.4	1.4	0.8	72.9
Agricultural labor	0.2	2.5	13.5	1.1	0.8	0.1	1.1	0.8	98.2
Unskilled labor	1.0	0.4	5.2	4.0	1.9	0.8	2.6	1.3	78.6
Skilled labor	0.7	0.3	3.4	2.4	1.1	0.7	2.0	1.1	63.6
Total labor	0.6	1.2	8.2	2.7	1.4	0.5	2.0	1.1	84.3
Capital	0.5	0.0	0.6	1.7	2.1	0.8	1.1	0.7	22.3
Factor share in value-added (percent)									
Land	0.5	5.2	2.0	0.8	1.6	1.5	2.6	2.1	3.1
Agricultural labor	1.4	27.1	12.8	1.2	2.3	2.5	4.7	3.7	5.7
Unskilled labor	47.6	22.3	37.0	37.6	20.5	40.3	31.0	36.3	32.0
Skilled labor	16.2	6.2	10.4	20.2	9.8	16.5	13.1	14.6	13.4
Total labor	65.2	55.6	60.1	59.0	32.7	59.3	48.7	54.7	51.0
Capital	34.3	39.3	37.9	40.3	65.7	39.3	48.7	43.2	45.9
Skill distribution of labor force (percent)									
Agricultural labor	9.2	80.3	63.4	16.1	20.8	9.5	21.2	26.6	44.6
Unskilled labor	76.7	16.6	31.7	73.1	69.8	73.8	66.5	60.6	46.3
Skilled labor	14.0	3.1	4.9	10.8	9.4	16.7	12.3	12.8	9.0
Unemployment rate (percent)									
Urban unskilled labor	21.4	7.2	16.9	8.6	1.7	16.4	10.5	13.6	
Capital and land intensity									
Capital/labor (US $1000 per worker)	20.5	0.8	2.1	18.0	42.8	41.7	15.5	18.3	7.5
Land/labor (hectares per worker)	0.8	0.32	0.55	0.73	0.6	2.2	0.35	0.35	0.41
Relative factor price (ratio)									
Capital rent/wage	3.19	97.75	39.02	4.04	4.77	1.81	7.04	4.86	12.82
Land rent/wage	1.23	32.57	7.77	1.89	8.07	1.29	16.80	12.64	16.09
Capital rent/land rent	2.60	3.00	5.02	2.14	0.59	1.40	0.42	0.38	0.80

Table A.5. (continued) Economic Data, Factor Endowments, and Trade Dependence for Regions in the Model

Measure	USA	EU 15	EU 10	Japan	Rest of OECD	Asian NIEs	Rest of World	All Developed Countries	Total
GDP and trade flows (billions of dollars)									
GDP	10082	7930	362	4178	1547	957	146	24099	31279
Exports	889	1139	146	453	510	478	44	3137	5330
Imports	1285	1163	169	413	465	471	65	3494	5525
Relative size in the world (percent)									
GDP	32.2	25.4	1.2	13.4	5.0	3.1	0.5	77.1	100.0
Exports	16.7	21.4	2.7	8.5	9.6	9.0	0.8	58.9	100.0
Imports	23.3	21.0	3.1	7.5	8.4	8.5	1.2	63.2	100.0
Trade dependence (percent)									
Exports/output	8.8	14.4	40.3	10.9	33.0	50.0	30.1	13.0	17.0
Imports/absorption	12.7	14.7	46.5	9.9	30.0	49.3	44.6	14.5	17.7
Share of factor endowment (percent)									
Land	12.5	5.3	2.1	0.3	7.1	0.2	1.7	27.2	100.0
Agricultural labor	0.3	0.7	0.5	0.2	0.1	0.3	0.9	1.8	100.0
Unskilled labor	6.3	8.3	1.6	3.7	1.5	2.1	1.7	21.4	100.0
Skilled labor	14.1	13.4	2.5	3.3	3.1	1.7	2.3	36.4	100.0
Total labor	4.9	6.0	1.3	2.3	1.2	1.3	1.5	15.7	100.0
Capital	26.6	27.0	1.3	17.8	5.0	2.9	0.7	77.7	100.0
Factor share in value-added (percent)									
Land	0.4	0.5	1.6	0.2	0.7	1.3	4.9	0.4	1.0
Agricultural labor	0.3	1.2	2.4	0.7	1.3	1.2	7.0	0.8	1.8
Unskilled labor	36.2	32.2	33.8	37.5	36.7	31.6	33.1	35.1	34.4
Skilled labor	25.8	22.6	15.4	23.3	22.5	19.2	13.1	24.0	21.7
Total labor	62.3	56.0	51.6	61.5	60.5	51.9	53.2	59.9	57.9
Capital	37.3	43.5	46.8	38.3	38.8	46.8	41.9	39.7	41.0
Skill distribution of labor force (percent)									
Agricultural labor	2.0	4.1	15.3	3.8	3.6	7.5	23.1	4.3	38.3
Unskilled labor	63.7	69.0	62.2	79.0	64.9	77.1	58.2	67.9	49.7
Skilled labor	34.3	26.9	22.5	17.2	31.5	15.4	18.7	27.8	12.0
Unemployment rate (percent)									
Urban unskilled labor	0.0	0.0	0.0	0.0	0.0	0.0	11.9		
Capital and land intensity									
Capital/labor (US $1000 per worker)	153.5	128.9	28.7	220.5	120.8	63.0	13.1	141.1	28.5
Land/labor (Hectares per worker)	1.19	0.42	0.74	0.07	2.86	0.1	0.6	0.8	0.5
Relative factor price (ratio)									
Capital rent/wage	0.39	0.60	3.16	0.28	0.53	1.43	6.67	0.47	2.52
Land rent/wage	0.55	2.09	4.13	5.81	0.40	37.44	18.41	0.89	3.83
Capital rent/land rent	0.71	0.29	0.76	0.05	1.33	0.04	0.36	0.52	0.66

Sources: Land and total labor (economically active population) endowment data: *FAO Statistical Year Book 2002* (Rome: United Nations Food and Agriculture Organization, 2002). Skilled and unskilled labor data: *ILO Yearbook of Labor Statistics 2002* (Geneva: International Labor Organization, 2002). Labor data for Taiwan: Republic of China Statistical Bureau, http://eng.stat.gov.tw. All other data: Calculated from the Global Trade Analysis Project Database, Version 6.0. Betina V. Dimaranan and Robert A. McDougall, eds., *Global Trade, Assistance, and Production: The GTAP 6 Data Base* (West Lafayette, Ind.: Center for Global Trade Analysis, Purdue University, 2006).

Notes: Capital stock is total investment minus depreciation. Factor returns are calculated as value-added data divided by their endowments. Aggregate data for developing countries include Asian NIEs and rest of the world; aggregate data for developed countries include EU 10, the members which acceded in 2004.

Table A.6. Net Trade Patterns across the World
(BILLIONS OF DOLLARS)

	China	Indonesia	Vietnam	Rest of ASEAN	India	Bangladesh	Rest of South Asia	Russia and FSU	Middle East and North Africa
Grains	0.2	-0.5	-0.1	-1.1	0.6	-0.3	0.0	0.7	-6.6
Oilseeds	-2.7	-0.3	0.0	-0.4	0.2	-0.1	-0.1	0.2	-0.7
Land-intensive agriculture total	**-2.5**	**-0.8**	**0.0**	**-1.5**	**0.8**	**-0.3**	**-0.1**	**0.9**	**-7.2**
Vegetables and fruits	1.5	0.0	0.2	0.9	-0.2	-0.1	0.0	-0.7	1.9
Other crops	0.3	1.2	0.7	1.5	0.6	-0.3	0.5	-0.4	-1.0
Livestock	-0.5	0.0	0.0	-0.1	-0.2	0.0	0.0	0.2	-0.7
Labor-intensive agriculture total	**1.3**	**1.1**	**0.9**	**2.4**	**0.1**	**-0.5**	**0.4**	**-0.9**	**0.2**
Meat and dairy products	0.0	0.0	-0.2	0.3	0.2	-0.1	-0.1	-2.4	-4.1
Sugar	-0.3	-0.1	0.0	0.2	0.2	-0.1	-0.1	-1.4	-0.3
Processed foods	3.4	2.9	1.3	8.6	1.3	-0.3	0.1	-0.5	-4.7
Beverages and tobacco	0.5	0.0	-0.4	-0.5	0.0	0.0	-0.1	-0.4	-1.5
Processed agriculture total	**3.7**	**2.8**	**0.7**	**8.6**	**1.7**	**-0.5**	**-0.2**	**-4.8**	**-10.6**
Food and agricultural products total	**2.5**	**3.0**	**1.6**	**9.5**	**2.7**	**-1.3**	**0.1**	**-4.8**	**-17.6**
Forestry and fishery	-1.2	0.5	0.0	1.0	-0.5	0.0	0.1	1.7	0.0
Crude oil and natural gas	-1.5	7.8	1.2	-2.5	-3.7	-0.1	-0.5	25.2	105.2
Wood and paper products	7.2	8.3	0.2	4.8	-0.4	-0.2	-0.3	0.2	-7.0
Natural resource-based products total	**4.5**	**16.6**	**1.5**	**3.3**	**-4.5**	**-0.4**	**-0.7**	**27.2**	**98.2**
Textiles	7.3	2.5	-0.8	1.6	6.5	0.2	4.4	-1.5	-2.1
Apparel	34.6	4.5	1.5	8.0	5.5	3.6	4.3	-1.3	7.5
Leather and footwear	29.7	2.7	2.3	2.0	1.5	0.3	0.4	-1.1	-0.5
Other manufactures	40.0	0.8	0.2	3.3	2.9	-0.1	0.4	0.1	1.2
Labor-intensive and other products total	**111.6**	**10.5**	**3.2**	**14.9**	**16.3**	**4.0**	**9.5**	**-3.9**	**6.1**
Chemical, rubber, and plastic products	-10.4	-0.7	-2.1	-1.4	-0.1	-0.8	-2.2	-0.5	-7.4
Petroleum, coal, and mineral products	0.5	2.9	-1.2	-1.6	-3.0	-0.5	-2.3	7.5	11.7
Metals and metal products	-1.5	0.6	-1.2	-7.5	-1.3	-0.6	-1.0	25.2	-14.5
Intermediate products total	**-11.5**	**2.8**	**-4.6**	**-10.4**	**-4.3**	**-1.9**	**-5.4**	**32.3**	**-10.1**
Motor vehicles and other transport equipment	-3.6	-2.5	-1.2	-3.7	-0.8	-0.6	-0.8	-1.6	-24.8
Electronic equipment	16.2	5.7	-0.5	50.2	-2.3	-0.4	-0.7	-4.4	-8.3
Other machinery	10.7	-2.5	-2.0	-8.2	-3.1	-1.2	-2.2	-9.5	-38.8
Capital-intensive finished products total	**23.4**	**0.7**	**-3.7**	**38.3**	**-6.2**	**-2.2**	**-3.6**	**-15.5**	**-71.9**
Trade and transportation	-14.9	-2.4	-2.5	7.8	-0.4	-0.2	0.3	-2.9	9.4
Financial services, banking, and insurance	-1.1	0.1	-1.0	-0.5	-0.3	-0.1	0.2	-1.0	-1.7
Communication, health, education, and public services	0.6	-0.5	-1.0	-0.3	0.2	0.5	0.2	-0.9	-10.0
Recreational and other services	-1.1	-4.4	-2.5	3.8	1.2	0.0	-0.1	-6.9	-1.8
Housing, utilities, and construction	-0.3	0.1	-0.4	-0.5	-0.1	0.0	0.1	-2.6	1.0
Services total	**-16.8**	**-7.0**	**-7.5**	**10.3**	**0.6**	**0.1**	**0.6**	**-14.4**	**-3.1**
Total	**113.7**	**26.6**	**-9.6**	**65.9**	**4.5**	**-1.6**	**0.4**	**20.8**	**1.5**

Table A.6. (continued) Net Trade Patterns across the World
(BILLIONS OF DOLLARS)

	South Africa	East Africa	Rest of Sub-Saharan Africa	Brazil	Mexico	Argentina	Rest of Latin America	Central America and Caribbean	All Developing Countries
Grains	0.1	-0.1	-1.1	-0.4	-1.6	3.0	-1.1	-0.9	-12.4
Oilseeds	0.0	0.0	0.2	2.7	-1.1	1.6	0.3	0.0	-1.1
Land-intensive agriculture total	**0.2**	**-0.1**	**-0.9**	**2.3**	**-2.8**	**4.6**	**-0.9**	**-0.9**	**-13.5**
Vegetables and fruits	1.1	0.1	0.7	0.1	2.3	0.7	3.1	1.8	11.6
Other crops	0.0	0.9	4.9	2.4	-0.4	0.2	1.7	1.3	12.2
Livestock	0.1	0.0	0.2	0.1	-0.2	0.1	0.1	0.0	-3.2
Labor-intensive agriculture total	**1.2**	**1.1**	**5.9**	**2.7**	**1.7**	**1.0**	**4.8**	**3.1**	**20.6**
Meat and dairy products	0.0	0.0	-1.0	2.7	-2.2	0.5	0.1	-0.9	-11.7
Sugar	0.3	0.0	0.4	1.5	0.0	0.0	0.1	1.3	1.3
Processed foods	0.1	0.0	-1.1	3.6	-0.6	5.4	3.4	-0.8	17.7
Beverages and tobacco	0.4	0.0	-0.7	-0.1	1.5	0.1	0.4	0.4	-2.1
Processed agriculture total	**0.8**	**0.0**	**-2.5**	**7.7**	**-1.3**	**6.2**	**3.9**	**0.0**	**5.1**
Food and agricultural products total	**2.2**	**1.0**	**2.6**	**12.6**	**-2.3**	**11.7**	**7.9**	**2.2**	**12.3**
Forestry and fishery	0.1	0.0	1.4	0.0	0.0	0.0	0.3	0.1	3.2
Crude oil and natural gas	-1.5	-0.1	20.3	-3.7	10.5	2.0	13.8	-2.4	139.4
Wood and paper products	0.9	-0.1	-0.4	3.7	-0.8	-0.5	0.8	-2.0	12.1
Natural resource-based products total	**-0.4**	**-0.2**	**21.3**	**0.0**	**9.7**	**1.5**	**15.0**	**-4.3**	**154.7**
Textiles	-0.2	-0.1	-1.9	-0.1	-0.4	-0.3	-1.2	-1.1	27.2
Apparel	0.0	0.0	0.4	0.0	4.4	-0.1	0.0	3.6	86.8
Leather and footwear	-0.1	0.0	-0.1	2.3	-0.2	0.7	-0.2	-0.2	30.9
Other manufactures	1.0	0.0	4.0	0.0	0.1	-0.3	-0.7	-0.9	51.0
Labor-intensive and other products total	**0.7**	**-0.1**	**2.4**	**2.3**	**3.9**	**-0.1**	**-2.2**	**1.4**	**195.9**
Chemical, rubber, and plastic products	-0.7	-0.5	-5.5	-6.7	-11.3	-2.0	-7.3	-3.9	-64.6
Petroleum, coal, and mineral products	4.1	-0.2	-1.6	1.5	-1.4	0.6	9.1	-1.0	14.2
Metals and metal products	9.9	0.0	-0.2	3.6	-3.5	0.4	7.7	-1.1	10.0
Intermediate products total	**13.3**	**-0.7**	**-7.3**	**-1.7**	**-16.2**	**-1.0**	**9.4**	**-6.1**	**-40.4**
Motor vehicles and other transport equipment	-1.3	-0.2	-8.3	1.5	8.3	-0.1	-6.5	-11.3	-52.2
Electronic equipment	-2.0	-0.2	-2.4	-4.4	10.3	-1.8	-4.9	-2.1	76.2
Other machinery	-1.9	-0.5	-9.0	-8.1	10.8	-2.7	-11.8	-5.6	-109.8
Capital-intensive finished products total	**-5.1**	**-0.9**	**-19.7**	**-11.0**	**29.4**	**-4.6**	**-23.2**	**-19.1**	**-85.8**
Trade and transportation	0.8	-0.1	-0.8	-2.5	-0.1	-1.8	-1.1	4.8	44.1
Financial services, banking, and insurance	0.1	-0.1	-0.5	-0.6	-3.9	-0.5	-0.7	0.3	-11.3
Communication, health, education, and public services	-0.1	-0.1	-0.5	-0.9	-0.7	-0.6	-0.2	1.2	-14.6
Recreational and other services	-0.5	-0.4	-4.3	-1.2	0.3	-0.4	-1.8	1.3	-13.7
Housing, utilities, and construction	0.4	0.0	-0.2	-2.0	0.3	-0.2	1.8	0.0	-3.5
Services total	**0.7**	**-0.6**	**-6.3**	**-7.2**	**-4.2**	**-3.6**	**-2.0**	**7.6**	**1.0**
Total	**11.3**	**-1.4**	**-7.1**	**-4.9**	**20.3**	**4.0**	**5.0**	**-18.3**	**237.7**

Table A.6. (continued) Net Trade Patterns across the World
(BILLIONS OF DOLLARS)

	USA	EU 15	EU 10	Japan	Rest of OECD	Asian NIEs	Rest of World	All Developed Countries
Grains	9.0	0.4	0.1	-2.2	5.0	-2.3	-1.1	12.4
Oilseeds	5.5	-4.0	0.2	-1.7	1.1	-0.9	0.0	1.1
Land-intensive agriculture total	**14.6**	**-3.6**	**0.2**	**-3.9**	**6.2**	**-3.1**	**-1.0**	**13.5**
Vegetables and fruits	-1.5	-6.6	-0.7	-2.3	-0.5	-1.6	-0.2	-11.6
Other crops	-0.7	-7.2	-1.1	-3.6	0.4	-1.9	-0.1	-12.2
Livestock	0.5	-1.7	0.1	-1.0	5.2	-2.4	0.1	3.2
Labor-intensive agriculture total	**-1.6**	**-15.5**	**-1.7**	**-6.9**	**5.1**	**-5.8**	**-0.1**	**-20.6**
Meat and dairy products	3.1	3.9	1.3	-8.3	11.8	-3.4	-0.9	11.7
Sugar	-0.5	-0.9	0.1	-0.4	0.5	-0.5	-0.1	-1.3
Processed foods	-1.9	-3.7	-1.2	-14.5	3.7	-4.2	-0.3	-17.7
Beverages and tobacco	-4.6	9.1	0.0	-2.5	0.1	-1.3	-0.6	2.1
Processed agriculture total	**-3.9**	**8.4**	**0.1**	**-25.8**	**16.0**	**-9.3**	**-1.8**	**-5.1**
Food and agricultural products total	**9.0**	**-10.7**	**-1.4**	**-36.5**	**27.3**	**-18.3**	**-3.0**	**-12.3**
Forestry and fishery	0.1	-2.7	0.4	-2.6	1.6	-1.0	0.6	-3.2
Crude oil and natural gas	-62.1	-68.7	-7.1	-33.4	31.9	-27.5	-3.3	-139.4
Wood and paper products	-31.2	4.8	4.8	-12.1	21.6	-2.3	-0.1	-12.1
Natural resource-based products total	**-93.3**	**-66.6**	**-1.9**	**-48.1**	**55.1**	**-30.7**	**-2.9**	**-154.7**
Textiles	-16.9	-3.4	-2.6	0.2	-4.5	17.0	-2.4	-27.2
Apparel	-43.7	-26.2	3.3	-14.3	-6.0	5.2	4.9	-86.8
Leather and footwear	-19.0	-3.1	-0.4	-5.3	-3.0	-8.8	0.3	-30.9
Other manufactures	-40.5	-4.5	-0.1	-1.5	-4.4	-0.6	-0.2	-51.0
Labor-intensive and other products total	**-120.1**	**-37.2**	**0.2**	**-20.9**	**-17.9**	**12.8**	**2.6**	**-195.9**
Chemical, rubber, and plastic products	-0.3	62.8	-9.7	14.5	-2.7	3.0	-4.2	64.6
Petroleum, coal, and mineral products	-3.3	-5.5	-0.6	-14.7	10.0	-9.9	-1.1	-14.2
Metals and metal products	-28.4	-3.0	-0.1	10.4	11.0	-5.7	0.8	-10.0
Intermediate products total	**-32.0**	**54.3**	**-10.4**	**10.2**	**18.4**	**-12.5**	**-4.4**	**40.4**
Motor vehicles and other transport equipment	-78.2	46.5	4.1	83.4	-3.6	9.7	-4.6	52.2
Electronic equipment	-58.0	-34.9	-2.9	39.3	-19.6	30.7	-2.4	-76.2
Other machinery	-27.6	80.1	-8.5	76.2	-10.5	-18.4	-5.8	109.8
Capital-intensive finished products total	**-163.8**	**91.8**	**-7.3**	**198.9**	**-33.7**	**21.9**	**-12.8**	**85.8**
Trade and transportation	-20.8	-9.8	4.7	-20.3	2.1	48.9	2.1	-44.1
Financial services, banking, and insurance	7.2	5.3	-1.3	-3.5	3.5	0.1	-0.1	11.3
Communication, health, education, and public services	23.7	-7.9	1.2	-4.3	1.8	-1.8	0.4	14.6
Recreational and other services	32.4	-2.1	0.0	-16.5	-0.2	5.5	-0.4	13.7
Housing, utilities, and construction	0.6	-0.2	0.9	-0.8	3.0	-1.3	0.4	3.5
Services total	**43.1**	**-14.7**	**5.6**	**-45.2**	**10.2**	**51.5**	**2.4**	**-1.0**
Total	**-357.1**	**16.9**	**-15.1**	**58.3**	**59.3**	**24.6**	**-18.1**	**-237.7**

Source: Betina V. Dimaranan and Robert A. McDougall, eds., *Global Trade, Assistance, and Production: The GTAP 6.0 Data Base* (West Lafayette, Ind.: Center for Global Trade Analysis, Purdue University, 2006).

APPENDIX B

Sensitivity Analysis

To assess the impact of the approach to developing country labor markets taken in the Carnegie model, we tested three additional versions of the model using the same base year data but with different labor market specifications. One version included the three labor categories (agricultural labor, urban unskilled labor, and skilled labor) with the assumption of full employment. A second included only two labor categories (unskilled labor and skilled labor) with the presence of unemployment of unskilled labor. A final category included those two labor categories with the assumption of full employment.

Table B.1 summarizes the main results from the sensitivity analysis. It illustrates the relative importance of different labor market specifications to the aggregate real income changes from different Doha trade liberalization scenarios. As might be expected, variation in the labor market specification affects the predicted impacts of a Doha trade agreement. Taking into account the presence of unemployment of unskilled labor in developing countries has a significant impact both on results for those countries' income gains and on the distribution of gains among developed and developing countries. Under different scenarios, gains in real income for developing countries as a group can be twice as large as under the assumption of full employment, or even higher. Overall, developing countries' share of the global gains from trade liberalization is about one-third higher when unemployment in their economies is taken into account.

The results for different developing countries vary widely, depending on factors such as the level of unemployment and the competitiveness of sectors that use unskilled labor in those economies. For example, China's overall income gains are more than twice as large when unemployment is included in the model. At the same time, a few developing countries that are less competitive would see smaller gains or larger losses because of the extra advantage that their more competitive counterparts enjoy when wages are constrained by unemployment. Mexico and Central America gain less, and Bangladesh loses more in the face of competition from countries with reserves of unemployed labor.

The sensitivity analysis suggests that models that do not acknowledge unemployment in developing countries probably understate to a significant degree gains for countries that have competitive manufacturing sectors, while minimizing the negative impacts on less competitive developing countries.

Modeling agricultural and unskilled labor separately has only a very moderate impact on global income gains and their distribution

Table B.1. Sensitivity to Labor Market Specification for Developing Countries
(CHANGE IN REAL INCOME, BILLIONS OF DOLLARS)

Country or Region	Central Doha Scenario[a]	Hong Kong Scenario[b]	Central Doha Scenario with "Special Products" for Developing Countries[c]	Full Liberalization[d]
Three categories of labor with initial unskilled labor unemployment in developing countries				
China	14.5	10.3	14.4	21.6
Indonesia	0.9	0.7	0.9	2.5
Vietnam	2.4	1.6	2.7	5.4
Rest of ASEAN	2.6	2.0	2.4	7.6
India	3.1	2.2	3.1	10.2
Bangladesh	-0.1	-0.1	-0.1	0.5
Rest of South Asia	0.4	0.3	0.3	1.2
Russia and FSU	0.4	0.3	0.5	0.5
Middle East and North Africa	1.7	1.2	1.6	5.2
South Africa	0.4	0.3	0.4	0.8
East Africa	-0.1	-0.1	-0.1	0.4
Rest of Sub-Saharan Africa	-0.2	-0.2	-0.2	3.3
Brazil	1.4	1.1	1.4	4.9
Mexico	0.1	0.0	0.0	0.3
Argentina	0.7	0.6	0.6	2.3
Rest of Latin America	0.4	0.3	0.4	1.0
Central America and Caribbean	1.0	0.7	0.8	4.0
Rest of the world	0.5	0.3	0.4	3.5
All developing countries	30.1	21.5	29.4	75.2
Asian NIEs	3.8	2.6	3.8	20.5
USA	6.5	4.6	6.3	16.1
EU 15	6.9	5.3	6.9	21.3
EU 10	0.6	0.5	0.6	1.6
Japan	8.0	6.5	8.1	26.6
Rest of OECD	2.7	2.3	2.7	6.9
All developed countries	28.5	21.9	28.3	92.9
World total	58.6	43.4	57.7	168.1
Developing country share	51.4	49.5	51.0	44.7
Three categories of labor with full employment assumption in developing countries				
China	6.4	4.5	6.4	13.0
Indonesia	0.6	0.4	0.6	1.6
Vietnam	1.4	0.9	1.7	4.0
Rest of ASEAN	1.6	1.1	1.5	4.0
India	2.2	1.8	1.4	7.0
Bangladesh	-0.1	0.0	0.0	0.2
Rest of South Asia	0.2	0.2	0.1	0.8
Russia and FSU	0.4	0.3	0.5	0.5
Middle East and North Africa	1.0	0.6	0.6	4.0
South Africa	0.2	0.1	0.2	0.1
East Africa	-0.1	-0.1	-0.1	0.5
Rest of Sub-Saharan Africa	-0.3	-0.3	-0.3	2.3
Brazil	0.5	0.3	0.4	1.6
Mexico	0.2	0.2	-0.1	0.4
Argentina	0.5	0.4	0.4	1.7
Rest of Latin America	0.1	0.1	0.1	0.0
Central America and Caribbean	1.0	0.8	0.8	4.1
Rest of the world	-0.2	-0.2	-0.1	0.0
All developing countries	15.7	11.1	14.0	45.6
Asian NIEs	3.8	2.6	3.8	20.4
USA	6.3	4.4	6.1	15.7
EU 15	6.8	5.3	6.8	21.2
EU 10	0.6	0.5	0.6	1.6
Japan	8.0	6.5	8.1	26.6
Rest of OECD	2.7	2.3	2.6	6.8
All developed countries	28.2	21.7	27.9	92.2
World total	43.9	32.8	42.0	137.8
Developing country share	35.8	33.9	33.4	33.1

Table B.1. (continued) Sensitivity of Labor Market Specification for Developing Countries
(CHANGE IN REAL INCOME, BILLIONS OF DOLLARS)

Country or Region	Central Doha Scenario[a]	Hong Kong Scenario[b]	Central Doha Scenario with "Special Products" for Developing Countries[c]	Full Liberalization[d]
Two categories of labor with Initial unskilled labor unemployment in developing countries				
China	15.3	11.5	15.4	24.0
Indonesia	0.9	0.7	0.9	2.5
Vietnam	1.6	1.3	1.8	2.5
Rest of ASEAN	2.7	2.1	2.5	7.3
India	3.3	2.3	3.5	10.7
Bangladesh	-0.1	-0.1	-0.1	0.5
Rest of South Asia	0.4	0.3	0.4	1.2
Russia and FSU	0.4	0.3	0.5	0.5
Middle East and North Africa	1.7	1.2	1.7	5.2
South Africa	0.4	0.3	0.4	0.8
East Africa	-0.1	-0.1	-0.1	0.4
Rest of Sub-Saharan Africa	-0.2	-0.2	-0.2	3.7
Brazil	1.4	1.1	1.4	5.0
Mexico	0.1	0.0	0.0	0.3
Argentina	0.7	0.6	0.6	2.3
Rest of Latin America	0.4	0.3	0.4	1.0
Central America and Caribbean	1.0	0.7	0.8	4.0
Rest of the world	0.6	0.4	0.4	4.1
All developing countries	30.7	22.7	30.4	76.0
Asian NIEs	3.9	2.7	3.9	19.3
USA	6.6	4.7	6.4	16.5
EU 15	6.7	5.2	6.7	21.0
EU 10	0.6	0.5	0.6	1.6
Japan	7.4	5.9	7.4	23.9
Rest of OECD	2.7	2.4	2.7	6.8
All developed countries	28.0	21.4	27.7	89.1
World total	58.6	44.1	58.2	165.1
Developing country share	52.3	51.4	52.3	46.0
Two categories of labor with full employment assumption in developing countries				
China	6.7	4.9	6.8	15.2
Indonesia	0.6	0.4	0.5	1.5
Vietnam	1.0	0.6	1.2	1.7
Rest of ASEAN	1.7	1.3	1.5	4.0
India	2.1	1.6	1.8	5.8
Bangladesh	0.0	0.0	0.0	0.2
Rest of South Asia	0.2	0.2	0.2	0.7
Russia and FSU	0.4	0.3	0.5	0.5
Middle East and North Africa	1.1	0.7	1.0	3.1
South Africa	0.2	0.2	0.2	0.2
East Africa	-0.1	-0.1	-0.1	0.4
Rest of Sub-Saharan Africa	-0.2	-0.2	-0.3	2.4
Brazil	1.1	0.9	1.0	4.5
Mexico	0.2	0.1	0.0	0.1
Argentina	0.6	0.5	0.5	1.9
Rest of Latin America	0.2	0.2	0.2	0.3
Central America and Caribbean	1.0	0.8	0.8	4.1
Rest of the world	-0.1	-0.1	-0.1	0.1
All developing countries	16.4	12.1	15.8	46.7
Asian NIEs	3.8	2.6	3.8	19.1
USA	6.4	4.6	6.3	16.2
EU 15	6.6	5.1	6.6	20.6
EU 10	0.6	0.5	0.6	1.6
Japan	7.3	5.9	7.4	23.8
Rest of OECD	2.7	2.3	2.6	6.8
All developed countries	27.5	21.1	27.3	88.1
World total	43.9	33.2	43.1	134.8
Developing country share	37.4	36.6	36.7	34.6

a. Scenario 3.
b. Scenario 6.
c. Scenario 4.
d. Scenario 9.

among developed and developing countries.[44] However, the effect is in the opposite direction from that of unemployment. Depending upon the scenario, the gains to developing countries as a group are about 2 to 6 percent *less* if agricultural and unskilled labor forces are modeled as distinct compared with modeling them as a single unskilled labor group. This suggests that models that combine these two distinct groups into one will tend to *overstate* the gains to developing countries, although the overstatement will be small.

These results seem reasonable. Because of the presence of initial unemployment, when global trade liberalization increases demand for agricultural or manufacturing products or both, it will increase demand for labor, absorbing agricultural or unskilled labor into the production process that was previously unemployed or underemployed. The presence of additional productive factors will increase production and income, and thus global and country welfare.

The sensitivity analysis indicates that properly modeling unemployment in the unskilled labor market is a crucial requirement to accurately measure the welfare impact of trade liberalization, especially in the short and medium term.

Notes

1. As used in this report, the term "the poorest countries" is interchangeable with least developed countries (LDCs) as defined by the United Nations, based on income per capita (below $750) and other indicators of economic weakness and vulnerability.
2. The model was constructed by Zhi Wang, the author of a highly regarded model that addressed the impact on the global trading system of China's accession to the WTO. See appendix A for more details of the model and other work by Wang. The project was made possible through the generous support of the Rockefeller Foundation and its Global Inclusion Program.
3. The Global Trade Analysis Project is an international consortium of researchers from academic, governmental, and intergovernmental institutions, who contribute trade and other economic data. The project is coordinated by the Center for Global Trade Analysis, which is housed in the Department of Agricultural Economics of Purdue University. The website is www.gtap.agecon.purdue.edu.
4. Thomas W. Hertel and Jeffrey J. Reimer, *Predicting the Poverty Impacts of Trade Reform*, World Bank Policy Research Working Paper 3444 (Washington: World Bank, 2004).
5. A few other recent models also attempt to improve the accuracy of the modeling of labor markets in developing countries. These include Centre d'Etudes Prospectives et d'Informations Internationales, or CEPII (November 2004), International Food Policy Research Institute, or IFPRI (April 2005), and United Nations Conference on Trade and Development, or UNCTAD (*Coping with Trade Reforms*, Geneva: UNCTAD, 2006); available at http://192.91.247.38/tab/events/namastudy/coping.asp?pf=1. These models are discussed in chapter 4.
6. This is similar to the market equilibrium specification in J. R. Harris and M. P. Todaro, "Migration, Unemployment and Development: A Two Sector Analysis," *American Economic Review* 60 (1970): 126–142. However, in the Carnegie model, the unskilled labor market equilibrium is formulated as a mixed complementarity problem (MCP). In such a formulation, the wage rate will be fixed at the baseline when there is unemployment in the economy. The employment rate will adjust to clear the labor market. If labor demand is such that full employment is reached, the unemployment rate will then be zero and the wage rate will adjust to clear the labor market.
7. In the model, this is represented as the substitutability of one type of labor for the other, with an elasticity of 1.
8. "Economically active population" is a broad measure that includes both wage earners and self-employed persons, including farmers. As used in this report, the term "labor force" refers to this broad group.
9. We use trade-weighted averages (including preferential rates) of ad valorem tariffs (including tariff rate quotas) plus the ad valorem equivalents (AVEs) of specific tariffs. The data are drawn from the GTAP 6 Data Base.
10. Domestic subsidies are modeled as a negative tax on industry gross output. Subsidy cuts are modeled as a reduction in the negative tax. Reductions are taken from the domestic support data for 2001 from the OECD producer support estimate (PSE) / consumer support estimate (CSE), incorporated in the GTAP 6 Data Base.
11. These agreements were made in the WTO's Doha Work Programme Decision Adopted by the General Council on August 1, 2004. This is often referred to as the July Framework Agreement. It is available at: www.wto.org/english/tratop_e/dda_e/draft_text_gc_dg_31july04_e.htm.
12. Doha Work Programme Ministerial Declaration

Adopted on December 18, 2005, available at: www.wto.org/english/thewto_e/minist_e/min05_e/final_text_e.htm.

13. NAMA includes both manufactured goods and other nonagricultural goods, such as minerals, petroleum, and forest products.
14. AGE models also can be used to conduct what are known as dynamic analyses that trace the adjustment process of economies between the initial and final equilibria. Such exercises project the end point of the adjustment process to some future date, and incorporate estimated growth from other sources in the interim. While dynamic modeling allows for interesting experiments, it also requires taking on additional theoretical assumptions that may or may not correspond to reality.
15. The most accurate term for this measure is "equivalent variation," defined as the amount of money that, paid to a person, group or economy, would make them as well off as the effects of a specified policy change. These gains are also referred to as "welfare" gains.
16. Data for 2004, World Trade Organization Statistics Database, available at: http://stat.wto.org.
17. The G-33 countries include Antigua and Barbuda, Barbados, Belize, Benin, Botswana, China, Congo, Côte d'Ivoire, Cuba, Dominican Republic, Grenada, Guyana, Haiti, Honduras, India, Indonesia, Jamaica, Kenya, Korea, Mauritius, Madagascar, Mongolia, Mozambique, Nicaragua, Nigeria, Pakistan, Panama, Peru, Philippines, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Senegal, Sri Lanka, Suriname, Tanzania, Trinidad and Tobago, Turkey, Uganda, Venezuela, Zambia, and Zimbabwe.
18. Refer to table 2.4 for full descriptions of the scenarios.
19. This result is consistent with results from most other recent models. For example, the World Bank model, which shows greater overall gains from agricultural liberalization than the Carnegie model, shows developing countries as a group losing under the most realistic agricultural scenario modeled. These results are discussed further in chapter 4.
20. This is scenario 3, which reflects net impact of liberalization of both manufactured goods and agricultural products.
21. Many other models predict a similar unwelcome pattern of results for developing countries under agricultural liberalization scenarios, discussed further in chapter 4.
22. Antoine Bouët, Lionel Fontagné, and Sébastien Jean, *Is Erosion of Tariff Preferences a Serious Concern?* CEPII Working Paper 2005-14 (Paris: Centre d'Etudes Prospectives et d'Informations Internationales, 2005).
23. WTO's Doha Work Programme Decision Adopted by the General Council on August 1, 2004, available at: www.wto.org/english/tratop_e/dda_e/draft_text_gc_dg_31july04_e; Doha Work Programme Ministerial Declaration Adopted on December 18, 2005, available at: www.wto.org/english/thewto_e/minist_e/min05_e/final_text_e.htm.
24. Kym Anderson, Will Martin, and Dominique van der Mensbrugghe, "Market and Welfare Implications of Doha Reform Scenarios," in *Agricultural Trade Reform & the Doha Development Agenda*, ed. Kym Anderson and Will Martin (New York and Washington: Palgrave Macmillan and World Bank, 2006), table 12.16.
25. Higher increases for Vietnam are attributable to the country's accession to the WTO, rather than Doha scenarios.
26. Santiago Fernandez de Cordoba and Sam Laird, *Coping with Trade Reforms* (Geneva: UNCTAD, 2006); available at http://192.91.247.38/tab/events/namastudy/coping.asp?pf=1.
27. The figure of 2.5 million is the estimate offered from the most current World Bank model under the most realistic Doha scenario modeled. Kym Anderson, Will Martin, and Dominique van der Mensbrugghe, "Global Impacts of the Doha Scenarios on Poverty," in *Poverty and the WTO: Impacts of the Doha Development Agenda*, ed. Thomas W. Hertel and L. Alan Winters (Washington: World Bank, 2006). Available at: http://siteresources.worldbank.org/INTRANETTRADE/Resources/Topics/285683-1109974429289/Chapter17_Trade&Povertybook_Hertel&Winters.pdf. The higher figure is found in William R. Cline, *Trade Policy and Global Poverty* (Washington, D.C.: Center for Global Development and Institute for International Economics, 2004), chapter 5 and table 5.3.
28. The CEPII, IFPRI, and UNCTAD models include other sectors but at highly aggregated levels that make them less useful for probing impacts in those sectors.
29. A useful overview and nontechnical analysis of trade modeling is provided in Roberta Piermartini and Robert Teh, *Demystifying Modeling Methods for Trade Policy*, Discussion Paper 10 (Geneva: World Trade Organization, 2005).
30. The Carnegie model and other models reviewed here assume that markets are perfectly competitive. In some other models, other market structures are used, including monopolistic competition and increasing returns to scale. These may be more realistic in some cases, but they require additional assumptions and data that may or may not improve the overall accuracy of the models' results.
31. The Global Trade Analysis Project is an international consortium of researchers from academic, governmental, and intergovernmental institutions who contribute trade and other economic data. The project

is coordinated by the Center for Global Trade Analysis, which is housed in the Department of Agricultural Economics of Purdue University. The website is www.gtap.agecon.purdue.edu.

32. Piermartini and Teh, *Demystifying Modeling Methods for Trade Policy*, pp. 34–35.
33. The G-20 is a group of developing countries organized around offensive agricultural interests. The group currently has 21 members: Argentina, Bolivia, Brazil, Chile, China, Cuba, Egypt, Guatemala, India, Indonesia, Mexico, Nigeria, Pakistan, Paraguay, Philippines, South Africa, Tanzania, Thailand, Uruguay, Venezuela, and Zimbabwe.
34. In the terminology used in interim agreements of the Doha Round at the WTO, "sensitive products" are agricultural products of all member countries which will be subject to lesser liberalization than the normal reductions that are agreed on. "Special products" are additional agricultural products of developing countries that will be subject to lesser liberalization than other agricultural products of developing countries based on consideration of livelihood security, food security, and rural development needs.
35. Kym Anderson, Will Martin, and Dominique van der Mensbrugghe, "Market and Welfare Implications of Doha Reform Scenarios," in *Agricultural Trade Reform*, table 12.16.
36. See table 4.2. For comparative static results, these are one-time gains. For dynamic results reported by some other models, the gains are annual, but they assume that additional investment or productivity gains will be induced by liberalization, so the gains are not attributable to trade policy changes alone.
37. As noted above, Vietnam's large apparent gains are mainly attributable to its pending accession to the WTO rather than to changes in trade policy that may be agreed on in the Doha Round.
38. A thorough discussion of the complementary measures that are needed to allow small-scale farmers to succeed under trade reform can be found in *Food and Agricultural Organization of the United Nations (FAO), The State of Food and Agriculture 2005: Agricultural Trade and Poverty—Can Trade Work for the Poor?* (Rome, FAO, 2005), part I.
39. Zhi Wang, "Impact of China's WTO Accession on the Patterns of World Trade," *Journal of Policy Modeling* 24, no. 1 (2003): 1–41; Zhi Wang "Impact of China's WTO Entry on Labor Intensive Export Market: A Recursive Dynamic CGE Analysis," *The World Economy* 22, no. 3 (1999): 379–405.
40. J. R. Harris and M. P. Todaro, "Migration, Unemployment and Development: A Two Sector Analysis," *American Economic Review* 60 (1970): 126–142.
41. Anthony Brook, David Kendrick, and Alexander Meeraus, *GAMS: A User's Guide* (New York: Scientific Press, 1998).
42. Hal Varian, *Microeconomic Analysis*, 2nd ed. (New York: W. W. Norton, 1984), p. 28.
43. Jeffrey D. Lewis, Sherman Robinson, and Zhi Wang, "Beyond the Uruguay Round: The Implication of an Asia Free Trade Area," *China Economic Review, An International Journal* 6, no. 1 (Spring 1995): 35–90.
44. This may be due to the relatively simple specification in the model of the underlying forces that drive migration between agricultural and unskilled urban labor markets. The segmentation of rural and urban labor markets in many developing countries and their interaction is an issue that should be addressed more fully in future models.

Carnegie Endowment for International Peace

The Carnegie Endowment for International Peace is a private, nonprofit organization dedicated to advancing cooperation between nations and promoting active international engagement by the United States. Founded in 1910, Carnegie is nonpartisan and dedicated to achieving practical results. Through research, publishing, convening and, on occasion, creating new institutions and international networks, Endowment associates shape fresh policy approaches. Their interests span geographic regions and the relations between governments, business, international organizations, and civil society, focusing on the economic, political, and technological forces driving global change. Through its Carnegie Moscow Center, the Endowment helps to develop a tradition of public policy analysis in the states of the former Soviet Union and to improve relations between Russia and the United States. The Endowment publishes FOREIGN POLICY, one of the world's leading journals of international politics and economics, which reaches readers in more than 120 countries and in several languages.